KUMARAGURU COLLEGE OF TECHNOLOGY

An autonomous Institution affiliated to Anna University, Chennai

COIMBATORE – 641 049

B.TECH., INFORMATION TECHNOLOGY

REGULATIONS 2018A (2023 Batch)

CURRICULUM AND SYLLABI

I to VIII Semesters

Department of Information Technology

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VISION

The department of Information Technology aspires to become a **school of excellence** in providing **quality education, constructive research** and **professional opportunities in Information Technology**.

MISSION

- To provide academic programs that engage, enlighten and empower the students to **learn technology through practice, service and outreach**
- To educate the students about **social responsibilities and entrepreneurship**
- To encourage **research through continuous improvement** in infrastructure, curriculum and faculty development in collaboration with industry and institutions

PROGRAMEDUCATIONAL OBJECTIVES (PEOs)

PEO1 : Graduates will have progressive learning and successful career in Information, Communication Technologies and their applications

PEO2 : Graduates will be leaders in their chosen field

PEO3 : Graduates will utilize the acquired technical skills and knowledge for the benefit of society

PROGRAMOUTCOMES (POs)

PO1 : **Engineering knowledge:**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 : **Problem analysis:**Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 : **Design/development of solutions:**Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 : **Conduct investigations of complex problems:**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 : **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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PO6 : **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 : **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 : **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 : **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 : **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 : **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 : **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Technical Skills: Apply the fundamental knowledge to **develop computer-based solutions** in the areas related to information management and networking.
2. Leadership Skills: Apply standard practices and strategies in **managing quality software products.**
3. Social Responsibility: Develop attitude to understand the societal issues and apply the acquired professional skills to **provide feasible IT based solutions**

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KUMARAGURU COLLEGE OF TECHNOLOGY

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REGULATIONS 2018

B.TECH INFORMATION TECHNOLOGY

CURRICULUM

List of Courses

S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Pre-requisite
BASIC SCIENCES(BS)										
1	U18MAI1202	Linear Algebra and Calculus	Embedded - Theory & Lab	BS	3	0	2	0	4	
2	U18PHI2202	Engineering Physics	Embedded - Theory & Lab	BS	3	0	2	0	4	
3	U18MAI2201	Advanced Calculus and Laplace Transforms	Embedded - Theory & Lab	BS	3	0	2	0	4	U18MAI1202
4	U18MAT3102	Discrete Mathematics	Theory	BS	3	1	0	0	4	
5	U18MAI4201	Probability and Statistics	Embedded - Theory & Lab	BS	3	0	2	0	4	
6	U18MAT5101	Partial Differential Equations and Transforms	Theory	BS	3	1	0	0	4	-
								Total Credits	24	

S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Pre-requisite
HUMANITIES AND SOCIAL SCIENCES(HS)										
1	U18………..	Language Elective	Embedded - Theory & Lab	HS	2	0	2	0	3	
2	U18ENI0202	Professional Communication	Embedded - Theory & Lab	HS	2	0	2	0	3	
3	U18VET4101	Universal Human Values 2: Understanding Harmony	Theory	HS	3	0	0	0	3	
4	U18ITP5605	Digital and Social Media Marketing	Practical	HS	0	0	6	0	3	-
								Total Credits	12	

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S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Pre-requisite
Language Electives										
1	U18FRI2201	French Level I	Embedded - Theory and Lab	HS	2	0	2	0	3	
2	U18GEI2202	German Level I	Embedded - Theory and Lab	HS	2	0	2	0	3	
3	U18HII2201	Hindi Level I	Embedded - Theory and Lab	HS	2	0	2	0	3	
4	U18JAI2201	Japanese LevelI	Embedded - Theory and Lab	HS	2	0	2	0	3	

S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Pre-requisite
ENGINEERING SCIENCES(ES)										
1	U18CSI1201	Structured Programming using C	Embedded - Theory & Lab	ES	3	0	2	0	4	
2	U18EEI1201	Basic Electrical and Electronics Engineering	Embedded - Theory & Lab	ES	3	0	2	0	4	
3	U18INI1600	Engineering Clinic-I	Project based course with lab	ES	0	0	4	2	3	
4	U18CSI2201	Python Programming	Embedded - Theory & Lab	ES	2	0	2	0	3	U18CSI1201
5	U18INI2600	Engineering Clinic-II	Project based course with lab	ES	0	0	4	2	3	U18INI1600
6	U18ECT3011	Principles of Communication	Theory	ES	3	0	0	0	3	
7	U18ITI3203	Object Oriented Programming	Embedded - Theory & Lab	ES	3	0	2	0	4	U18CSI2201
8	U18INI3600	Engineering Clinic-III	Project based course with lab	ES	0	0	4	2	3	U18INI2600
9	U18INI4600	Engineering Clinic-IV	Project based course with lab	ES	0	0	4	2	3	U18INI3600
Total Credits									30	

S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Pre-requisite
Professional Core (PC)										
1	U18ITI2201	Digital Logic and Microprocessor	Embedded - Theory & Lab	PC	3	0	2	0	4	U18EEI1201
2	U18ITT3001	Computer Architecture	Theory	PC	3	0	0	0	3	-
3	U18ITI3202	Data Structures	Embedded - Theory & Lab	PC	3	0	2	0	4	-
4	U18ITT4001	Operating Systems	Theory	PC	3	0	0	0	3	-

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5	U18ITI4202	Design and Analysis of Algorithms	Embedded - Theory & Lab	PC	3	0	2	0	4	U18ITI3202
6	U18ITI4303	Data Base Management Systems	Embedded - Theory &Project	PC	3	0	0	2	4	-
7	U18ITI4204	Computer Networks	Embedded - Theory & Lab	PC	3	0	2	0	4	U18ECT3011
8	U18ITI5201	Data Mining Techniques	Embedded - Theory & Lab	PC	3	0	2	0	4	U18ITI4303, U18MAI4201
9	U18ITT5002	Cryptography and Network Security	Theory	PC	3	0	0	0	3	U18ITI4204
10	U18ITI5203	Mobile and Pervasive Computing	Embedded - Theory & Lab	PC	3	0	2	0	4	U18ITI4204
11	U18ITI5304	Software Engineering	Embedded - Theory & Project	PC	3	0	0	2	4	-
12	U18ITT6001	Information Security	Theory	PC	3	0	0	0	3	U18ITT5002
13	U18ITT6002	Internet of Things – Architecture and Protocols	Theory	PC	3	0	0	0	3	U18ITI4204
14	U18ITI6203	Web Technology	Embedded - Theory & Lab	PC	3	0	2	0	4	U18ITI3203
15	U18ITI6304	Big Data Analytics	Embedded - Theory & Project	PC	3	0	0	2	4	U18ITI5201
16	U18ITI7202	Cloud Computing	Embedded - Theory and Lab	PC	2	0	2	0	3	U18ITI4204
17	U18ITI7203	Machine Learning	Embedded - Theory and Lab	PC	3	0	2	0	4	U18ITI5201
								Total Credits	**62**	

S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Pre-requisite
				Project Work (PW)						
1	U18ITP7704	Project Phase-I	Project only Course	Project Work	0	0	0	6	3	
2	U18ITP8701	Project Phase-II	Project only Course	Project Work	0	0	0	24	12	
								Total Credits	15	

S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Pre-requisite
			Professional Elective (Theory/Embedded) (PE)							
1	U18****	Professional Elective – I	Theory	PE	3	*	*	*	3	
2	U18****	Professional Elective – II	Theory	PE	3	*	*	*	3	

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3	U18****	Professional Elective – III	Theory	PE	3	*	*	*	3	
4	U18****	Professional Elective – IV	Theory	PE	3	*	*	*	3	
								Total Credits	12	
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
Open Elective (OE)										
1	U18****	Open Elective – I	Theory	OE	3	0	0	0	3	
2	U18****	Open Elective – II	Theory	OE	3	0	0	0	3	
								Total Credits	6	

Professional Electives / honours - Specialization Track (2023 Batch)

S. No	Specialization Track	Course Code	Course Name	Course Mode	L	T	P	J	C
1	Extended Reality	U18CSE0314	3D Modeling and Game Design	Embedded - Theory & Project	2	0	0	2	3
2		U18CSE0315	Augmented Reality and Virtual Reality Application Development	Embedded - Theory & Project	2	0	0	2	3
3		U18CSE0016	Advanced Metaverse Technologies	Theory	3	0	0	0	3
4		U18CSE0228	Game Programming	Embedded - Theory & Lab	2	0	2	0	3
5		U18CSE0229	Advanced Modelling in Game Design	Embedded - Theory & Lab	2	0	2	0	3
6		U18CSE0230	AI/ML in Games	Embedded - Theory & Lab	2	0	2	0	3
7		U18CSE0534	Game Design and Development Using Unreal Engine	Practical	0	0	6	0	3
8	IoT, Edge, UAV	U18CSE0217	Embedded Systems for IoT	Embedded - Theory & Lab	2	0	2	0	3
9		U18CSE0318	IoT Systems Design	Embedded - Theory & Project	2	0	0	2	3
10		U18CSE0219	IoT Application Development	Embedded - Theory & Lab	2	0	2	0	3
11		U18CSE0220	Software Systems for 3D Printing	Embedded - Theory & Lab	2	0	2	0	3
12		U18CSE0221	Robotic Operating Systems	Embedded - Theory & Lab	2	0	2	0	3
13		U18CSE0022	Software Defined Vehicle	Theory	3	0	0	0	3
14		U18CSE0532	Intelligent IoT Systems with Cloud and AI Integration	Practical	0	0	6	0	3
15	Cyber Security	U18CSE0223	Ethical Hacking and Network Defence	Embedded - Theory & Lab	2	0	2	0	3

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16		U18CSE0024	Cyber Ethics and Laws	Theory	3	0	0	0	3
17		U18CSE0225	Secure Software Development	Embedded - Theory & Lab	2	0	2	0	3
19		U18CSE0226	Network Security Administration	Embedded - Theory & Lab	2	0	2	0	3
20		U18CSE0227	Digital Forensics	Embedded - Theory & Lab	2	0	2	0	3
21		U18CSE0533	Digital Evidence and Cyber Investigation	Practical	0	0	6	0	3
22	Automation and Artificial Intelligence	U18AIE0211	Computer Vision	Embedded - Theory & Lab	2	0	2	0	3
23		U18AIE0212	Intelligent Automation Systems	Embedded - Theory & Lab	2	0	2	0	3
24		U18AIE0214	Generative AI	Embedded - Theory & Lab	2	0	2	0	3
25		U18AIE0015	Responsible AI	Theory	3	0	0	0	3
26		U18AIE0227	Introduction to Large Language Models	Embedded - Theory & Lab	2	0	2	0	3
27		U18AIE0528	AI and ML Infrastructure Engineering	Practical	0	0	6	0	3
28		U18AIE0530	Agentic AI	Practical	0	0	6	0	3
29	Data Science, Analytics and Visualization	U18AIE0217	Data Processing Techniques	Embedded - Theory & Lab	2	0	2	0	3
30		U18AIE0218	Data Modelling	Embedded - Theory & Lab	2	0	2	0	3
31		U18AIE0219	Data Analysis and Visualization	Embedded - Theory & Lab	2	0	2	0	3
32		U18AIE0220	Business Intelligence for Decision Making	Embedded - Theory & Lab	2	0	2	0	3
33		U18AIE0021	Data Ethics and Privacy	Theory	3	0	0	0	3
34		U18AIE0226	Digital Twin Analytics	Embedded - Theory & Lab	2	0	2	0	3
35	Network and Distributed Computing	U18ITE0032	Cryptocurrency and Bitcoins	Theory	3	0	0	0	3
36		U18ITE0333	Web3 and DApp Development	Embedded - Theory & Project	2	0	0	2	3
37		U18ITE0334	Advanced Networking Technologies	Embedded - Theory & Project	2	0	0	2	3
38		U18ITE0218	Smart Contract Development	Embedded - Theory & Lab	2	0	2	0	3

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39		U18ITE0019	Decentralized Finance	Theory	3	0	0	0	3
40	Cloud Computing	U18ITE0220	Virtualization and Resource Management	Embedded - Theory & Lab	2	0	2	0	3
41		U18ITE0221	Cloud Infrastructure and Architecture	Embedded - Theory & Lab	2	0	2	0	3
42		U18ITE0222	Cloud Storage Management	Embedded - Theory & Lab	2	0	2	0	3
43		U18ITE0323	Cloud Application Development	Embedded - Theory & Project	2	0	0	2	3
44		U18ITE0224	Cloud Security	Embedded - Theory & Lab	2	0	2	0	3
45		U18ITE0325	Cloud Automation	Embedded - Theory & Project	2	0	0	2	3
46		U18ITE0535	Cloud Infrastructure and Solutions Architecture	Practical	0	0	6	0	3
47	Web and Software Development	U18ITE0226	Full Stack Software Development	Embedded - Theory & Lab	2	0	2	0	3
48		U18ITE0227	UI and UX Design	Embedded - Theory & Lab	2	0	2	0	3
49		U18ITE0228	Principles of DevOps	Embedded - Theory & Lab	2	0	2	0	3
50		U18ITE0229	iOS Application Development using Swift	Embedded - Theory & Lab	2	0	2	0	3
51		U18ITE0030	Service Oriented Architecture	Theory	3	0	0	0	3
52		U18ITE0031	Software Quality Management	Theory	3	0	0	0	3
53		U18ITE0537	DevOps Mastery	Practical	0	0	6	0	3

OTHER PROFESSIONAL ELECTIVE COURSES										**Pre-requisite**
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1.	U18ITE0001	Artificial Intelligence	Theory	PE	3	0	0	0	3	U18MAT3102
2.	U18ITE0002	Deep Learning	Theory	PE	3	0	0	0	3	U18ITI7203
3.	U18ITE0003	Data Visualization	Theory	PE	3	0	0	0	3	
4.	U18ITE0014	Business Intelligence	Theory	PE	3	0	0	0	3	
5.	U18ITE0015	Natural Language Processing	Theory	PE	3	0	0	0	3	
6.	U18ITE0016	Information Retrieval Techniques	Theory	PE	3	0	0	0	3	
7.	U18ITE0004	Information Coding Techniques	Theory	PE	3	0	0	0	3	

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8.	U18ITE0005	Web Application Security	Theory	PE	3	0	0	0	3	U18ITT5001 U18ITI6203
9.	U18ITE0006	Biometric Systems	Theory	PE	3	0	0	0	3	
10.	U18ITE0007	Blockchain Technology	Theory	PE	3	0	0	0	3	U18ITT5002
11.	U18ITE0008	Adhoc and Sensor Networks	Theory	PE	3	0	0	0	3	U18ITI4204
12.	U18ITE0009	Next Generation Networks	Theory	PE	3	0	0	0	3	U18ITI4204
13.	U18ITE0010	Software Defined Networks	Theory	PE	3	0	0	0	3	U18ITI4204
14	U18ITE0017	Security of Internet of Things	Theory	PE	3	0	0	0	3	U18ITT6002
15.	U18ITE0011	Distributed Systems	Theory	PE	3	0	0	0	3	U18ITT4001
16.	U18ITE0012	Principles of Compiler Design	Theory	PE	3	0	0	0	3	
17.	U18ITE0013	Graphics and Multimedia	Theory	PE	3	0	0	0	3	
18.	U18CSE0013	Professional Readiness for Innovation, Employability and Entrepreneurship	Theory	PE	0	0	6	0	3	
19.	U18ITE0536	Foundations of Research and Scientific Writing in Computing	Practical	PE	0	0	6	0	3	
20.	U18CSE0235	Technical Entrepreneurship for Computer Engineers	Embedded	PE	1	0	4	0	3	
21.	U18CSE0736	Entrepreneurship Practicum	Project	PE	0	0	0	6	3	
22.	U18AIE0529	Pragmatic Programming	Practical	PE	0	0	6	0	3	
23.	U18AIE0031	Quantum Computing Foundations	Theory	PE	3	0	0	0	3	

S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	Pre-requisite
Mandatory Courses										
1	U18TLR1001	Heritage of Tamils	Theory	Mandatory	1	0	0	0	1	
2	U18CSR1001	Disruptive Technologies	Theory	Mandatory VAC (non CGPA)	2	0	0	0	2	
3	U18MAR0003	Tech for Good: Achieving the SDG's by the Role of ICT	Embedded - Theory & Lab	Mandatory VAC (non CGPA)	1	0	2	0	2	
4	U18TLR2001	Tamils and Technology	Theory	Mandatory	1	0	0	0	1	
5	U18CHT4000	Environmental Science and Engineering	Theory	Mandatory (non CGPA)	3	0	0	0	0	
6	U18INT5000	Constitution of India	Theory	Mandatory (non CGPA)	2	0	0	0	0	
Total Credits									2	

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Courses Offered by Forge (for Protosem Students)

S.No	Course Code	Course Name	Course Type	Credits
1.	U18CSE0828	Computational Hardware	PE	3
2.	U18CSE0829	Coding For Innovators	PE	3
3.	U18CSE0830	Industrial Design & Rapid Prototyping Techniques	PE	3
4.	U18CSE0831	Industrial Automation	PE	3
5.	U18CSP0532	MUP Development	Practical	12
6.	U18AIE0233	Industrial Robotics	PE	3

Edge Courses–(Additional Credits - 2022 batch onwards)

S.No	Course Code	Course Title	Credits
1	U18ITR0001	Fundamentals of Digital Design	2
2	U18ITR0002	Mobile App Development Using MIT	2
3	U18ITR0003	Software Entrophy	2

OPEN ELECTIVES									
S. No	**Course code**	**Course Title**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**
1	U18MEO0014	Sustainable Innovations and Practices	Theory	OE	3	0	0	0	3
2	U18MEO0015	Electric and Autonomous Mobility	Theory	OE	3	0	0	0	3
3	P18CAO0001	Modern Financial Strategies and Innovations	Theory	OE	3	0	0	0	3
4	P18CAO0002	Sports Analytics and Emerging Technologies	Theory	OE	3	0	0	0	3
5	P18CAO0003	Healthcare Innovation and Technology	Theory	OE	3	0	0	0	3
6	P18CAO0004	Corporate Strategy and Innovation	Theory	OE	3	0	0	0	3
7	P18CAO0005	Gamification and Gaming	Theory	OE	3	0	0	0	3
8	P18CAO0006	Environmental Innovations and Management	Theory	OE	3	0	0	0	3
9	P18CAO0207	Startup Registration	Embedded	OE	1	0	4	0	3
10	U18ENO0518	Professional Skills for Career Growth	Practical	OE	0	0	6	0	3
11	U18ENO0519	Advanced Communication Skills for International Higher Education	Practical	OE	0	0	6	0	3

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TENTATIVE SEMESTER

SEMESTER I										Pre-requisite
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U18MAI1202	Linear Algebra and Calculus	Embedded - Theory & Lab	Basic Sciences	3	0	2	0	4	-
2	U18CSI1201	Structured Programming using C	Embedded - Theory & Lab	Engineering Sciences	3	0	2	0	4	-
3	U18EEI1201	Basic Electrical and Electronics Engineering	Embedded - Theory & Lab	Engineering Sciences	3	0	2	0	4	-
4	U18…..	Language Elective	Embedded - Theory & Lab	Humanities and Social Sciences	2	0	2	0	3	-
5	U18INI1600	Engineering Clinic I	Embedded – Lab & Project	Engineering Sciences	0	0	4	2	3	-
6	U18TLR1001	Heritage of Tamils	Theory	Mandatory	1	0	0	0	1	
7	U18CSR1001	Disruptive Technologies	Theory	Mandatory VAC (non CGPA)	2	0	0	0	2	
Total Credits									**19**	
Total Periods per week									**28**	

SEMESTER – II										Pre-requisite
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U18MAI2201	Advanced Calculus and Laplace Transforms	Embedded - Theory & Lab	Basic Sciences	3	0	2	0	4	U18MAI1201
2	U18PHI2202	Engineering Physics	Embedded - Theory & Lab	Basic Sciences	3	0	2	0	4	-
3	U18CSI2201	Python Programming	Embedded - Theory & Lab	Engineering Sciences	2	0	2	0	3	U18CSI1201
4	U18ITI2201	Digital Logic and Microprocessor	Embedded - Theory & Lab	Professional Core	3	0	2	0	4	U18EEI1201
5	U18ENI0202	Professional Communication	Embedded - Theory & Lab	Humanities and Social Sciences	2	0	2	0	3	
6	U18INI2600	Engineering Clinic II	Embedded - Lab& Project	Engineering Sciences	0	0	4	2	3	U18INI1600
7	U18TLR2001	Tamils and Technology	Theory	Mandatory	1	0	0	0	1	
8	U18MAR0003	Tech for Good: Achieving the SDGs by the role of ICT	Embedded - Theory & Lab	Mandatory VAC (non CGPA)	1	0	2	0	2	
Total Credits									**22**	

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	Total Periods per week	33

SEMESTER – III										Pre-requisite
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U18MAT3102	Discrete Mathematics	Theory	Basic Sciences	3	1	0	0	4	-
2	U18ECT3011	Principles of Communication	Theory	Engineering Sciences	3	0	0	0	3	-
3	U18ITT3001	Computer Architecture	Theory	Professional Core	3	0	0	0	3	-
4	U18ITI3202	Data Structures	Embedded - Theory & Lab	Professional Core	3	0	2	0	4	-
5	U18ITI3203	Object Oriented Programming	Embedded - Theory & Lab	Engineering Sciences	3	0	2	0	4	U18CSI2201
6	U18ITI4303	Data Base Management Systems	Embedded - Theory & Lab	Professional Core	3	0	0	2	4	-
7	U18INI3600	Engineering Clinic III	Embedded –Lab & Project	Engineering Sciences	0	0	4	2	3	U18INI2600
								Total Credits	**25**	
								Total Periods per week	**31**	

SEMESTER – IV										Pre-requisite
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U18MAI4201	Probability and Statistics	Embedded - Theory & Lab	Basic Sciences	3	0	2	0	4	-
2	U18ITT4001	Operating Systems	Theory	Professional Core	3	0	0	0	3	-
3	U18ITI4204	Computer Networks	Embedded - Theory & Lab	Professional Core	3	0	2	0	4	U18ECT3011
4	U18ITI6203	Web Technology	Embedded – Theory & Lab	Professional Core	3	0	2	0	4	U18ITI3203
5	U18ITI7202	Cloud Computing	Embedded – Theory and Lab	Professional Core	2	0	2	0	3	U18ITI4204
6	U18INI4600	Engineering Clinic IV	Embedded - Lab& Project	Engineering Sciences	0	0	4	2	3	U18INI3600
7	U18VET4101*	Universal Human Values 2: Understanding Harmony	Theory	Humanities and Social Sciences	2	1	0	0	3	
8	U18CHT4000	Environmental Science and Engineering	Theory	MC	3	0	0	0	0	
								Total Credits	**24**	

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Total Periods per week	**34**

SEMESTER – V										**Pre-requisite**
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U18MAT5101	Partial Differential Equations and Transforms	Theory	Basic Sciences	3	1	0	0	4	-
2	U18ITI4202	Design and Analysis of Algorithms	Embedded - Theory & Lab	Professional Core	3	0	2	0	4	U18ITI3202
3	U18ITI5201	Data Mining Techniques	Embedded - Theory & Lab	Professional Core	3	0	2	0	4	U18ITI4303, U18MAI4201
4	U18ITT5002	Cryptography and Network Security	Theory	Professional Core	3	0	0	0	3	U18ITI4204
5	U18ITI5203	Mobile and Pervasive Computing	Embedded - Theory & Lab	Professional Core	3	0	2	0	4	U18ITI4204
6	U18ITP5605	Digital and Social Media Marketing	Practical	Humanities and Social Sciences	0	0	6	0	3	-
7	U18ITE--**	Professional Elective I	Theory	Professional Elective	3	0	0	0	3	-
8	U18ITE--**	Professional Elective II	Theory	Professional Elective	3	0	0	0	3	-
Total Credits									**28**	
Total Periods per week									**34**	

SEMESTER – VI										**Pre-requisite**
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U18ITT6001	Information Security	Theory	Professional Core	3	0	0	0	3	U18ITT5002
2	U18ITT6002	Internet of Things – Architecture and Protocols	Theory	Professional Core	3	0	0	0	3	U18ITI4204
3	U18ITI5304	Software Engineering	Embedded - Theory & Project	Professional Core	3	0	0	2	4	-
4	U18ITI7203	Machine Learning	Embedded – Theory and Lab	Professional Core	3	0	2	0	4	U18ITI5201
5	U18ITI6304	Big Data Analytics	Embedded – Theory & Project	Professional Core	3	0	0	2	4	U18ITI5201
6	U18ITE----	Professional Elective III	Theory	Professional Elective	3	0	0	0	3	-

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7	U18ITE----	Professional Elective IV	Theory	Professional Elective	3	0	0	0	3	-
8	U18-------	Open Elective	Theory	Professional Elective	3	0	0	0	3	-
								Total Credits	**27**	
								Total Periods per week	**32**	

SEMESTER – VII										**Pre-requisite**
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U18INT5000	Constitution of India	Theory	MC	2	0	0	0	0	
2	U18-------	Open Elective I	Theory	Professional Elective	3	0	0	0	3	-
5	U18ITP7704	Project Phase I	Project	Project Work	0	0	0	6	3	-
								Total Credits	**6**	
								Total Periods per week	**11**	

SEMESTER – VIII										**Pre-requisite**
S.No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U18ITP8701	Project Phase II	Project	PW	0	0	0	24	12	U18ITP7704
								Total Credits	**12**	
								Total Periods per week	**24**	

List of Mandatory Non-Credit Courses					
S.No	**Couse Code**	**Course Title**	**Course Mode**	**CT**	**Semester**
1	U18CHT4000	Environmental Science and Engineering	Theory	MC	4
2	U18INT5000	Constitution of India	Theory	MC	5

List of Mandatory Courses with Credits					
S.No	**Course Code**	**Course Title**	**Course Mode**	**Credit**	**Semester**
1	U18VET4101	Universal Human Values 2: Understanding Harmony	Theory	3	4

S.No	**BATCH**	**Total Credits**
1	**2023**	**163**

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BASIC SCIENCES(BS)

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U18MAI1202	LINEAR ALGEBRA AND CALCULUS (Common to All branches)

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Identify eigenvalues and eigenvectors and apply Cayley Hamilton theorem.

CO2: Apply orthogonal diagonalization to convert quadratic form to canonical form.

CO3: Solve first order ordinary differential equations and apply them to certain physical situations.

CO4: Solve higher order ordinary differential equations.

CO5: Evaluate the total derivative of a function, expand the given function as series and locate the maximum and minimum for multivariate function.

CO6: Determine Rank, Inverse, Eigenvalues, Eigenvectors of the given matrix, Maxima-Minima of the function and Solving Differential equations using MATLAB

Pre-requisite: NIL

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S			M				M	M		M
CO2	S	S			M				M	M		M
CO3	S	S			M				M	M		M
CO4	S	S			M				M	M		M
CO5	S	S			M				M	M		M
CO6	S	S			M				M	M		M

COURSE ASSESSMENT METHODS:

DIRECT
1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product 3. Demonstration etc (as applicable) (Theory component) 4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component) 5. Model Examination (lab component) 6. End Semester Examination (Theory and lab components)
INDIRECT
1. Course-end survey

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THEORY COMPONENT

MATRICES **6 Hours**

Rank of a matrix – Consistency of a system of linear equations - Rouche's theorem - Solution of a system of linear equations - Linearly dependent and independent vectors– Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley Hamilton theorem (excluding proof)

DIAGONALISATION OF A REAL SYMMETRIC MATRIX **6 Hours**

Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS **11 Hours**

Leibnitz's equation – Bernoulli's equation – Equations of first order and higher degree - Clairauts form– Applications: Orthogonal trajectories.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS **11 Hours**

Linear equations of second and higher order with constant coefficients – Euler's and Legendre's linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients – Applications.

FUNCTIONS OF SEVERAL VARIABLES **11 Hours**

Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition, 2011.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Kreyzig E., "Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons, 2011.
4. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007
5. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics",S. Chand & Co., New Delhi, (Reprint) 2008
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai,2003
7. Weir, MD, Hass J, Giordano FR: Thomas' Calculus, Pearson education 12^{th} Edition, 2015
8. P.Bali., Dr. Manish Goyal., Transforms and partial Differential equations, University Science Press, New Delhi, 2010
9. G.B.Thomas and R.L.Finney, Calculus and analytical geometry, 11^{th} Edition, PearsonEducation, (2006)

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LAB COMPONENT

List of MATLAB Programmes:

1. Introduction to MATLAB.
2. Matrix Operations - Addition, Multiplication, Transpose, Inverse
3. Rank of a matrix and solution of a system of linear equations
4. Characteristic equation of a Matrix and Cayley-Hamilton Theorem.
5. Eigenvalues and Eigenvectors of Higher Order Matrices
6. Curve tracing
7. Solving first order ordinary differential equations.
8. Solving second order ordinary differential equations.
9. Determining Maxima and Minima of a function of one variable.
10. Determining Maxima and Minima of a function of two variables.

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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U18PHI2201 **Engineering Physics**
(Common to AU, ECE, CE, IT, MEC, ME)

L	T	P	J	C
3	**0**	**2**	**0**	**4**

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Understand the principles of motion and rotation of a rigid body in the plane.

CO2: Enhance the fundamental knowledge in properties of matter and its applications relevant to various streams of engineering and technology.

CO3: To introduce the phenomenon of heat and account for the consequence of heat transfer in engineering systems.

CO4: To apply the concepts of electrostatics and dielectrics for various engineering applications.

CO5: To understand the basics of magnetostatics.

CO6: To introduce and provide a broad view of the smart materials and Nano science to undergraduates.

Pre-requisites: High School Education

CO PO Mapping

COs	**Programme Outcomes (POs)**												**PSO**	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2
CO1	S		M									M	M	
CO2	S		M									M	M	
CO3	S		M									M	M	
CO4	S		M									M		M
CO5	S		M									M		M
CO6	S		M	M								M		M

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Cooperative learning report, Assignment; Group Presentation, Project report, Poster preparation, 3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 4. Model examination (lab component) 5. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

KINEMATICS & RIGID BODY MOTION **9 Hours**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler’s laws of motion, their independence from Newton’s laws, and their necessity in describing rigid body motion; Examples.

PROPERTIES OF MATTER **9 Hours**

Hooke's Law Stress - Strain Diagram - Elastic moduli - Relation between elastic constants - Poisson's Ratio - Expression for bending moment and depression - Cantilever - Expression for Young's modulus by Non-uniform bending and its experimental determination.

HEAT **9 Hours**

Specific heat capacity, thermal capacity. Temperature rise. Coefficient of linear thermal expansion. Methods of measurement of thermal expansion. Thermal stresses in composite structures due to non-homogeneous thermal expansion. Applications -The bimetallic strip. Expansion gaps and rollers in engineering structures. Thermal conductivity: differential equation of heat flow. Lee's disc apparatus for determination of thermal conductivity. Thermal Insulation. Convection and radiation. Applications to refrigeration and power electronic devices.

ELECTROSTATICS & MAGNETOSTATICS **9 Hours**

ELECTROSTATICS: Maxwell’s equation for electrostatics – E due to straight conductors, circular loop, infinite sheet of current - electric field intensity (D) - Electric potential - dielectrics - dielectric polarization - internal field – Clasious - Mosotti equation - dielectric strength - applications.

MAGNETOSTATICS: Maxwell’s equation for magnetostatics - B in straight conductors, circular loop, infinite sheet of current - Lorentz force, magnetic field intensity (H) – Biot–Savart’s Law – Ampere’s Circuit Law –Magnetic flux density (B).

NEW ENGINEERING MATERIALS AND NANO TECHNOLOGY **9 Hours**

New Engineering Materials: Metallic glasses – preparation, properties and applications – Shape memory alloys (SMA) – characteristics, properties of NiTi alloy applications - advantages and disadvantages of SMA.

Nano Materials: synthesis - Ball milling - Sol-gel - Electro deposition — properties of nano particles and applications. – Carbon Nano Tubes – fabrication by Chemical Vapour Deposition - structure, properties & applications.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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REFERENCES

1. Essential University Physics, Vols. 1 and 2., Richard Wolfson, Pearson Education, Singapore, 2011.
2. Engineering Mechanics (2nd ed.), Harbola M. K., Cengage publications, New Delhi, 2009.
3. Concepts of Physics, H. C. Vermavol 1 and 2, BharatiBhawan Publishers & Distributors; First edition (2017).
4. Engineering Electromagnetics, W. H. Hayt and John A. Buck, 6th Edition, Tata McGraw Hill, New Delhi, 2014.
5. Theory and Problems of Electromagnetic Schaum's Outline Series, 5th Edition, Joseph A. Edminister, Tata McGraw Hill Inc., New Delhi, 2010.
6. Engineering Physics, Rajendran V., Tata McGraw-Hill Education Pvt. Ltd., 2010
7. Nano – the Essentials, Pradeep T., McGraw-Hill Education, Pvt. Ltd., 2007.

Lab component:

LIST OF EXPERIMENTS

1. Non-uniform bending – Determination of Young's modulus
2. Compound Pendulum – Determination of acceleration due to gravity
3. Spectrometer – Determination of wavelength of mercury source using grating
4. Air wedge - Determination of thickness of thin sheet
5. Semiconductor Laser:
   a. Determination of wavelength of laser
   b. Determination acceptance angle and numerical aperture of an optialfibre.
   c. Determination of particle size
6. Melde's string – Determination of frequency of a turing fork
7. Determination of band gap of a semiconductor
8. Ultrasonic interferometer – Determination of velocity of sound and compressibility of a liquid
9. Luxmeter – Determination of efficiency of solar cell
10. Lee's disc – Determination of thermal conductivity of a bad conductor

Experiments for Demonstration:

1. Hall effect
2. Hardness Test
3. Four probe experiment
4. Hysteresis curve

REFERENCES

1. Laboratory Manual of Engineering Physics, Dr. Y. Aparna& Dr. K. Venkateswara Rao, V.G.S Publishers.
2. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
3. Great Experiments in Physics, M.H. Shamos, Holt, Rinehart and Winston Inc., 1959.
4. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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U18MAI2201 **ADVANCED CALCULUS AND LAPLACE TRANSFORMS**
(Common to All branches)

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Evaluate double and triple integrals in Cartesian coordinates and apply them to calculate area and volume.

CO2: Apply various integral theorems for solving engineering problems involving cubes and rectangular parallelepipeds.

CO3: Construct analytic functions of complex variables and transform functions from z-plane to w-plane and vice-versa, using conformal mappings.

CO4: Apply the techniques of complex integration to evaluate real and complex integrals over suitable closed paths or contours.

CO5: Solve linear differential equations using Laplace transform technique.

CO6: Determine multiple integrals, vector differentials, vector integrals and Laplace transforms using MATLAB.

Pre-requisites: U18MAI1201 – LINEAR ALGEBRA AND CALCULUS

CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**PROGRAMME OUTCOMES (POs)**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S			M				M	M		M
CO2	S	S			M				M	M		M
CO3	S	S			M				M	M		M
CO4	S	S			M				M	M		M
CO5	S	S			M				M	M		M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II (Theory component) 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) (Theory component) 3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 4. Model examination (lab component) 5. End Semester Examination (Theory and lab component)
INDIRECT
1. Course-end survey

<u>THEORY COMPONENT</u>

MULTIPLE INTEGRALS **9 Hours**

Double integration – Cartesian coordinates – Change of order of integration - Triple integration in Cartesian coordinates – Applications: Area as double integral and Volume as triple integral.

VECTOR CALCULUS **9 Hours**
Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Verification of theorem and simple applications.

ANALYTIC FUNCTIONS **9 Hours**
Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy-Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs)– Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping: $w = z + c$, cz , $1/z$ – Bilinear Transformation

COMPLEX INTEGRATION **9 Hours**
Cauchy's integral theorem –Cauchy's integral formula –Taylor's and Laurent's series – Singularities –Residues –Residue theorem –Application of residue theorem for evaluation of real integrals – Contour Integration (excluding poles on the real axis).

LAPLACE TRANSFORMS **9 Hours**
Definition - Properties: Superposition, Shift in t or Time Delay, Shift in s, Time Derivatives, Time Integral-Initial Value Theorem - Final Value Theorem - Transform of periodic functions - Inverse transforms - Convolution theorem – Applications: Solution of linear ordinary differential equations of second order with constant coefficients.

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 45 Hours

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition, 2011.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
4. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2008.
5. Kreyzig E., "Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons, 2011.
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai, 2003.
7. Weir, MD, Hass J, Giordano FR: Thomas' Calculus Pearson education 12th ED, 2015.

<u>LAB COMPONENT</u>

<u>List of MATLAB Programmes:</u>

1. Evaluating double integral with constant and variable limits.
2. Area as double integral
3. Evaluating triple integral with constant and variable limits
4. Volume as triple integral
5. Evaluating gradient, divergence and curl

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6. Evaluating line integrals and work done
7. Verifying Green's theorem in the plane
8. Evaluating Laplace transforms and inverse Laplace transforms of functions including impulse.
9. Heaviside functions and applying convolution.
10. Applying the technique of Laplace transform to solve differential equations.

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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U18MAT3102 **DISCRETE MATHEMATICS**
(Common to CSE, IT, ISE)

L	T	P	J	C
3	1	0	0	4

Course Outcomes:
After successful completion of this course, the students should be able to

CO1: Have a better understanding of sets and application of set theory.
CO2: Apply the knowledge of relations, equivalence relation and their properties.
CO3: Understand different kinds of functions.
CO4: Apply the knowledge of Combinatorics
CO5: Understand logical arguments and constructs simple mathematical proofs.
CO6: Know various graphs and learn different algorithms.

Pre-requisite courses: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
Cos	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2	S	M										
CO3	S	M										
CO4	S	S	M									
CO5	S	S	M									
CO6	S	S	M									

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

TOPICS COVERED:

SET THEORY **9+3 Hours**
Algebra of sets – The power set – Ordered pairs and Cartesian product – principle of inclusion and exclusion.

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Relations on sets –Types of relations and their properties - Equivalence relations –Relational matrix and the graph of relation – Operations on relations.

FUNCTIONS **9+3 Hours**

Functions – Classification of functions –Type of functions – Injective, surjective and bijective functions –Composition of functions – Inverse functions –Permutation functions.

COMBINATORICS **9+3 Hours**

Mathematical induction- The basics of counting–Permutations and combinations-Recurrence relations -Solving linear recurrence relations

LOGIC **9+3 Hours**

Propositions- Logical operators- Normal forms –Rules of inference-Consistency and inconsistency-Propositional logic- Proofs-Predicates- Quantifiers- Universe of discourse – Logical equivalences and implications for quantified statements-Rules of specification and generalization – Validity of arguments.

GRAPH THEORY **9+3 Hours**

Graphs- Types of graphs- Matrix representation of graphs- Graph isomorphism- Walk - Path- Cycles- Eulerian graphs -Hamiltonian graphs- Planar graphs- Euler formula- Shortest path algorithms.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. Liu C.L, "Elements of Discrete Mathematics, Second Edition, McGraw Hill 1985.
2. Mott J.L, Kandel A. and Baker T.P.,"Discrete Mathematics for Computer Scientists and Mathematicians, Second Edition, Prentice Hall India, 1986.
3. J.P.Trembly, R. Manohar, Discrete Mathematical Structures with applications to Computer Science, TMHInternational Edition (Latest Edition).
4. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science, Prentice – Hall, Engle Cliffs, N. J.
5. Harary F, Graph Theory, Narosa, 1969.
6. Thomas H.C., A Leiserson C.E., Rivest R.L, Stein C.A., "Introduction to a Algorithms(2nd Edition),MIT press and McGraw-Hill.2001.

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U18MAI4201 **PROBABILITY AND STATISTICS**
(Common to CSE, IT, ISE)

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Compute the statistical measures of correlation and regression.

CO2: Understand the concept of probability and its role in engineering.

CO3 : Construct probabilistic models for observed phenomena through distributions, which play an important role in many engineering applications.

CO4 : Carry out hypothesis testing and interpret the results

CO5: Understand the principles of design of experiments and perform analysis of variance.

CO6: Sketch control charts and outlines the process control.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S							M	M		M
CO2	S	S							M	M		M
CO3	S	S							M	M		M
CO4	S	S							M	M		M
CO5	S	S							M	M		M
CO6	S	S							M	M		M

Course Assessment methods

DIRECT
1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product 3. Demonstration etc (as applicable) (Theory component) 4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component) 5. Model Examination (lab component) 6. End Semester Examination (Theory and lab components)
INDIRECT
1. Course-end survey

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THEORY COMPONENT

CORRELATION AND REGRESSION **6 Hours**

Correlation – Karl Pearson's Correlation coefficient – Spearman's Rank Correlation – Regression lines.

PROBABILITY AND RANDOM VARIABLES **12 Hours**

Axioms of probability - Conditional probability – Total probability – Bayes' theorem - Random variable – Distribution function – properties – Probability mass function – Probability density function – moments- moment generating functions.

NORMAL DISTRIBUTION **5 Hours**

Normal distribution – Moments, Moment Generating functions and properties.

TESTING OF HYPOTHESIS **9 Hours**

Small samples tests based on t and F distributions (single mean, difference of means, paired *t*-test and variance ratio test) – Chi-square test for independence of attributes and goodness of fit

DESIGN OF EXPERIMENTS **8 Hours**

Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD).

STATISTICAL QUALITY CONTROL **5 Hours**

Concept of process control - Control charts for variables – Mean and Range charts – Control charts for attributes – p, np, c – charts.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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REFERENCES

1. Veerarajan T., Probability, Statistics and Random Processes, Tata McGraw Hill, 3^{rd} edition 2008.
2. Gupta S. P, "Statistical Methods", Sultan Chand & Sons Publishers, 2014.
3. Johnson R. A., Miller & Freund's "Probability and Statistics for Engineers", Sixth Edition, Pearson Education, Delhi, 2000.
4. Gupta.S.C and Kapoor.V.K, Fundamentals of Mathematical Statistics, 11^{th} extensively revised edition, Sultan Chand & Sons, 2007.
5. Walpole R. E., Myers S.L. & Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc, 9^{th} edition, 2012.
6. Gupta S.C, and KapurV.K "Fundamentals of Applied Statistics", Sultan Chand, New Delhi, 4^{th} Edition, 2014.
7. Charles Henry Brase and Corrinne PellilloBrase "Understandable Statistics", D.C. Heath and Company, Toronto, 9^{th} edition, 2007.

LAB COMPONENT : Using R Studio

1. Introduction to R programming
2. Application of descriptive statistics – Mean, Median, Mode and standard deviation
3. Applications of Correlation and Regression
4. Application of Normal distribution
5. Application of Student – t test
6. Application of F test
7. Application of Chi-square test
8. ANOVA – one way classification
9. ANOVA - two way classification
10. Control charts for variables (mean and range chart)

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total : 30 Hours

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U18MAT5101 **PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS**

L	T	P	J	C
3	1	0	0	4

Course Outcomes (COs):

After successful completion of this course, the students should be able to:

CO1: Form partial differential equations and solve certain types of partial differential equations.

CO2: Know how to find the Fourier Series and half range Fourier Series of a function

CO3: To know how to solve one dimensional wave equation, one dimensional heat equation in steady state using Fourier series.

CO4: Apply Fourier series to solve the steady state equation of two dimensional heat equation in Cartesian coordinates.

CO5: Apply the Fourier transform, Fourier sine and cosine transform to certain functions and use Parseval's identity to evaluate integrals..

CO6: Evaluate Z – transform for certain functions. Estimate Inverse Z – transform of certain functions and to solve difference equations using them.

Pre-requisite: NIL

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
Cos	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M			M				M	M		S
CO2	S	M		M								
CO3	S	S	S		S				M	M		S
CO4	S	M	M									M
CO5	S	M	M		S							
CO6	S	S			S				M	M		S

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

PARTIAL DIFFERENTIAL EQUATIONS **9+3 Hours**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

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FOURIER SERIES **9+3 Hours**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS
5+2 Hours

Classification of second order quasi linear partial differential equations – Formulation of wave and heat equations using physical laws - Solutions of one dimensional wave equation – One dimensional heat equation (excluding insulated ends)

BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS
4+1 Hours

Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

FOURIER TRANSFORM **9+3 Hours**

Fourier Integral Theorem – Representation of Functions – Infinite Fourier transforms – Sine and Cosine Transforms – Properties – Transforms of simple functions – convolution theorem – Parseval's identity.

Z –TRANSFORM **9+3 Hours**

Z-transform - Elementary properties – Convolution theorem- Inverse Z – transform (by using partial fractions, residue methods and convolution theorem) – Solution of difference equations using Z - transform.

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total: 60 Hours

References:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition. 2014.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand& Company ltd., New Delhi, 2006.
4. Ian Sneddon., "Elements of partial differential equations", McGraw – Hill, New Delhi, 2003.
5. Arunachalam T., "Engineering Mathematics III", Sri Vignesh Publications, Coimbatore 2009.

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HUMANITIES AND SOCIAL SCIENCES (HS)

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LANGUAGE ELECTIVES

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U18FRI2201 - FRENCH LEVEL -I
(Common to all)

L	T	P	J	C
2	0	2	0	3

Course Objectives:

1. To train the students to learn basic French
2. To teach them to learn basic grammar and vocabulary.
3. To train them to converse in French in day-to-day scenarios

Course Outcomes:

After the course the students will be able to:

CO1: to help students acquire familiarity in the French alphabet & basic vocabulary

CO2: listen and identify individual sounds of French

CO3: use basic sounds and words while speaking

- read and understand simple advertisements, brochures and invitations
- understand and use basic grammar and appropriate vocabulary in completing language tasks

CO/PO Mapping:

Assessment Methods:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	**Programme Outcomes (POs)**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1									S	S		S		
CO2									S	S		S		
CO3									S	S		S		

Direct
1. Continuous Assessment of Skills 2. Assignment 3. Written Test 4. End Semester Examination
Indirect
1. Course-end survey

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UNIT 1 **12 Hours**

Introduction to France and its regions - French alphabets and numbers, countries and nationality

Grammaire – Verbs – s’appeler, être, avoir, definite and indefinite articles Communication – Greetings, Self Introduction.

Unit II **12 Hours**

Basic vocabulary, colours, months and days

Grammaire - Verbes - Conjugation : Present tense (ER, IR, RE ending verbs) – Adjective possesive Communication – Talk about family and friends, date, time etc.

Unit III **12 Hours**

Hobbies, interests and daily routine

Grammaire – Irregular verbs – Releflexive verbs - Future proche Communication – Talking about hobbies and interests.

UNIT IV **12 Hours**

Vocabulary of places and transport

Grammaire – Pertinent verbs, adjective demonstrative, past tense, propositions
Communication – Narrating an incident or story

UNIT V **12 Hours**

Vocabulary of food, services, money

Grammaire – Negation, Verbs – acheter, manger, payer, articles partitifs
Communication – Accept and refuse an invitation, situation in a restaurant

Theory: 30 **Tutorial:** **Practical: 30** **Project: 0** **Total: 60 Hours**

References:

1. Grammaire Progressive du Français, CLÉ International, 2010.
2. Saison 1, Marie-Noëlle Cocton et al, Didier, 2014.
3. Préparation à l’examen du DELF A1 – Hachette

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U18GEI2201 - GERMAN LEVEL I
(Common to all)

L	T	P	J	C
2	0	2	0	3

Course Objectives:

- To train the students to learn basic German.
- To teach them to learn basic grammar and vocabulary.
- To train them to converse in German in day-to-day scenarios.

Course Outcomes:

After the course, the students will be able to:

CO1: to help students acquire familiarity in the German alphabet & basic vocabulary.

CO2: listen and identify individual sounds of German.

CO3: use basic sounds and words while speaking.

- read and understand simple advertisements, brochures and invitations.
- understand and use basic grammar and appropriate vocabulary in completing language tasks.

CO/PO Mapping:

Assessment Methods:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	**Programme Outcomes (POs)**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1									S	S		S		
CO2									S	S		S		
CO3									S	S		S		

Direct
1. Continuous Assessment of Skills 2. Assignment 3. Written Test 4. End Semester Examination
Indirect
1. Course-end survey

UNIT – 1 **12 Hours**

Introduction to Germany and its regions –German basic phrases, alphabets, numbers, countries and nationality

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Grammaire – Verbs – sein, haben, definite and indefinite articles Communication – Greetings, Self-Introduction.

Unit II **12 Hours**

Basic vocabulary, colours, months and days

Grammaire - Verbes - Conjugation : Present tense (regular verbs) – Adjective possesive Communication – Talk about family and friends, date, time etc.,

Unit III **12 Hours**

Hobbies, interests and daily routine

Grammaire – Irregular verbs Communication – Talking about hobbies and interests.

UNIT IV **12 Hours**

Vocabulary of places and transport

Grammaire – Cases, adjective demonstrative, past tense, propositions Communication – Narrating an incident or story.

UNIT V **12 Hours**

Vocabulary of food, services, money

Grammaire – Negation, Verbs – kaufen, essen, bezahlen Communication – Accept and refuse an invitation, situation in a restaurant.

Theory: 30 **Tutorial:** **Practical: 30** **Project: 0** **Total: 60 Hours**

References:

1. Studio d - Deutsch alsFremdsprache - Grundstufe - A1.
2. Fit Fur Goethe-Zertifikat A1 (Start Deutsch 1)
3. Mit ErfogZum Goethe-Zertifikat A1

Software:

All internet tools.

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U18HII2201-HINDI LEVEL-I

L	T	P	J	C
2	0	2	0	3

Course Objectives

1. To help the students learn Hindi Scripts Vowels and Consonants.
2. To help the students learn basic Hindi grammar.
3. To make the students understand the way the Language is to be spoken.
4. To ensure that the students are empowered with the linguistic knowledge.
5. To make the students acquire basic conversational skill.

Course Outcomes

1. Recognize and write Hindi alphabets.
2. Students will get to know the usage of words.
3. Students confident enough to speak Hindi.
   Students sound grammatically correct and confident.

CO/PO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	**Programme Outcomes (POs)**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1									**S**	**S**		**S**		
CO2									**S**	**S**		**S**		
CO3									**S**	**S**		**S**		

Assessment Methods:

Direct
1. Continuous Assessment of Skills 2. Assignment 3. Written Test 4. End Semester Examination
Indirect
1. Course-end survey

UNIT – 1

Introduction to Hindi language - Recognize and write Alphabets – Identify basic sentence structure – Greet each other – Ask questions - Days of the week – Numbers – Expressing time.

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Listening : Listening to Greetings, Numbers and Time.
Speaking : Self Introduction

UNIT – 2

Identify what is there and what is not there – Use postpositions(mein, par, ke paas etc.) – Use of singular/plural – Masculine/Feminine – Name and identify relatives – Express possession with kinship terms (ka/ke/kii) – parts of body

Listening : Listening for specific information, Family members, Parts of body
Speaking : Introducing one's family,

UNIT – 3

Vowels, consonants and conjoint letters and related vocabulary – Fruits, Vegetables, Food and Groceries – Use possessive pronouns – use interrogative pronouns (kaun,kiskaa,kiskii,kiske,kahaan se) – Present habitual actions – past habitual actions – today, tomorrow ,yesterday , day before yesterday, day after tomorrow (aaj/kal/parson)

Listening : Simple conversation between Shop keeper and customer
Speaking : Names of fruits and vegetables , Express one's daily routine

UNIT – 4

Create and follow a simple recipe – Use indirect verbs with nouns (isko, usko,..etc.) – express needs Ask about and express wishes and preferences – Use infinitive – use comparative and superlative degree of adjectives – Use more interrogative words – Explain about future plans – simple future actions

Listening : Listening to a simple recipe
Speaking : Express your needs and wishes , future plans

UNIT – 5

Learn about some festivals like Diwali, Pongal, Holli etc. – Learn some short stories

Listening : Short stories
Speaking : Making small stories , Describe your favorite festival.

Theory: 30 Tutorial: Practical: 30 Project: 0 Total: 60 Hours

References:

1.Hindi Prachar Vahini-1, Prathmic Exam. (For Basics And Grammar)
2.Hindi Prachar Vahini-2 Madhyama Book(For Spoken Hindi) D.B.Hindi Prachar Sabha, T.Nagar, Chennai.
3.Sabari Hindi Speaking Course, For Spoken. Sabari Book House, Salem

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U18JAI2201 – Japanese Level I

L	T	P	J	C
2	0	2	0	3

Course Objectives:

1. To enable students, achieve a basic exposure on Japan, Japanese language and culture.
2. To make students familiar with the Japanese cultural facets and social etiquettes.
3. To make the students acquire basic conversational skills.
4. To help students learn the Japanese scripts viz. hiragana and a few basic kanji.
5. To help students learn the basic Japanese grammar.

Course Outcomes:

After the course, the students will be able to:

CO1: Recognize and write Japanese alphabet.

CO2: Speak using basic sounds of the Japanese language.

CO3: Apply appropriate vocabulary and grammar needed for simple conversation in Japanese language. Comprehend the simple day to day conversation and give correct meaning.

CO/PO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	**Programme Outcomes (POs)**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1									S	S		S		
CO2									S	S		S		
CO3									S	S		S		

Assessment Methods:

Direct
1. Continuous Assessment of Skills 2. Assignment 3. Written Test 4. End Semester Examination
Indirect
1. Course-end survey

UNIT -I **12 Hours**

Japan : Land and culture - Introduction to Japanese language – Greetings – Seasons - Days of the week - Months of the year – Dates of the month - Self introduction – Numbers (Upto 99,999) – Expressing time – Conversation audio and video.

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Listening: Listening to Greetings - Listening for Specific Information: Numbers, Time.
Speaking: Self-Introduction

UNIT – 2 **12 Hours**

Family relationships - Colours - Parts of body - Profession - Directions - Time expressions (today, tomorrow, yesterday, day before, day after) - Japanese housing and living style - Food and transport (vocabulary) - Stationery, fruits and vegetables.
Listening: Listening for Specific Information: Directions, Family Members, Parts of body
Speaking: Introducing one's family.

UNIT - 3 **12 Hours**

Hiragana Chart 1 - vowels and consonants and related vocabulary – Hiragana Charts 2&3, double consonants, vowel elongation and related vocabulary – Introduction to Kanji – Basic Vocabulary – Basic Conversational Phrases.
Listening: Listening to Japanese Alphabet Pronunciation, Simple Conversation.
Speaking: Pair Activity (Day to day situational conversation)

UNIT - 4 **12 Hours**

Katakana script and related vocabulary – Basic kanjis: naka, ue, shita, kawa , yama , numbers (1-10, 100, 1000, 10,000 and yen) , person, man, woman, child, tree , book , hidari, migi, kuchi , 4 directions - Usage of particles wa, no, mo and ka and exercises - Usage of kore, sore, are, kono, sono, ano, arimasu and imasu - Particles – ni (location) and ga , donata and dare - Particles ni (time), kara, made , ne , koko, soko, asoko and doko - Directions : kochira, sochira, achira and dochira , associated vocabulary (mae, ushiro, ue, shita, tonari, soba, etc.)
Listening: Listening to conversation with related particles
Speaking: Individual Activity (Constructing simple sentences using particles)

UNIT - 5 **12 Hours**

Introduction to Verbs - Verbs –Past tense, negative - i-ending and na-ending adjectives introduction - ~masen ka, mashou - Usage of particles de, e , o, to, ga(but) and exercises - Adjectives (present/past – affirmative and negative) – Counters - ~te form
Listening: Listening to different counters, simple conversations with verbs and adjectives.
Speaking: Pair Activity (Explaining one's daily routine by using appropriate particles and verbs)
Theory: 30 **Tutorial:** **Practical: 30** **Project: 0** **Total: 60 Hours**

Reference:

1. Japanese for dummies.Wiley publishing co.Inc.,USA.
2. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
3. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

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4. www.japaneselifestyle.com
5. www.learn-japanese.info/
6. www.kanjisite.com/
7. www.learn-hiragana-katakana.com/typing-hiragana-characters/

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U18ENI0202 **Professional Communication**

L	T	P	J	C
2	0	2	0	3

Course Outcomes:

On successful completion of the course, the student will be able to

CO1: Listen to audio contents related to professional communication and prepare a short note.
CO2 : Discuss with peers on a given topic with original thoughts.
CO3 : Read technical papers, patents and professional documents and extract main themes
CO4 : Write technical papers, reports, blogs and professionally communicate with relevant stakeholder.

CO/PO Mapping:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	**Programme Outcomes (POs)**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1									S	S		S		
CO2									S	S		S		
CO3				M					S	S		S		
CO4				M					S	S		S		

Assessment Methods

Direct
1. Continuous Assessment of Skills 2. Assignment 3. Written Test 4. End Semester Examination
Indirect
1. Course-end survey

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UNIT –1 **12 Hours**

Grammar and Vocabulary: Sentence Construction using Purpose and Function - Cause and Effect expressions, Common mistakes in conversations and Text Writings.

Reading: 21st Century skills. Modes of Communication: L-S-R-W. Types of Communication: Personal and Professional Communication. World's popular Languages - Glimpses of Essential English, Etiquettes in Professional Communication.

Writing: Writing E-Mail for Professional interactions - Formatting style and guidelines - crafting compelling subject lines and body text

Practical Component:

Listening: Listening to TED/TECH Talks / Speeches of Leaders

Speaking: Just -a–minute

Continuous Assessment 1:

Speaking: Introducing Self – Introducing a Chief Guest of Your Choice (10 Marks)

UNIT -2 **12** Hours

Grammar and Vocabulary: Tenses and Voices.

Reading: Note Making (Linear) and Summary Writing.

Listening: Listening for Specific Information (Dates, events, place, time etc.)

Practical Component:

Speaking:(Presentation) Presenting the Recent Happening (at National / International Level) using PPT

Writing: Drafting letters to an International Institutions for Research collaborations – Drafting letters to foreign companies for commercial partnerships - Drafting a proposal for an event- Product Review.

Continuous Assessment 2:

Writing: Writing Emails to an International Client on a New Project proposal (10 Marks)

UNIT–3 **12** Hours

Grammar and Vocabulary: Concord

Reading: Reading - Subskills, Reading and Responding to texts, Cloze Test

Encoding and Decoding Professional Communication: Editorials

Writing: Writing Captions, Slogans,and Tagline - Describing gadgets and products - Writing Technical Instructions and Recommendations.

Listening: Listening to Product Descriptions /Reviews

Practical Component:

Reading: Government Policy, Tender Documents.

Speaking: Describing an Event/Place, Sharing Personal Experiences

Continuous Assessment 3:

Writing: Review Writing (1 page) out of three technical papers of your choice (10 Marks)

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UNIT–4 **12 Hours**

Grammar and Vocabulary: Effective use of Punctuation and Proof-reading Techniques, Spotting Errors and Error Correction – Competitive Exams, Discourse Markers

Reading: Reading and comprehending - Reading a Patent document, analyze the features and extract the technical contents.

Writing: Paragraph writing (Expository, Narrative, Comparing & Contrasting and Persuasive)

Listening: Listening to Short Stories and Presenting Reflections

Practical Component: Group Discussion

Continuous Assessment 4:

Speaking: Group Discussion using a group not more than 6 in a Group (10 Marks)

UNIT–5 **12 Hours**

Grammar and Vocabulary: Appropriate vocabulary for interpretation of graphics.

Reading: Reading and Interpreting Graphical Representations (Line Graphs / Stacked Bar / Infographics)

Writing: Process Writing (Technical and Non-technical)- Report Writing – (Types and Format, Writing Project Reports) - Itinerary and Travelogue - Writing blogs on professional / core topics

Listening: Listening to Technical Context (Technical Videos) and Popular Interviews

Practical Component:

Mock interview (HR)

Continuous Assessment 5:

Speaking: Mock Interview for a Technical Position (10 Marks)

Theory: 30 **Tutorial:** **Practical: 30** **Project: 0** **Total: 60 Hours**

Reference Books

1. Goldsberg D.,*Life Skills and Leadership for Engineers*, University of Skinois, Tata McGraw Hill, 2005.
2. Gallo C., *Talk like TED*. St. Martin's Press, 2015.
3. Lewis N., *Word Power Made Easy*, Simon and Schuster, 1979.
4. Raman M., and Sharma S., *Technical Communication – English Skills for Engineers*, Oxford Higher Education, 2009.
5. Seely J., *Oxford Guide to Effective Writing and Speaking*, Oxford University Press, 1998.
6. British Council Learn English Teens through[https://learnenglishteens.britishcouncil.org/.](https://learnenglishteens.britishcouncil.org/)

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U18VET4101	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	L	T	P	J	C
		2	1	0	0	3

COURSE OUTCOMES:

After successful completion of this course, the students shall be able to

CO1: Develop a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.

CO2: Understand (or develop clarity) of the harmony in the human being, family, society and nature/existence

CO3: Strengthen their self-reflection.

CO4: Develop commitment and courage to act.

Pre-requisites:-None. Universal Human Values 1(Desirable)

CO-PO AND CO-PSO MAPPING:

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
Cos	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M	M	M	S			M	-	-
CO2						S	M		S	S		S	-	-
CO3								M	M		W	S	-	-
CO4								S	M		M	M	-	-

COURSE ASSESSMENT METHODS:

Direct
1. Assessment by faculty mentor 2. Self-assessment 3. Socially relevant project/Group Activities/Assignments 4. End Semester Examination
Indirect
1.Assessment by peers(Survey form)

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COURSECONTENTS:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course,recapitulation from Universal HumanValues-I.
2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation-as the process for self-exploration.
3. Continuous Happiness and Prosperity-A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility-the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module2: Understanding Harmony in the Human Being – Harmony in Myself!

1. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’.
2. Understanding the needs of Self (‘I’) and ‘Body’ –happiness and physical facility.
3. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life.
Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Module3: Understanding Harmony in the Family and Society-Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society - Undivided Society, Universal Order-from family to world family.

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Include practice session store flection relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module4: Understanding Harmony in the Nature and Existence- Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually inter acting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc

COURSE DURATION:

No	MODULE	HOURS
1	Module1	[7Theory+3Tutorial] 10Hrs
2	Module2	[6Theory+3 Tutorial]9Hrs
3	Module3	[7Theory+3Tutorial] 10Hrs
4	Module4	[5Theory+3 Tutorial]8Hrs
5	Module5	[5Theory+3 Tutorial]8Hrs
	Total	**45**

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TEXT BOOK

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS

1. JeevanVidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz
15. https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ
16. https://www.uhv.org.in/uhv-ii

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U18ITP5605 **DIGITAL AND SOCIAL MEDIA MARKETING**

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- This course provides a hands-on, project- and lab-based approach to mastering social media marketing across leading digital platforms.
- Students will learn to create, manage, and optimize engaging content while analysing campaign performance using real-world tools.
- Emphasizing strategic planning and ethical practices, the course prepares students to design and execute effective digital marketing campaigns that drive audience engagement and business growth.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Explore key social media platforms, tools, and services for marketing. [K2]

CO2: Evaluate emerging social media tools and innovative content formats for digital engagement. [K5]

CO3: Develop practical skills to create and manage effective social media marketing campaigns. [K6]

CO4: Apply creative strategies to build and engage audiences across diverse digital channels. [K3]

CO5: Formulate strategic social media marketing plans incorporating analytics and user-generated content. [K6]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S												M		
CO2	S				S								M		
CO3	S		S					M					M		
CO4	S							M					M		
CO5	S				S				S				M		

COURSE ASSESSMENT METHODS:

DIRECT
1. Project 2. Project presentation/Report 3. Lab Assignments, 4. Demo presentations, 5. Quiz/peer review(optional)
INDIRECT
1. Course-end survey

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PRACTICAL COMPONENTS:

FACEBOOK ENGAGEMENT LAB **12 Hours**

- Create and optimize Facebook business profiles and fan pages.
- Design interactive marketing content for groups and pages.
- Use Facebook marketing tools and checklists for campaign setup.

Lab tasks:

- Build a Facebook business page with marketing posts.
- Run content engagement tests and gather insights.

TWITTER CAMPAIGN LAB **12 Hours**

- Set up and optimize a Twitter profile for marketing.
- Explore Tweet management tools such as TweetDeck.
- Develop campaigns using trends and hashtags.

Lab tasks:

- Manage multiple Twitter accounts and schedule tweets.
- Experiment with Twitter grading and analysis tools for optimization.

YOUTUBE VIDEO MARKETING LAB **12 Hours**

- Create and manage a YouTube channel targeted at marketing goals.
- Produce engaging video content and understand video SEO principles.

Lab tasks:

- Upload and optimize a marketing video.
- Monitor video performance and audience interaction.

LINKEDIN B2B MARKETING LAB **12 Hours**

- Build professional LinkedIn profiles for companies.
- Use LinkedIn tools for networking and lead generation.

Lab tasks:

- Create LinkedIn corporate profiles and connect with target audiences.
- Draft recommendations and testimonials to enhance credibility.

INSTAGRAM CONTENT MARKETING AND AUDIENCE ENGAGEMENT LAB **12 Hours**

- Basics of Instagram inbound marketing
- Using Instagram Lives and story-based webinars for engagement
- Techniques for creating Reels and boosting interactions
- Building and growing a professional Instagram business profile
- Designing carousel posts and infographics for effective storytelling
- Content curation using Highlights, Saved posts, and leveraging User-Generated Content (UGC)

Lab tasks:

- Set up and optimize an Instagram business profile for a chosen brand or cause
- Create an Instagram Live session or story webinar outline and run a simulated event
- Produce and publish engaging reels focusing on specific marketing objectives
- Design carousel posts and infographics using Canva or similar tools
- Curate content with Highlights and Saved posts, and develop a plan to incorporate UGC into the campaign

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CAPSTONE PROJECT AND DIGITAL ENGAGEMENT CAMPAIGN: 30 Hours

- Students form teams to devise and execute a complete digital marketing campaign across multiple platforms.
- Campaign includes content creation, scheduling, engagement measurement, and optimization.
- Teams present their strategy, results, and learnings at course end.

Theory: 0 Tutorial: 0 Practical: 90 Project: 0 Total: 90 Hours

REFERENCES:

1. "Social Media Marketing: A Strategic Approach" by Melissa Barker, Donald I. Barker, Nicholas F. Bormann, and Krista E. Neher
2. "Social Media Marketing Workbook: How to Use Social Media for Business" by Jason McDonald.
3. "Content Rules: How to Create Killer Blogs, Podcasts, Videos, Ebooks, Webinars (and More) That Engage Customers and Ignite Your Business" by Ann Handley and C.C. Chapman

ONLINE COURSES:

1. https://www.coursera.org/learn/social-media-marketing-introduction
2. https://www.coursera.org/professional-certificates/facebook-social-media-marketing
3. https://www.udemy.com/course/digital-marketing-guide/?couponCode=PMNVD2025
4. https://www.udemy.com/course/become-a-kick-ass-social-media-manager/?Coupon Code=PMNVD2025

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ENGINEERING SCIENCES
(ES)

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U18CSI1201 **STRUCTURED PROGRAMMING USING C**

(Common to CSE,ISE& IT)

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, The students should be able to

CO1: Acquire knowledge on different problem solving techniques.
CO2: Use appropriate data types and control structures for solving a given problem.
CO3: Execute different array and string operations.
CO4: Experiment with the usage of pointers and functions.
CO5: Organize data using structures and unions.
CO6: Demonstrate data persistency using files**.**

Pre-requisites :Nil

CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	PROGRAMME OUTCOMES (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M							L			
CO2	S	M							L	L		
CO3	S	L			L	L			L	L		L
CO4	M	L	M	L	L	L			L	L		M
CO5	M	L	M	L	L	L			L	L		M
CO6	L	L	M	L	L	L			L	L		L

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II (Theory Component) 2. Assignment (Theory Component) 3. Group Presentation (Theory Component) 4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 5. Model examination (lab component) 6. End Semester Examination (Theory and lab component)
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

STRUCTURED PROGRAMMING **7 Hours**

Algorithms, building blocks of algorithms (instructions/statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving.

ARRAYS AND STRINGS **11 Hours**

Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements. Defining an array – Processing an array –Multidimensional Arrays Character Arithmetic

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– Defining a string – NULL character – Initialization of Strings – Reading and Writing Strings – Processing Strings –Searching and Sorting of Strings.

FUNCTIONS, STORAGE CLASSES 9 Hours

Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Passing arrays to functions –Function with string - Recursion – Storage classes

POINTERS 9 Hours

Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function – Pointers and one dimensional arrays – operations on pointers– Dynamic memory allocation

STRUCTURES, UNIONS AND FILES 9 Hours

Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions

Files: Opening and Closing a Data File – Reading and writing a data file – Processing a data file – Unformatted data files – Concept of binary files – Accessing a file randomly using fseek

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and ManasGhosh, "Programming in C", Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
5. ReemaThareja, "Programming in C", Second Edition, Oxford University Press, 2011.

LAB COMPONENT CONTENTS

LIST OF EXPERIMENTS

1. Writing algorithms, flowcharts and pseudo codes for simple problems.
2. Programs on expressions and conversions
3. Programs using if, if-else, switch and nested if statements
4. Programs using while, do-while, for loops
5. Programs on one dimensional arrays, passing arrays to functions and array operations
6. Programs using two dimensional arrays, passing 2D arrays to functions
7. Programs using String functions
8. Programs using function calls, recursion, call by value
9. Programs on pointer operators, call by reference, pointers with arrays
10. Programs using structures and unions.
11. Programs on file operations and modes.
12. Working with text files, random files and binary files

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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U18EEI1201 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to CSE,IT,ISE)

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1 Solving basic DC and AC circuits

CO2 Select suitable DC machine for given application

CO3 Select suitable AC machine for given application

CO4 Characterize logic gates, semiconductor devices according to their applications

CO5 Identify electronic components and use them to design simple circuits.

Pre-requisites :Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)												PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	M										W		
CO2	M	M										W		
CO3	M	M										W		
CO4	M	M										W		
CO5	M	M										W		

COURSE ASSESSMENT METHODS

DIRECT

1. Continuous Assessment Test I, II (Theory Component)
2. Assignment (Theory Component)
3. Group Presentation (Theory Component)
4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component)
5. Model examination (lab component)
6. End Semester Examination (Theory and lab component)

INDIRECT

1. Course-end survey

DC circuits: **9 Hours**

Basic circuit elements and sources, Ohms law, Kirchhoff’s laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis.

AC circuits: **9 Hours** Alternating voltages and currents –SinglePhase Series RL, RC, RLC Circuits, Power in AC circuits –PowerFactor.

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Electrical Machines: **9 Hours**
Construction, Working Principle andapplications of DC generators, DC Motors, single phase Transformers, three phase and single phase induction motors.

Semiconductor devices and Circuits: **9 Hours** PN junction diode – Zener Diode – Half wave and Full wave rectifier-voltage regulators – Bipolar Junction transistors,JFET, MOSFET – characteristics

Digital Systems: **9 Hours**
Binary Number System – Logic Gates – Boolean algebra – Half and Full Adders -subtractor– Multiplexer – Demultiplexer-decoder-flip flops.

Theory:45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

TEXT BOOKS:

1. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
2. Sedha R.S., "Applied Electronics", S. Chand & Co., 2006.

REFERENCES

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, 2017.
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.
3. Mehta V K, "Principles of Electronics", Third Edition, S.Chand& Company Ltd, 1994.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, 2003.

LABORATORY EXPERIMENTS

1. Measurement of electrical quantities–voltage,current,power&power factor in RL, RC and RLC circuits.
2. Verification of Kirchoff's Voltage and Current Laws.
3. Verification of Mesh and Nodal analysis.
4. Load test on DC shunt motor.
5. Load test on single phase transformer.
6. Load test on single phase induction motor.
7. Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EXNOR gates.
8. Full wave rectifier with and without filter.
9. Input and output Characteristics of BJT – CE configuration.
10. Characteristics of PN junction diode and Zener diode.

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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L	T	P	J	C
0	0	4	2	3

U18INI1600 **ENGINEERING CLINIC - I**

COURSE OBJECTIVES

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution

CO2: Understand the project management techniques

CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S			
CO3										S				

Course Assessment methods:

Direct
1. Project reviews 50% 2. Workbook report 10% 3. Demonstration& Viva-voce 40%
Indirect
1. Course Exit Survey

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of

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reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.
In the first semester, students will focus primarily on IOT with C programming using Arduino.

GUIDELINES:
1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Theory:0 Tutorial: 0 Practical: 60 Project: 30 Total: 90 Hours

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L	T	P	J	C
2	0	2	0	3

U18CSI2201 PYTHON PROGRAMMING

(Common to All Branches)

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Classify and make use of python programming elements to solve and debug simple logical problems.(K4,S3)

CO2: Experiment with the various control statements in Python.(K3,S2)

CO3: Develop Python programs using functions and strings.(K3,S2)

CO4: Analyze a problem and use appropriate data structures to solve it.(K4,S3)

CO5: Develop python programs to implement various file operations and exception handling.(K3,S2)

Pre-requisites : U18CSI1201 – Structured Programming Using C

CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak															
Cos	**PROGRAMME OUTCOMES (POs)**												**PSO**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO1 0**	**PO 11**	**PO1 2**	**PS O1**	**PS O2**	**PSO 3**
CO1		S			M					M		M			
CO2			M							M		M			
CO3			M							M		M		M	
CO4	S	S	M		M					M		M	M	M	
CO5			M							M		M			

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test, Assignment 3. Viva, Experimental Report for each Experiment (lab Component) 4. Model Examination (lab component) 5. End Semester Examination (Theory and lab components)
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

BASICS OF PYTHON PROGRAMMING 6 Hours

Introduction-Python Interpreter-Interactive and script mode-Values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.

CONTROL STATEMENTS AND FUNCTIONS IN PYTHON 6 Hours

Conditional (if), alternative (if-else), chained conditional (if-elif-else)-Iteration-while, for, break, continue, pass – Functions-Introduction,inbuilt functions, user defined functions, passing parameters, return values, recursion, Lambda functions.

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DATA STRUCTURES: STRINGS,LISTS and SETS 7 Hours

Strings-String slices, immutability, string methods and operations -Lists-creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions-list processing-list comprehension, searching and sorting, Sets-creating sets, set operations.

DATA STRUCTURES: TUPLES, DICTIONARIES 5 Hours

Tuples-Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value- Dictionaries-operations and methods, Nested Dictionaries.

FILES, MODULES, PACKAGES 6 Hours

Files and Exception-Text files, reading and writing files, format Operator-Modules-Python Modules-Creating own Python Modules-packages, Introduction to exception handling.

Theory: 30 Tutorial: 0 Practical: 0 Project: 0 Total: 30 Hours

REFERENCES

1. Ashok NamdevKamthane,Amit Ashok Kamthane, “Programming and Problem Solving with Python” , Mc-Graw Hill Education,2018.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second edition, Updated for Python 3, Shroff / O’Reilly Publishers, 2016.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd,” Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
6. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem Solving Focus”, Wiley India Edition, 2013.

E BOOKS AND ONLINE LEARNING MATERIALS

1. www.mhhe.com/kamthane/python
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff / O’Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

LAB COMPONENT CONTENTS

LIST OF EXPERIMENTS

1. Implement simple python programs using interactive and script mode.
2. Develop python programs using id() and type() functions
3. Implementrange() function in python
4. Implement various control statements in python.
5. Develop python programs to perform various string operations like concatenation,slicing, Indexing.
6. Demonstrate string functions using python.
7. Implementuser defined functions using python.
8. Develop python programs to perform operations on list
9. Implement dictionary and set in python

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10. Develop programs to work with Tuples.
11. Create programs to solve problems using various data structures in python.
12. Implement python program to perform file operations.
13. Implement python programs using modules and packages.

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

ONLINE COURSES AND VIDEO LECTURES:

- http://nptel.ac.in
- https://www.edx.org/course/introduction-to-python-fundamentals-1
- https://www.edx.org/course/computing-in-python-ii-control-structures-0
- https://www.edx.org/course?search_query=Computing+in+Python+III%3A+Data+Structures

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U18INI2600 **ENGINEERING CLINIC – II**

L	T	P	J	C
0	0	4	2	3

COURSE OBJECTIVES

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S			
CO3										S				

COURSE ASSESSMENT METHODS:

Direct
1.Project reviews 50% 2.Workbook report 10% 3.Demonstration& Viva-voce 40%
Indirect
1. Course Exit Survey

CONTENT:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

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In the second semester, students will focus primarily on Raspberry pi based controllers with Python programming .

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

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U18ECT3011 PRINCIPLES OF COMMUNICATION

L	T	P	J	C
3	0	0	0	3

Course Outcomes:
After successful completion of this course, the students should be able to

CO1: Describe the fundamental concepts of communication systems
CO2: Compare analog modulation schemes.
CO3: Explain digital modulation schemes.
CO4: Classify standard base band data transmission techniques.
CO5: Paraphrase the spread spectrum techniques and multiple access techniques

Pre-requisite: Nil

					CO/PO Mapping							
COs					Programme Outcomes(POs)							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	M	W										
CO3	M	W	W									
CO4	M											
CO5	M	W										

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment,Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

Topics covered:

INTRODUCTION TO COMMUNICATION SYSTEMS **3 Hours**
Basics of Communication System– Electromagnetic Spectrum – Need for Modulation.

ANALOG MODULATION: **12 Hours**

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Principles of amplitude modulation - AM envelope, Frequency spectrum and bandwidth, Modulation index and percent modulation, AM power distribution – AM Modulator and Demodulator, AM transmitter and receivers - TRF, Super heterodyne receivers. Angle Modulation - FM and PM, Mathematical representation, waveform, Bandwidth, FM modulators and Demodulators, Direct and Indirect FM transmitters.

DIGITAL MODULATION TECHNIQUE **10 Hours**

Introduction, Binary ASK, PSK, QPSK and Binary FSK, Concepts of M-ary Modulation schemes.

BASEBAND DATA TRANSMISSION **10 Hours**

Sampling theorem, Reconstruction of message from its samples, PCM, line coding techniques DPCM, DM, ADM, ISI, Time Division multiplexing, Digital Multiplexers.

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES **10 Hours**

Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, Processing gain, Probability of error, FH spread spectrum, multiple access techniques

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES:

1. Wayne Tomasi, ―Electronic Communication Systems: Fundamentals through Advanced, Pearson Education, 2001.
2. Simon Haykin, ―Digital Communications, John Wiley & Sons, 2003
3. Simon Haykin, ―Communication Systems, John Wiley & Sons, 4thedn., 2001.
4. Taub& Schilling, ―Principles of Communication Systems, TMH, 2ndedn., 2003
5. Blake, ―Electronic Communication Systems, Thomson Delman, 2ndedn., 2002.

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U18ITI3203 **OBJECT ORIENTED PROGRAMMING**

L	T	P	J	C
3	0	2	0	4

COURSE OBJECTIVES:

- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
- Be aware of the important topics and principles of software development.
- Write computer programs to solve specified problems.
- Use the Java SDK environment to create, debug and run simple Java programs.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 : Interpret the need of various OOPS concept
CO2 : Apply the OOPS concepts for developing application
CO3 : Apply the concepts of packages and interfaces to write simple applications
CO4 : Explore the importance of strings and stream classes
CO5 : Summarize the importance of exception handling and threads
CO6 : Apply the concepts of collections for handling data

Pre-requisites : Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M											W		
CO2	S	M	M		M							M	M	M	
CO3	S	M	M		M								M		S
CO4	M	M											M		
CO5	M	M											M		
CO6	S	M	M	M								M	M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva (Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

Object Oriented Programming basics **9 Hours**

Introduction to OOP – Attributes, Methods, Modelling Real World using OOP - Data types - Variables and Arrays – Operators – Control Statements – Classes and Objects – Constructors.

Inheritance & Polymorphism **9 Hours**

Inheritance – types of inheritance –Method overriding – Polymorphism – Method overloading – constructor overloading – Dynamic Method Dispatch - Packages – defining and packages – interfaces – implementing and extending interfaces

I/O and Strings **9 Hours**

I/O basics: Streams – Byte streams and Character streams – Files – String handling – String operations – String methods – Wrapper classes

Exceptions & Multithreading **9 Hours**

Exception Handling – Using try and catch – Built-in Exceptions – User-defined Exception. Threading – Life cycle of a thread – Thread Implementation – Synchronization – Inter-thread Communication

Collections **9 Hours**

Overview of Collections Interfaces, List Interface and its implementations, Generics, List looping, Stack, Priority Queues, Map in Java

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. Herbert Schildt, “The Complete Reference– Java”, Tata McGraw Hill, Ninth edition,2014
2. Deitel and Deitel, “Java: How to Program”, Ninth Edition, Prentice Hall, Tenth Edition,2014
3. Bruce Eckel , ”Thinking in Java”, Fourth Edition, Pearson Education, 2006
4. Cay S. Horstmann, Gary Cornell, ”Core Java, Volume I—Fundamentals”, Eighth Edition, Sun Microsystems, 2011.

LAB COMPONENTS

List of Experiments:

1. Basic programs
2. Working with classes and objects
3. Programs in inheritance
4. Programs in polymorphism
5. String Handling
6. Programs in Exception handling
7. Programs in multithreading
8. Stack and Queue implementation using collection interfaces

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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U18INI3600 ENGINEERING CLINIC - III

L	T	P	J	C
0	0	4	2	3

COURSE OBJECTIVES

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

COURSE OUTCOMES

AFTER SUCCESSFUL COMPLETION OF THIS COURSE, THE STUDENTS SHOULD BE ABLE TO:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S			
CO3										S				

COURSE ASSESSMENT METHODS:

Direct

1. Project reviews 50%
2. Workbook report 10%
3. Demonstration& Viva-voce 40%

Indirect

1. Course Exit Survey

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Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the III semester, students will focus primarily on Design project combining concepts learnt in Engineering clinics I and II

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Theory: 0 Tutorial: 0 Practical: 60 Project: 30 Total: 90 Hours

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U18INI4600 ENGINEERING CLINIC IV

L	T	P	J	C
0	0	4	2	3

COURSE OBJECTIVES

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	S	S	S	S	S	M	W		S			S		
CO2											S			
CO3										S				

COURSE ASSESSMENT METHODS:

Direct
1.Project reviews 50% 2.Workbook report 10% 3.Demonstration& Viva-voce 40%
Indirect
1. Course Exit Survey

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the IV semester, students will focus primarily on Reverse engineering project to improve performance of a product

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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Theory: 0 Tutorial: 0 Practical: 60 Project: 30 Total: 90 Hours

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PROFESSIONAL CORE (PC)

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U18ITI2201	DIGITAL LOGIC AND MICROPROCESSOR

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Demonstrate the knowledge of logic gates, Boolean algebra, minimization techniques and apply to design a combinational circuits

CO2: Analyse and design sequential circuits

CO3: Program 8086 for the given problems

CO4: Interface 8086 with peripheral devices

Pre-requisites :U18EEI1201 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M	M		M							M	M		
CO2	M	M										M	M		
CO3	M	M	W		M							M	M		
CO4	M	M	W									M			

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

<u>Theory Component contents</u>

COMBINATIONAL CIRCUITS **10 Hours**

Review of number systems - Logic gates: NAND, NOR gate as universal building blocks - Simplification of four-variable Boolean equations using Karnaugh maps - Half adder, Full adder, Half subtractor, Full subtractor - 4-bit parallel adder and subtractor - 3-bit binary decoder – Decimal to BCD encoder – 8-to-1 multiplexer, 1-to-8 Demultiplxer

SEQENTIAL LOGIC CIRCUITS **8 Hours**

Flip flops SR, JK, T, D and Master slave – Characteristic table and equation –Application table – Edge triggering –Level Triggering –Realization of one flip flop using other flip flops – Register – shift registers - Universal shift register .

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DESIGN OF SEQUENTIAL CIRCUITS **9 Hours**

Design of synchronous sequential circuits: state diagram - State table – State minimization – State assignment. Counters: Synchronous Binary counters – Modulo n counter - Decade - BCD counters, Asynchronous counter, Ring counters.

8086 MICROPROCESSOR ARCHITECTURE AND INSTRUCTION SET **10 Hours**

Pin diagram - CPU architecture - Memory segmentation - Internal operations - Addressing modes -Instruction formats - Assembler instruction formats: Data transfer instructions, Arithmetic instructions, Logical instructions, Branch-and-loop instructions – Interrupts: Software and Hardware interrupts, Software interrupt programming

PERIPHERAL CHIPS **8 Hours**

8255 (PPI), 8254 (Timer), 8257 (DMA), 8259 (PIC), 8251 (USART), 8279(Key Board Display Interface)

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

LAB COMPONENT:

LIST OF EXPERIMENTS **30 Hours**

I. Digital Electronics

1. Implementation of Logic Circuits
2. Adder and Subtractor
3. Combinational Circuit Design
   a) Design of Decoder and Encoder
   b) Design of Code Converter
   c) Design of multiplexers and de multiplexers
4. Sequential Circuit Design
   a) Implementation of Shift registers, Serial Transfer
   b) 4-bit Binary Counter
   c) BCD Counter

II. Microprocessors

5. ALP Arithmetic programming
   a) Write an ALP to find out factorial of a given hexadecimal number using 8086 MP Data: OAH, OFH, 1OH
   b) Write an ALP to perform 16 bit arithmetic operations (ADD, SUB, MUL, DIV)
   c) Write an ALP to generate the sum of first 'N' natural numbers using 8086 MP
6. Sorting and Data Movement
   a) Write an ALP to order give set of hexadecimal numbers in ascending and descending order. Data: 0AH, 0FH, 0DH, 10H, 02H
   b) Write an ALP to move block of data from locations 1200H-1205H to 2200H – 2205H
   c) Write an ALP to reverse the given string Data: WELCOME
7. Write an ALP to generate square wave using 8255 PPI
8. Write an ALP to display the given message using 8279 PKI
9. Write an ALP to interface analog to digital converter.

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Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30 Hours**

REFERENCES

1. M. Morris Mano, Digital Logic and Computer Design, 3rd Edition, Pearson Education, 2013.
2. Douglas V. Hall, Microprocessors and Interfacing, TMH, 2010.
3. Thomas L. Floyd, “Digital Fundamentals”, Pearson Education, Inc, New Delhi, 2013
4. Yu-Cheng Liu, Glenn A. Gibson, Microcomputer Systems: The 8086/8088 Family, PHI, 2010.
5. Barry B. Brey, “The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4 and Core2”, Pearson, 2012.

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U18ITT3001 COMPUTER ARCHITECTURE

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To understand the basic structure of a digital computer.
- To discuss the operation of various components of computing systems.
- To study the different ways of communicating with I/O devices
- To enhance the processor operation by employing pipelining

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Explain micro level operations of computer using the concepts of hardware and software coordination.

CO2 Compare different types of memories and their performances.

CO3 Apply the knowledge of binary arithmetic operations to understand the design of hardware components

CO4 Enumerate various control methodologies using programming and their effect on the hardware components

CO5 Describe the performance enhancement techniques for data handling and I/O handling

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes (POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO 1	S												M		
CO 2	M	M										M	M		
CO 3	S												M		
CO 4	S	M											M		
CO 5		S											M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment,Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

THEORY COMPONENT CONTENTS

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BASIC STRUCTURE OF COMPUTERS **7 Hours**

Functional Units - Basic Operational Concepts - Bus Structures - Software Performance - Memory Locations and Addresses - Memory Operations - Instruction and Instruction Sequencing - Addressing Modes - Assembly Language - Basic I/O Operations - Stacks and Queues.

BASIC PROCESSING UNIT **8 Hours**

Fundamental Concepts - Execution of a Complete Instruction - Multiple Bus Organization - Hardwired Control – Micro programmed Control – Microinstructions- Micro program Sequencing-Wide Branch Addressing

ARITHMETIC UNIT **11 Hours**

Addition and Subtraction of Signed Numbers - Design of Fast Adders - Multiplication of Positive Numbers - Signed Operand Multiplication and Fast Multiplication - Integer Division - Floating Point Numbers and Operations.

MEMORY SYSTEM **9 Hours**

Basic Concepts - Semiconductor RAM- Internal Organization of Memory Chips- Static Memories-ROM- Speed, Size and Cost - Cache Memories - Performance Considerations - Virtual Memory

PIPELINING AND I/O ORGANIZATION **10 Hours**

Pipelining - Basic Concepts - Data Hazards - Instruction Hazards -Superscalar operation- Out –of-Order Execution- Interrupts - Direct Memory Access.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, "Computer Organization", 5^{th} Edition McGraw-Hill, 2014.
2. R.D.Dowsing, F.W.D.Woodhams and Ian Marshall, "Computers From Logic To Architecture", Mcgraw Hill Publishing Company, UK, 2000
3. Ian East, "Computer Architecture And Organization", Pitman Publishing, (A Division Of Longman Group UK Limited), Taylor & Francis E-Library, 2005
4. William Stallings, "Computer Organization and Architecture - Designing for Performance", 9^{th} Edition, Prentice Hall, 2012.
5. David A.Patterson and John L.Hennessy, "Computer Organization and Design: The hardware / software interface", 4^{th} Edition, Morgan Kaufmann, 2008.
6. John P.Hayes, "Computer Architecture and Organization", 3^{rd} Edition, McGraw Hill, 2002.

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L	T	P	J	C
3	0	2	0	4

U18ITI3202 **DATA STRUCTURES**

COURSE OBJECTIVES:

- Master the implementation of linked data structures such as stack, queues, linked lists, trees etc.
- To choose the appropriate data structure and algorithm design method for a specific application

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1	Explain various sorting algorithms.
CO2	Explain various searching algorithms.
CO3	Explain the concepts of List, Stack and queue
CO4	Explain the concepts of trees and graphs
CO5	Implement the given problem using Linear and Non-Linear Data Structures
CO6	Identify and Demonstrate the usage of various data structures using simple applications.

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M											M		
CO2	M	M											M		
CO3	M	M											M		
CO4	M	M											M		
CO5	S	S		M								M	M		
CO6	S	S	M	M						M		S	M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

THEORY COMPONENT CONTENTS

SORTING AND SERACHING **9 Hours**

Basics of data structures-Types-Time and space complexity-Selection-sort- Bubble sort - Insertion sort - Quick sort, Shell sort, Merge sort- External sorting Searching techniques: Sequential search, Binary search. Hashing - Hash Functions- Collision Resolution strategies.

LINKED LIST AND STACK **9 Hours**

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Array list-Review of Pointers- Linked lists –Types- Operations - Creation, Insertion, Deletion, Modification, Merging, Splitting, Traversal – Applications: Polynomial operations, Set operations, Hash table implementation
Stacks – Operations –Applications of Stack - Infix to Postfix Conversion, Expression Evaluation – Tower of Hanoi problem, Maze Problems

QUEUES **9 Hours**
Queues - Operations on Queues, Queue Applications- Job scheduling, Circular Queue-Operations- Round robin scheduling, Dequeue. Priority Queues with Binary Heaps- - Binary Heap Implementation -The Structure Property- The Heap Order Property- Heap Operations

TREES **9 Hours**
General Trees Representation - Tree Traversals- -Binary Search Tree- Threaded Binary Tree - Balanced Binary Search Trees- AVL Tree - AVL Tree Implementation -Applications of trees- Directory structure – Expression tree –B Trees

GRAPHS **9 Hours**
Graphs and their representation: BFS, DFS– Shortest Path Algorithms – Dijkstra's Algorithm- Minimum Spanning tree- Kruskal’s Algorithm – Prims algorithm- Topological Sorting

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. M.A.Weiss, “Data Structures and Algorithm Analysis in C”, Second edition, Pearson Education Asia, 2007.
2. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, “Fundamentals of Computer Algorithms”, Second Edition, Universities Press, Hyderabad, 2008.
3. Jean Paul Tremblay and Paul G. Sorenson, An introduction to data structures with applications 2nd edition, Tata McGraw-Hill, 20014
4. Gilberg and Ferouzan, Data Structures using C, Pearson Education 2004.
5. Robert L. Kruse, Clovis L. Tondo, Bruce P. Leung, ‘Data Structures and Program Design in C’, PHI, 1996.
6. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures &Algorithms, Pearson Education, New Delhi, 2009.

LAB COMPONENTS:

LIST OF EXPERIMENTS

1. Implementing searching algorithms – linear and binary
2. Implementing sorting algorithms – selection sort, insertion sort, quick sort
3. Implementing Set operations using Linked List
4. Implementing stack using array and Linked List
5. Implementing stack applications(Balancing Paranthesis, Infix to postfix conversion)
6. Implementing queue applications(Job scheduling- FIFO, Round Robin)
7. Implementing priority queue
8. Implementing Binary Search trees

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9. Implementing AVL trees
10. Implementing BFS and DFS algorithms

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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L	T	P	J	C
3	0	0	0	3

U18ITT4001 OPERATING SYSTEMS

COURSE OBJECTIVES:

- To learn the fundamentals of Operating Systems and various computing environment.
- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in file, disk and memory management in contemporary OS

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1	Experiment with various CPU scheduling algorithms with the understanding of operating system concepts
CO2	Apply the methods for process coordination
CO3	Apply the various memory management strategies
CO4	Illustrate the various file management strategies
CO5	Apply the disk scheduling policies

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	M										M	M		
CO2	S	M										M	M		
CO3	S	M										M	M		
CO4	S	M										M	M		
CO5	S	M										M	M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS:

INTRODUCTION AND PROCESS MANAGEMENT 9 Hours

Introduction: Operating System Structure – Operating System Operations – Process Management – Memory Management – Storage Management
System Structures: Operating System Services – System Calls – Types of System Calls – System Programs – Process Concept**-** Process Scheduling – Operations on Processes – Inter-process Communication–**Multithreaded Programming:** Overview – Multithreading Models – Threading Issues.
Process Scheduling: Basic Concepts – Scheduling Criteria – Scheduling Algorithms

PROCESS COORDINATION 11 Hours
Synchronization: The Critical-Section Problem – Peterson's Solution – Synchronization Hardware – Mutex Locks - Semaphores – Classic problems of Synchronization – Monitors–**Deadlocks:** System Model – Deadlock Characterization – Methods for Handling Deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection – Recovery from Deadlock

MEMORY MANAGEMENT 10 Hours
Memory-Management Strategies: Swapping – Contiguous Memory Allocation – Paging – Structure of the Page Table – Segmentation.
Virtual-Memory Management: Demand Paging – Copy-on-Write – Page Replacement – Allocation of Frames – Thrashing

FILE MANAGEMENT 8 Hours
File System: File Concept – Access Methods – Directory and Disk Structure –Protection
File System Implementation: File System Structure – File System Implementation – Directory Implementation – Allocation Methods – Free-space Management.

SECONDARY-STORAGE MANAGEMENT 7 Hours
Mass Storage Structure: Disk Structure – Disk Scheduling – Disk Management – Swap-Space Management
Case Study: Linux system, Windows 7

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons (Asia) Pvt. Ltd, Ninth Edition, 2014.
2. Andrew S. Tanenbaum, "Modern Operating Systems", 4th edition Prentice Hall of India Pvt. Ltd, 2014.
3. William Stallings**, "**Operating Systems: Internals and Design Principles",Pearson Education,Ninth Edition, 2018.
4. Harvey M. Deitel, "Operating Systems", Pearson Education Pvt. Ltd, Third Edition, 2003.

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U18ITI4202 DESIGN AND ANALYSIS OF ALGORITHMS

L	T	P	J	C
3	0	2	0	4

COURSE OBJECTIVES:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1	Explain the fundamentals of analysis of algorithm
CO2	Explain mathematical analysis for recursive and non-recursive Algorithms
CO3	Explain the design techniques Brute force, Divide and Conquer, Decrease and Conquer, Dynamic programming
CO4	Explain the design techniques Greedy algorithms, back tracking, Branch and Bound
CO5	Explain the concepts of NP complete problems
CO6	Implement various algorithms design techniques suitable for real world applications.

Pre-requisites: U18ITI3202 - DATA STRUCTURES

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	W										M	M		
CO2	M	W	M									M	M		
CO3	M	W										M	M		
CO4	M	W										M	M		
CO5	M	W										M	M		
CO6	S	S	M	M						M		S	M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

INTRODUCTION TO ALGORITHM ANALYSIS **9 Hours**
Notion of Algorithm - Fundamentals of Algorithmic Problem Solving - Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency: Analysis Framework - Asymptotic Notations and Basic Efficiency Classes. Mathematical Analysis of Non-recursive Algorithms and Recursive Algorithms.

BRUTE FORCE AND DIVIDE AND CONQUER **9 Hours**
Brute Force Method - Sequential Search and Brute Force string matching, Exhaustive search. Divide and Conquer – Merge Sort, Decrease and Conquer-Josephus problem

DYNAMIC PROFRAMMING AND GREEDY **9 Hours**
Dynamic Programming - Warshall's and Floyd's Algorithm- Greedy Technique - Knapsack problem – Job sequencing with deadlines, Huffman trees

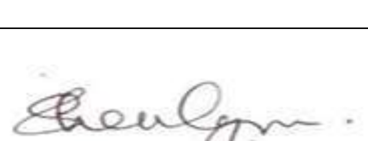
BACKTRACKING AND BRANCH AND BOUND **9 Hours**
Backtracking - N-Queen's Problem – Sum of subsets-Hamiltonian Circuit problem- Branch and Bound-Assignment Problem-Traveling Salesman Problem

NP COMPLETE **9 Hours**
Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems

REFERENCES:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2008.
2. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Universities Press, Hyderabad, 2008.
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, Prentice Hall of India,New Delhi, 2007
4. NarasimhaKarumanchi, "Data Structure and Algorithmic Thinking with Python",Carrer Monk publications,2017
5. Brad Miller and David Ranum, "Problem Solving with Algorithms and Data Structures using Python" , Franklin Beedle, 2014.
6. https://www.tutorialspoint.com/python/

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**



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LAB COMPONENTS:

LIST OF EXPERIMENTS

1. Implementing Dijikstra's algorithm
2. Implementing Prim's algorithm
3. Implementing Brute force string Matching Algorithm
4. Implementing Josephus problem
5. Implementing 8- queen problem
6. Implementing Knight tour problem
7. Implementing Merge Sort Quick Sort
8. Implementing Floyd's and Warshall's Algorithms
9. Implementing Huffman trees

Theory: 0   Tutorial: 0   Practical: 30   Project: 0   Total: 30 Hours

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U18ITI4303	DATABASE MANAGEMENT SYSTEMS

L	T	P	J	C
3	0	0	2	4

COURSE OBJECTIVES:

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database and relational modeling
- To understand and use data manipulation language to query, update, and manage a database
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency,
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS situation.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Outline an ER model for a defined problem
CO2 Explain the basic concepts of query processing and query optimization algorithms.
CO3 Describe the concepts of transaction and storage management.
CO4 Explain the basic concepts of database security and NoSQL
CO5 Design a database for a given problem.
CO6 Develop an RDBMS application

Pre-requisites: **Nil**

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	M					M						M		
CO2	M	M											M		
CO3	M	M											M		
CO4	M								M				M		
CO5	S	M			M		M		S	S		M	M	M	M
CO6	S	M			M		M		S	S		M	M	M	M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Project report (Project Component) 4. Project Review and Presentation (Project Component)
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

INTRODUCTION **9 Hours**

Database system Architecture: Data Abstraction – Data Independence – Data Definition Language – Data Manipulation Language.

Data Models: E-R model - network model – relational and object oriented data models – integrity constraints – data manipulation operations.

DATABASE DESIGN **9 Hours**

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DMK constructs, Open source and Commercial DBMS – MYSQL, ORACLE, DB2, SQL server.

Relational Database Design: Domain and data dependency - Armstrong's axioms - Normal forms – Dependency preservation – Lossless design.

DATA STORAGE AND QUERYING **9 Hours**

Data Storage: Overview of Physical Storage Media – RAID - File Organization - Organization of Records in Files - Data Dictionary Storage.

Data Indexing and Hashing: Basic Concepts - Ordered Indices - B+ Tree Index Files - Multiple Key Access - Static and Dynamic Hashing.

Query Processing: Evaluation of relational algebra expressions – Query equivalence – Join Strategies – Query optimization algorithms.

TRANSACTION MANAGEMENT **9 Hours**

Transaction processing: Transaction Concept - Transaction Model – ACID property – Serializability.

Concurrency Control: Lock Based Protocols - Time Stamped Based Protocols - Deadlock Handling.

Recovery System: Failure Classification – Storage - Log Based Recovery - Shadow Paging.

ADVANCED TOPICS **9 Hours**

Database Security: Authentication - Authorization and access control - DAC, MAC and RBAC models – Intrusion detection – SQL injection.

NoSQL: Working with Column oriented Databases – Hbase distributed storage architecture – Document store internals – Understanding Key-Value Stores in Memcache and Redis – Eventually consistent Non-Relational Databases – Performing CRUD operations: Creating Records, Accessing Data, updating and deleting Data

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. Abraham Silberschatz, Henry Korth, and S. Sudarshan, Database System Concepts, Sixth edition, McGraw-Hill.2011.
2. R. Elmasri and S. Navathe, Fundamentals of Database Systems, Sixth Edition,

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Pearson Education,2011
3. Thomas M. Connolly and Carolyn E. Begg, “Database Systems - A Practical Approach to Design, Implementation, and Management”, fifth edition, Pearson Education, 2010.
4. C.J.Date, A. Kannan and S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
5. Tiwari, Shashank. Professional NoSQL. John Wiley & Sons, 2011.(Unit V)

Online Courses and Video Lectures:

1. http://nptel.ac.in

PROJECT COMPONENTS:

LIST OF EXPERIMENTS

1. DDL and DML commands
2. Transaction control commands and aggregate functions
3. Joins and Nested Queries
4. Constraints and Views
5. High level programming language extensions (Control structures, Procedures and Functions).
6. Cursors and Triggers
7. Embedded SQL
8. Sample projects like
   i. Hospital Management
   ii. Railway Ticket Reservation
   iii. Student Mark List Processing
   iv. Employee Pay Roll Processing
   v. Inventory Control

Theory: 0 Tutorial: 0 Practical: 0 Project: 30 Total: 30 Hours

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U18ITI4204 **COMPUTER NETWORKS**

L	T	P	J	C
3	0	2	0	4

COURSE OBJECTIVES:

- Learn the data communication system and the importance of layered architecture
- Describe the various network and data link layer protocols.
- Make use of the network layer concepts to solve a problem.
- Explain the functions of transport layer and application layer protocols.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to :

CO1 Outline the data communication system and the purpose of layered architecture
CO2 Explain the data link layer protocols.
CO3 Outline the network layer protocols.
CO4 Apply the network layer concepts to solve a problem.
CO5 Illustrate the functions of transport layer protocols.
CO6 Summarize the application layer protocols.

Pre-requisite : U18ECT3011 – PRINCIPLES OF COMMUNICATION

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes (POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO 1	M												M		
CO 2	S	W	W							W	W		M		
CO 3	S	W								W	W		M		
CO 4	S	M	M							W	W	W	M		
CO 5	S	W	W							W	W		M		
CO 6	M									W	W		M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva (Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS:

DATA COMMUNICATIONS **5 Hours**

Data Communication– Networks–The OSI Model– Layers in the OSI Model – TCP/IP Protocol Suite – Addressing – Transmission Media

DATA LINK LAYER **10 Hours**

Encoding - Framing – Error Detection – Reliable Transmission – IEEE 802.3 – IEEE 802.5 – IEEE 802.11 – IEEE 802.15.1

NETWORK LAYER **10 Hours**

Circuit Switching – Packet Switching – Switching and Bridging – Cell Switching - Internetworking -Sub netting – IPv6 – Routing Techniques: Distance vector (RIP) – Link state (OSPF) — Interdomain Routing (BGP).

TRANSPORT LAYER **10 Hours**

UDP – TCP – Congestion Control and Resource Allocation: TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service: Integrated Services – Differentiated Services.

APPLICATION LAYER **10 Hours**

Domain Name System – Electronic Mail (SMTP, MIME, IMAP) – File Transfer (FTP) – WWW (HTTP) – Network Management (SNMP).

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
2. William Stallings, "Data and Computer Communications", Tenth edition, Pearson Education, 2013.
3. Behrouz A Forouzan, "Data Communications and Networking", Fifth edition, Tata McGraw–Hill, New Delhi, 2013.
4. James F. Kurose, Keith W. Ross, "Computer Networking, A Top–Down Approach Featuring the Internet", Sixth edition, Pearson Education, 2012.

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LAB COMPONENTS:

List of Experiments:

1. Develop client server based TCP applications using UNIX socket programming functions.
2. Develop client server based UDP applications using UNIX socket programming functions.
3. Implementation of HTTP or DNS and ARP or RARP protocols.
4. Implementation of sliding window and CRC protocols.
5. Implementation of distance vector / link state routing protocols.
6. Study of network simulation tools such as NS3/QUALNET/OPNET/Packet Tracer.
7. Performance analysis of routing protocols using Wireshark.
8. Performance analysis of TCP and UDP protocol using simulation tool
9. Demonstrate the working of network tools such as Ping, TCPDump, Traceroute, Netstat, IPconfig.

Theory: 0 **Tutorials: 0** **Practical: 30** **Project: 0** **Total Hours: 30**

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U18ITI5201 **DATA MINING TECHNIQUES**

L	T	P	J	C
3	0	2	0	4

COURSE OBJECTIVES:

- Identify the scope and necessity of Data Mining algorithms for the society.
- To understand various tools of Data Mining and their techniques to solve the real time problems.
- To develop further interest in research and design of new Data Mining techniques.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Summarize the data pre - processing process
CO2 Explain the association rule Mining algorithm for correlation analysis
CO3 Apply decision tree algorithm for classification
CO4 Apply and analyze Bayesian networks algorithm for classification
CO5 Apply various clustering algorithms for different datasets
CO6 Model a simple application with data mining tools.

Pre-requisite: U18ITI4303 - DATABASE MANAGEMENT SYSTEM, U18MAI4201 – PROBABILITY AND STATISTICS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	1	2	3
CO1	M	M											M		
CO2	M	M											M		
CO3	S	M											M		
CO4	S	S	M			M							M		
CO5	S	M	M			M							M		
CO6	S	S	M	M	M	M	M		M	M		M	M	M	M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Model examination (Lab component) 4. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

THEORY COMPONENT CONTENTS **9 Hours**

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INTRODUCTION TO DATA MINING

Data mining - Related technologies - Machine Learning, DBMS, OLAP, Statistics - Data Mining Goals - Stages of the Data Mining Process - Data Mining Techniques - Knowledge Representation Methods – Applications

DATA PRE PROCESSING **9 Hours**

Data preprocessing-Data mining primitives – Data mining query language - Concept description – Data generalization and characterization – Analytical characterization – Mining descriptive statistical measures in large databases- Mining frequent patterns, Associations, and Correlations

CLASSIFICATION AND PREDICTION **9 Hours**

Introduction – Decision tree induction – Bayesian classification – Back propagation – Lazy learners – Other classification methods – Prediction – Evaluating the accuracy-Case study in social media analysis

CLUSTERING TECHNIQUES **9 Hours**

Similarity and distance measures – Hierarchical algorithms – Partition algorithms – Outlier analysis -Case study in social media analysis

APPLICATIONS OF DATA MINING **9 Hours**

Web mining – Web content mining – Structure and Usage mining – Spatial mining – Time series and sequence mining – Graph mining

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. J. Han, MKamber, "Data Mining: Concepts and Techniques", Third edition, Elsevier, New Delhi, 2011.
2. Dunham M, "Data Mining: Introductory and Advanced Topics", Prentice Hall, New Delhi, 2002.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedma, "The Elements of Statistical Learning: Data Mining, Inference and Prediction", Prentice Hall, New Delhi, Second Edition, 2009.
4. Hand.D, Mannila H, Smyth.P, "Principles of Data Mining", MIT press, USA,2001.

LAB COMPONENT:

Perform the following experiments on any one of the data mining tools like RapidMiner, WEKA,R-Programming, Orange, Dendrogram (Hierarchal clustering) for any real time applications

1. Discover Association Rule Mining
2. Classification algorithms-Decision Tree, CART, Random Forest,J48,ZeroR
3. Clustering algorithms-K-Means, K-Medoids , Hierarchal clustering

Theory: 0 Tutorial: 0 Practical:30 Project: 0 Total: 30 Hours

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U18ITT5002 CRYPTOGRAPHY AND NETWORK SECURITY

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Cryptography
- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to deploy encryption techniques to secure data in transit across data networks.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1	Explain security attacks and issues in computer systems and networks.
CO2	Apply the mathematics. symmetric and asymmetric algorithms related to cryptography
CO3	Explain the purpose and working of authentication and system level security algorithms
CO4	Apply the appropriate security mechanism for different computing environment
CO5	Apply appropriate security methods to solve real life applications

Pre-requisite: U18ITI4204 - COMPUTER NETWORKS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	1	2	3
CO1	M	M										M	M		
CO2	S	M										M	M		
CO3	M	M										M	M		
CO4	S	M			M			M				M			M
CO5	M	M						S				M			M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Exam
Indirect
1. Course Exit Survey

THEORY COMPONENT CONTENTS

INTRODUCTION1 10 Hours

OSI Security Architecture - Classical Encryption Techniques – Cipher Principles–Data Encryption Standard–Block Cipher Design Principles and Modes of Operation–Evaluation Criteria for AES–AES Cipher– Triple DES– Placement of Encryption Function–Traffic Confidentiality.

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PUBLICKEYCRYPTOGRAPHY **9 Hours**

Introduction to Number Theory -Key Management - Diffie-Hellman Key Exchange – Elliptic Curve Architecture and Cryptography – Confidentiality using Symmetric Encryption– Public Key Cryptography and RSA.

AUTHENTICATIONANDHASHFUNCTION **9 Hours**

Authentication Requirements – Authentication Functions – Message Authentication Codes–Hash Functions–Security of Hash Functions and MACs – Secure Hash Algorithm – HMAC Digital Signatures – Authentication Protocols–Digital Signature Standard.

NETWORKSECURITY **9 Hours**

Authentication Applications: Kerberos – X.509 Authentication Service– Electronic Mail Security–PGP–S/MIME-IP Security–Web Security- Practical implementation of security using GPG Suite.

SYSTEMLEVELSECURITY **8 Hours**

Intrusion Detection —Firewall Design Principles–Trusted Systems. Case study: Biometric authentication and Ethical Hacking

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. WilliamStallings, "Cryptography and Network Security – Principles and Practices", Sixth edition, Prentice Hall of India, 2014.
2. AtulKahate, "Cryptography and Network Security", 2nd Edition, Tata McGraw Hill, 2008
3. Bruce Schneier, "Applied Cryptography", JohnWiley&SonsInc, 2001.
4. CharlesPfleeger and Shari Lawrence P fleeger, "Security in Computing", Fourth edition, PearsonEducation,2015.

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U18ITI5203 **MOBILE AND PERVASIVE COMPUTING**

L	T	P	J	C
3	0	2	0	4

COURSE OBJECTIVES:

- To make students familiar with fundamentals of mobile communication systems.
- To study the working principles of wireless LAN and its standards
- To build skills in working with Wireless Networking Protocols

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO 1: Outline the basic concepts and principles in mobile computing.
CO 2: Explain GSM architecture and protocols.
CO 3: Analyze characteristics of different types of wireless LAN network protocols
CO 4: Explain the principles of 4G networks.
CO 5: Identify the pervasive and ubiquitous computing characteristics as well as context-aware computing and their applications.
C0 6: Design and develop mobile applications using android platform.

Pre-requisite: U18ITI4204-COMPUTER NETWORKS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													PSO		
COs	**Programme Outcomes (POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO 1	M												M		
CO 2							M		M				M		
CO 3	M	M			S	M				M		M	M		
CO 4	M												M		
CO 5		M			S		M		M			M	M		
CO 6	S	S		S	S	M		M	M			M	S	M	M

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Model examination (Lab component) 4. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

THEORY COMPONENT CONTENTS

WIRELESS COMMUNICATION **9 Hours**

Cellular systems- Frequency Management and Channel Assignment- Types of Handoff and their Characteristics -Dropped Call Rates & their Evaluation - MAC - SDMA - FDMA - TDMA - CDMA - Cellular Wireless Networks.

MOBILE COMMUNICATION SYSTEMS **9 Hours**

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GSM – Architecture -Location Tracking and Call Setup - Mobility Management- Handover-Security - GSM SMS –International roaming for GSM- call recording functions-subscriber and service data management –Mobile Number portability - GPRS –Architecture-GPRS procedures-attach and detach procedures - PDP context procedure-combined RA/LA update procedures-Billing.

WIRELESS NETWORKS **10 Hours**

Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sublayer - Introduction - Mobile IP - IP packet delivery - Agent discovery -Tunnelling and Encapsulation - IPV6 - Mobile ad-hoc network – Routing - Destination Sequence distance vector - Dynamic source routing TCP enhancements for wireless protocols - Traditional TCP - Congestion control - fast retransmit/fast recovery -Implications of mobility - Classical TCP improvements - Indirect TCP, Snooping TCP - Mobile TCP - Time out freezing - Selective retransmission - Transaction oriented TCP .

OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM **9 Hours**

Introduction – LTE - A System Architecture - LTE RAN - OFDM Air Interface - Evolved Packet Core- LTE Requirements - LTE-Advanced - LTE-A in Release - OFDMA – Introduction - OFDM Principles - LTE Uplink – SC - FDMA - Summary of OFDMA.

PERVASIVE COMPUTING **8 Hours**

Pervasive Computing- Principles, Characteristics- Interaction Transparency, Context aware, Automated Experience Capture. Architecture for Pervasive Computing- Pervasive Devices-Embedded controls- Smart Sensors and Actuators -Context Communication and Access Services.

Theory: 45 **Tutorial : 0** **Practical : 0** **Project : 0** **Total hours:45**

REFERENCES:

1. Jochen H. Schller, ― Mobile Communications, Second Edition, Pearson Education, New Delhi, 2007.
2. JuhaKorhonen, ― Introduction to 4G Mobile Communications, Artech House Publishers, 2014.
3. M. Bala Krishna, Jaime LloretMauri, ― Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks, CRC 2016
4. SengLoke, "Context-Aware Computing Pervasive Systems", Auerbach Pub., New York, 2007.
5. UweHansmannetl , "Pervasive Computing", Springer, New York, 2001.
6. William Stallings, "Wireless Communications and Networks", Pearson Education, 2009.
7. KavehPahlavan, PrasanthKrishnamoorthy, "Principles of Wireless Networks", First Edition, Pearson Education, 2003.
8. Andreas F. Molisch, "Wireless Communications", 2nd Edition, Wiley 2010.
9. SengLoke, "Context-Aware Computing Pervasive Systems", Auerbach Pub., New York, 2007.

LAB COMPONENT:

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List of Experiments:

1. Create an android application using Layouts, Widgets and Event listeners.
2. Create an android application using Activities, Indents, Fragments and Notifications.
3. Create an android application using Menus.
4. Create an android application Storage, Media and Animations.
5. Create an android application using Location and Google Map.
6. Create an android application using Database Framework.
7. Create an android application using Localization and Sensors.

Theory: 0 Tutorial : 0 Practical : 30 Project : 0 Total hours:30

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L	T	P	J	C
3	0	0	2	4

U18ITI5304 SOFTWARE ENGINEERING

COURSE OBJECTIVES:

- Knowledge of basic SW engineering methods and practices, and their appropriate application.
- Describe software engineering layered technology and Process frame work.
- A general understanding of software process models such as the waterfall and evolutionary models.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Apply software engineering principles, process models, and methods to develop software systems

CO2 Analyze end-user needs and derive software requirements using suitable requirement engineering techniques.

CO3 Develop software solutions by selecting appropriate process models and Design practices for large-scale systems.

CO4 Implement standardized coding, testing, and quality assurance techniques to ensure reliable and maintainable software.

CO5 Identify project management activities such as estimation, scheduling, risk handling and quality control in software projects.

CO6 Model software applications using structured and object-oriented approaches, including relevant UML diagrams

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes (POs)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	1	2	3
CO1	M	M											M		
CO2	M	M	M	M									M		
CO3	M	M	M	M	W								M		
CO4											M	W	M		
CO5	S	S							M				M	M	M
CO6	S	S								M			M	M	M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. End Semester Examination (Theory) 4. Project report (Project Component) 5. Project Review and Presentation (Project Component)
Indirect
1. Course-end survey

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THEORY COMPONENT

CONTENTS **9 Hours**

INTRODUCTION

Software Engineering Discipline, Software, Generic vs. Custom-made software products-distinctive characteristics of software products. **Software Development Models:** Life cycle models-Linear ,Sequential, Evolutionary, Unified models, Agile development -Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Case study in agile processing model.

REQUIREMENTS ENGINEERING **9 Hours**

Classification of Requirements-System Requirements and Software Requirements, Functional and Non-Functional requirements, Requirement Engineering Tasks.
System Models: Domain Analysis and Modeling, Data Models, Functional Models-Structured Analysis Model, Object Oriented Models- Cloud, State, Use Case Models, Sequence and Activity diagrams, Relationship among the Object Oriented Models, Building Object Oriented Analysis Models

SOFTWARE DESIGN AND IMPLEMENTATION **9 Hours**

Architectural Design-Decomposition strategy, Partitions and Layers, Structured System Design-Use of Heuristics for Design Refinements, Object-Oriented Design- User Interface Design-Reusable Components, Patterns, Frame works, Coding – Choice of Programming Language, Coding Standards

SOFTWARE TESTING **9 Hours**

Software Testing: Conventional Testing and SDLC Testing, Formal Technical Reviews, Walkthroughs, Inspections, Black-Box vs. Glass-Box Testing, Testing Strategies, Quality Dimensions, Process Quality and Product Quality, Quality Assurance Planning, Quality Measurements, Software Configuration Management.

SOFTWARE PROJECT MANAGEMENT **9 Hours**

Software Projects, Project Feasibility Study, Project Planning, Project Organization, Estimation of Project Effort-Measuring Software Attributes and Productivity, COCOMO for Effort Estimation. Risk Management, Project Scheduling, Measurement during Software Projects.
Software Maintenance: Planning for Maintenance, maintenance Activities, Reengineering

Theory: 45 Tutorial : 0 Practical : 0 Project : 0 Total hours:45

REFERENCES:

1. R.S. Pressman, "Software Engineering – A Practitioner's Approach", Eighth edition, McGraw Hill International Edition, 2014.
2. Stephen Schach, "Software Engineering", Seventh edition, TMH, New Delhi, 2007.
3. PankajJalote, "An Integrated Approach to Software Engineering", Third edition,

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NarosaPublishing House, 2005.
4. M.Blaha and J.Rumbaugh, “Object Oriented Modeling and Design with UML”, Second edition, Prentice-Hall India, 2006.
5. I Sommerville, “Software Engineering”, Seventh edition, Pearson Education, 2004
6. “Agile Software Development with Scrum”By Ken Schawber, Mike Beedle,Publisher: Pearson
7. “ Agile Testing: A Practical Guide for Testers and Agile Teams”,By Lisa Crispin, Janet Gregory,Publisher: Addison Wesley

PROJECT COMPONENT:
Make use of tools like Trello, DevOps
List of Projects

1. A Car Rental System
2. Accounts Management Software
3. Airline Reservation System
4. Army Management System
5. ATM System
6. Auto Repair Shop Management System
7. Automotive Store Management System
8. Banking System
9. Bus Ticket Reservation
10. Cafeteria Ordering System
11. Car Insurance System
12. Clothing Store Management
13. College Management System
14. Ebook Shopping
15. Enterprise Resource Planning System
16. Event Organizing, Planning and Management System
17. Gym Workout Application
18. Hospital Management System
19. Hostel Accommodation System
20. Hotel Management System

Theory: 0 Tutorial: 0 Practical: 0 Project: 30 Total: 30 Hours

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L	**T**	**P**	**J**	**C**
3	**0**	**0**	**0**	**3**

U18ITT6001 INFORMATION SECURITY

COURSE OBJECTIVES:

- To learn various types of security threats, attacks and its issues
- To understand the principles, major issues and basic approaches in information security
- To gain knowledge on various security models and policies

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Describe threats to information security and security SDLC.
CO2 Identify the security threats and attacks.
CO3 Analyze the mechanism to assess and control risk.
CO4 Describe the types of security policies and standards.
CO5 Identify security issues related to personnel decisions, and qualifications of security personnel.

Pre-requisite: U18ITT5002 – CRYPTOGRAPHY AND NETWORK SECURITY

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
	Programme Outcomes(POs)														
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M					M		M					M		M
CO2	M					M		M				M	M		M
CO3	M					M		S				M			M
CO4	M					M		S							M
CO5	M				S	M		S				M			M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment/Case studies, Group Presentation 3. End Semester Exam
Indirect
1. Course Exit Survey

<u>THEORY COMPONENT CONTENTS</u>

INTRODUCTION 9 Hours

History - Information Security - Critical characteristics of information - NSTISSC security model - Components of an information system - Securing the components - Balancing security and access - The SDLC - The security SDLC.

SECURITY INVESTIGATION 9 Hours

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Need for security - Business needs - Threats – Attacks – Legal - Ethical and professional issues.

SECURITY ANALYSIS **9 Hours**
Risk management: Identifying and assessing risk - Assessing and controlling risk .

LOGICAL DESIGN **9 Hours**
Blueprint for security - Information security policy - Standards and practices - ISO 17799/BS 7799 – NIST models - VISA international security model - Design of security architecture - Planning for continuity - Data Protection and Information Security in India.

PHYSICAL DESIGN **9 Hours**
Security technology – IDS - Scanning and analysis tools –Access control devices - Physical security - Security and personnel.

Case studies on HIPAA, PCI, SOX

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES:

1. Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, Fourth Edition, Thomson Publishing, India Edition, 2011.
2. Micki Krause, Harold F. Tipton, “Handbook of Information Security Management”, Vol 1-3 CRC Press LLC, 2004.
3. Stuart McClure, et al., “Hacking Exposed”, Tata McGraw- Hill, Sixth edition2009.
4. Matt Bishop, “Computer Security Art and Science”, Pearson/PHI, 2002.

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U18ITT6002 **INTERNET OF THINGS – ARCHITECTURE AND PROTOCOLS**

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To understand the architecture of IoT
- To understand the protocols related with IoT
- To understand the relationship of IoT with other domains

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Explain the architectural overview of IoT

CO2 Describe the IoT Reference Architecture and real-world design constraints

CO3 Discuss the various protocols for IoT

CO4 Explain the Security constraints behind IoT

CO5 Analyze IoT applications in real time scenario.

CO6 Describe the relationship of IoT with other domains

Pre-requisite: U18ITI4204 - COMPUTER NETWORKS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M												M		
CO2	M	M											M		M
CO3	M		W										M		
CO4	M							M					M		
CO5	M	S		M			M					M	M		M
CO6	M				M		M						M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Exam
Indirect
1. Course Exit Survey

THEORY COMPONENT CONTENTS

OVERVIEW **9 Hours**

IoT-An Architectural Overview– Building an architecture, Main design principles and needed

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capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management

REFERENCE AARCHITECTURE

9 Hours

IoT Architecture State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture. Real-World Design Constraints- Introduction, Technical Design constraints, Data representation and visualization, Interaction and remote control.

PROTOCOLS **9 Hours**

PHY/MAC Layer -Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, Network Layer-IPv4, IPv6, 6LoWPAN, Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT

SERVICE LAYER PROTOCOLS & SECURITY

9 Hours

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL, Application Layer

IOT IN CLOUD AND DATA ANALYTICS

9 Hours

Connecting IoT to cloud – Cloud Storage for IoT – Data Analytics for IoT – Software & Management Tools for IoT. CASE STUDIES: Various Real time applications of IoT- Home Automation – Environment – Energy –Agriculture – Industry - Health care applications

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)
3. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.
4. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer
5. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118- 47347-4, Willy Publications
6. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014
7. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
8. https://onlinecourses.nptel.ac.in/noc17_cs22/course
9. https://www.coursera.org/specializations/internet-of-things
10. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

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L	T	P	J	C
3	0	2	0	4

U18ITI6203   WEB TECHNOLOGY

COURSE OBJECTIVES:

- To create interactive web pages using HTML and JavaScript.
- To learn the importance of client side and server-side technologies
- To develop client /server-based applications using different technologies
- To learn the importance of web services

COURSE OUTCOMES :

After successful completion of this course, the students should be able to

CO1 Understand and build dynamic and interactive web sites
CO2 Interpret the role of XML and AJAX in web applications
CO3 Develop applications using PHP and MySQL
CO4 Develop interactive web applications using Node js and MongoDB
CO5 Make use Java based technologies (JSP and Servlet) to develop applications.
CO6 Develop Rest based web services

Pre-requisite: U18ITI3203 – OBJECT ORIENTED PROGRAMMING

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M								M		M	M		
CO2	M	M											M		
CO3	S	S	M		M				M	M		M	M		
CO4	S	S	M		M				M	M		M	S	M	M
CO5	S	S								M		M	S	M	M
CO6	S	S								M		M	S	M	M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva(Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

<u>THEORY COMPONENT CONTENTS</u>

CLIENT SIDE TECHNOLOGIES   9 Hours

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Introduction to HTML- Introduction to Cascading Style Sheets -Client-Side Programming: Introduction to JavaScript – Functions – Objects – Arrays – Built - in Objects –Using JSON to represent Objects-DOM –Event Handling.

CLIENT SIDE TECHNOLOGIES:XML, AJAX, ANGULAR JS **9 Hours**

XML: Documents and Vocabularies –XML DTD-XML Schema-XSLT-XML parsers-AJAX: AJAX Framework.

Introduction to AngularJS –Features of AngularJS -Expressions and Data Biding -Working with Directives-Controllers-Filters-Modules-Forms

SERVER SIDE TECHNOLOGIES–PHP **9 Hours**

PHP Basics-Arrays-Functions-Form handling with data- Pattern Matching -–Storing the data in DB

SERVER SIDE TECHNOLOGIES: Node js and MongoDB **9 Hours**

Node js – Introduction - Advantages of Node JS -HTTP module – Building APIs using modules, events and packages.

MongoDb –Introduction –create database-Manipulating Mongo Db documents from Node.js-accessing MongoDB from node.js.

WEBSERVICES **9 Hours**

Servlet - JSP - Restful Based Web services: Architecture-java. API for Restful Based Web Services-Developing and consuming Restful based web services in Java - Introduction to enterprise beans-types-Lifecycle of enterprise beans

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total hours: 45**

REFERENCES

1. Deitel&Deitel, et.al "Internet & World Wide Web - How To Program", Pearson Education, Fifth Edition, 2011.
2. Marty Hall and Larry Brown "Core Servlets and Java Server Pages, Volume1",Prentice Hall Education, Second Edition,2006.
3. Robert W. Sebesta, "Programming the World Wide Web", Eighth edition, Pearson pulications,2015.
4. Frank P.Coyle, "XML, Web Services and the Data Revolution",Addison-Wesley,2002.
5. Brad Dayley, Brendan Dayley, Caleb Davley "Node.js, MongoDB and Angular Web Development", second edition, Addison Wesely,2018.
6. Ken Williamson, "Learning AngularJS: A Guide to AngularJS Development", O'Reilly Medisa Inc., 2015
7. www.w3schools.com
8. https://nodejs.org/en/docs/guides/
9. https://www.tutorialspoint.com

LAB COMPONENTS:

List of Experiments:

1. To create a simple html file to demonstrate the use of different tags.

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2. Client side scripts for validating web form controls and creating events using Java Script
3. Program using JSON and Javascript
4. Program using XML Schema
5. Program using XSLT/XSL and AJAX
6. Web application development using PHP
7. Web application development using JSP with JDBC
8. Creation of Restful based web services and consume it an application
9. Web application development using Node js and MongoDB
10. Creation of web enabled applications using Struts/Spring Framework

Theory: 0 **Tutorial: 0** **Practical: 30** **Project: 0** **Total hours: 30**

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L	T	P	J	C
3	0	0	2	4

U18ITI6304 BIG DATA ANALYTICS

COURSE OBJECTIVES:

- Understand the Big Data Platform and its use cases
- Provide an overview of Hadoop architecture
- Develop data analytics solutions using python

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Apply Big Data concepts and Hadoop ecosystem components to select suitable storage and processing solutions for large-scale datasets (K3).

CO2: Analyze Hadoop 2.x cluster architecture, YARN components, and MapReduce execution workflow to assess distributed data processing efficiency (K4).

CO3: Apply Apache Pig Latin programs and HBase data models to process and manage semi-structured and unstructured data (K3).

CO4: Analyze Hive data models, partitioning, and bucketing techniques to optimize analytical query performance (K4).

CO5: Apply MongoDB schema design and CRUD operations to integrate MongoDB with Hadoop for Big Data analytics and data migration (K3).

CO6: Apply Big Data analytics tools and Hadoop ecosystem components to implement real-world data processing problem (K3).

Pre-requisites: U18ITI5201 – DATA MINING TECHNIQUES

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes (POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO 1	M								M				M		
CO 2	M				S							M	M		
CO 3	M	M		M	S	M	M					M	S		
CO 4	M								M				M		
CO 5	S		M	M	S	M						M	S		S
CO 6	S	M			M								M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. End Semester Examination (Theory) 4. Project report (Project Component) 5. Project Review and Presentation (Project Component)
Indirect
1. Course-end survey

THEORY COMPONENT CONTENTS

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INTRODUCTION **9 Hours**

Introduction to Big Data - Big Data Challenges - Big Data Architecture - Hadoop & its Features - Hadoop Ecosystem - Hadoop 2.x Core Components - Hadoop Storage: HDFS (Hadoop Distributed File System) - Hadoop Processing: MapReduce Framework - Different Hadoop Distributions

HADOOP COMPONENTS **9 Hours**

Hadoop 2.x Cluster Architecture - Hadoop Cluster Modes -Common Hadoop Shell Commands - Hadoop 2.x Configuration Files - Single Node Cluster & Multi-Node Cluster set up -Basic Hadoop Administration - Traditional way vs MapReduce way - Why MapReduce - YARN Components - YARN Architecture - YARN MapReduce Application Execution Flow - YARN Workflow - Anatomy of MapReduce Program -Input Splits, Relation between Input Splits and HDFS Blocks – MapReduce: Combiner &Partitioner

PIG and HBase **9 Hours**

Introduction to Apache Pig – MapReduce vs Pig - Pig Components & Pig Execution - Pig Data Types & Data Models in Pig - Pig Latin Programs - Shell and Utility Commands - Pig UDF & Pig Streaming - Testing Pig scripts with Punit - Aviation use-case in PIG

Apache HBase: Introduction to NoSQL Databases and HBase - HBase v/s RDBMS - HBase Components - HBase Architecture - HBase Run Modes - HBase Configuration - HBase Cluster Deployment

HIVE **9 Hours**

Introduction to Apache Hive - Hive vs Pig - Hive Architecture and Components - Hive Metastore - Limitations of Hive - Comparison with Traditional Database - Hive Data Types and Data Models - Hive Partition - Hive Bucketing - Hive Tables (Managed Tables and External Tables) - Importing Data - Querying Data & Managing Outputs - Hive Script & Hive UDF

MONGODB **9 Hours**

Introduction to MongoDB – Architecture – Schema Design and Modelling – CRUD operations - Integration of MongoDB with Hadoop and Data Migration MongoDB with Hadoop (MongoDB to Hive)

Theory: 45 **Tutorial : 0** **Practical : 0** **Project : 0** **Total hours:45**

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REFERENCES:

1. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012.
2. Chris Eaton, Dirk deroos et al., “Understanding Big Data ”, McGraw Hill, 2012.
3. Kyle Banker, Peter Bakkum, et al.,“ MongoDB in Action”, Second Edition, Manning Publications, 2016
4. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
5. Wes McKinney, "Python for Data Analysis", O'Reilly Media.2012
6. Sebastian Raschka, “Python Machine Learning”, Packpub.com,2015

PROJECT COMPONENTS:

LIST OF PROJECTS

1. Twitter data sentimental analysis using Hive.
2. Health care Data Management using Apache Hadoop ecosystem
3. Stock Market Data Processing using Big Data.
4. Retail data analysis using Hadoop.
5. Climatic Data analysis using Hadoop.
6. Facebook data analysis using Hadoop and Hive.
7. Air line on time performance using Hadoop.

Theory: 0 Tutorial: 0 Practical:0 Project: 30 Total: 30 Hours

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U18ITI7202 **CLOUD COMPUTING**

L	T	P	J	C
2	0	2	0	3

COURSE OBJECTIVES:

- To understand cloud computing challenges and services
- To acquire knowledge about various cloud tools
- To develop different optimization algorithm for cloud environment

COURSE OUTCOMES:
After Successful completion of this course, the students will be able to:

CO1 Develop private cloud using tools
CO2 Identify cloud service and its applications
CO3 Illustrate functions of web service with cloud service
CO4 Apply virtualization concepts for real time problems
CO5 Develop Economic based scheduling algorithm
CO6 Create algorithm using different Queuing model

Pre-requisite: U18ITI4204-COMPUTER NETWORKS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M			S							M	M		
CO2	M	M			S							M	M		
CO3	M	M			S							M	M		
CO4	M	M			S							M	M		
CO5	S	S			S							S	S		
CO6	S	S			S							S	S		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva(Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components
Indirect
1 Course Exit Survey

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THEORY COMPONENT CONTENTS

CLOUD INTRODUCTION **7 Hours**

Cloud Computing Fundamentals: Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing , usage scenarios and Applications , Business models around Cloud – Major Players in Cloud Computing - Issues in Cloud - Eucalyptus - Nimbus - Open Nebula, CloudSim

CLOUD SERVICES AND FILE SYSTEM **8 Hours**

Types of Cloud services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service – Communication as services. Service providers- Google App Engine, Amazon EC2, Microsoft Azure, Sales force. Introduction to Map Reduce, GFS, HDFS, Hadoop Framework

COLLABORATING WITH CLOUD **7 Hours**

Collaborating on Calendars, Schedules and Task Management – Collaborating on Event Management, Contact Management, Project Management – Collaborating on Word Processing, Databases – Storing and Sharing Files- Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Collaborating via Social Networks – Collaborating via Blogs and Wikis

VIRTUALIZATION FOR CLOUD **8 Hours**

Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation an and binary translation, HLL VM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V

Theory: 30 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 30 Hours**

LIST OF EXPERIMENTS

1.Study and compare various simulators in cloud computing.
2.Setup a Private Cloud Using Open Stack or Eucalyptus.
3.Develop Market oriented cloud computing model using Aneka toolkit
4.Compare energy conscious algorithm using green cloud simulator
5.Develop Economic based scheduling algorithm for cloud computing
6.Create algorithm using different Queuing model for cloud computing

REFERENCES

1. Bloor R., Kanfman M., Halper F. Judith Hurwitz ―Cloud Computing for Dummies‖ (Wiley India Edition),2010
2. John Rittinghouse& James Ransome, ―Cloud Computing Implementation Management and Strategy‖, CRC Press, 2010.

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3. Antohy T Velte ,Cloud Computing : ―A Practical Approach‖, McGraw Hill,2009
4. Michael Miller, Cloud Computing: ―Web-Based Applications That Change the Way You Work and Collaborate Online‖, Que Publishing, August 2008.
5. James E Smith, Ravi Nair, ―Virtual Machines‖, Morgan Kaufmann Publishers, 2006.
6. http://cloud-standards.org/wiki/index.php?title=Main_Page

Theory:0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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L	T	P	J	C
3	0	2	0	4

U18ITI7203 **MACHINE LEARNING**

COURSE OBJECTIVES:

- To understand the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To understand the latest trends in machine learning
- To design appropriate machine learning algorithms for problem solving

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1 Apply concept learning approaches using hypothesis space, version spaces, inductive bias, and heuristic search.

CO2 Use decision tree and neural network learning algorithms to address learning problems and overfitting scenarios.

CO3 Apply back-propagation and genetic algorithms to solve learning and optimization problems.

CO4 Interpret Bayesian learning models and probabilistic algorithms for machine learning.

CO5 Select appropriate machine learning techniques for different problem domains such as instance-based, rule-based, analytical, and reinforcement learning.

Pre-requisite: U18ITI5201- DATA MINING TECHNIQUES

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	S											M		
CO2	M	M											M		
CO3	M	M	M										M		
CO4	M	M	M										M		
CO5	M	M	M	M	M				M			M	M	M	M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva(Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

INTRODUCTION **9 Hours**

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

NEURAL NETWORKS AND GENETIC ALGORITHMS **9 Hours**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

BAYESIAN AND COMPUTATIONAL LEARNING **9 Hours**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

INSTANT BASED LEARNING **9 Hours**

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

ADVANCED LEARNING **9 Hours**

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

Theory: 45 Tutorial: 0 Practical:0 Project: 0 Total: 45 Hours

REFERENCES:

1. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. EthemAlpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Kevin P. Murphy , Machine Learning A Probabilistic Perspective, The MIT Press,2012
5. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014
6. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.

LAB COMPONENT:

List of Projects:

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1.Supervised and Unsupervised learning
2.Social Media Analysis
3.Sentimental Analysis
4.Recommender Systems
5.Prediction algorithms

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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PROJECT WORK(PW)

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U18ITP7704	PROJECT PHASE I	L	T	P	J	C
		0	0	0	6	3

Course Outcomes

After successful completion of this course, the students should be able to	
CO1: Formulate an experimental design to solve complex engineering & Social problems.	
CO2: Develop skills for independent &team oriented research	
CO3: Analyze, evaluate, interpret and justify an experimental data	
CO4: Write a dissertation report.	

Pre-requisite: All the courses

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	S	S	M								S	S		
CO2										S				S	S
CO3				S	S								S		
CO4								S		S			S		

Course Assessment methods

Direct
1. Project Review 2. End Semester Viva Voce Examination
Indirect
1. Course Exit Survey

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U18ITP8701	PROJECT PHASE II	L	T	P	J	C
		0	0	0	24	12

Course Outcomes

After successful completion of this course, the students should be able to	
CO1: Formulate an experimental design to solve complex engineering & Social problems.	
CO2: Develop skills for independent &team oriented research	
CO3: Analyze, evaluate, interpret and justify an experimental data	
CO4: Write a dissertation report.	

Pre-requisite: All the courses

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	S	S	S								S	S		
CO2										S				S	S
CO3				S	S								S		
CO4								S		S			S		

Course Assessment methods

Direct
1 Project Review 2 End Semester Viva Voce Examination
Indirect
1 Course Exit Survey

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Professional Electives / Honours

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Specialization Track: Extended Reality

U18CSE0314 3D MODELING AND GAME DESIGN

L	T	P	J	C
2	0	0	2	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Understand the foundational knowledge of 3D modeling and apply on a real time scenario in creating object and environment [K3].
CO2: Design and analyse the usage of Game objects and Assets using Physics and Lights[K4].
CO3: Apply Navigations, Particle systems and audio develop simple games [K3].

Pre–requisite: U18ITI3203 - Object Oriented Programming

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S		S		S							M			
CO2	M	S	S				M	M							S
CO3			M	S		S		M	S	S	W		S		S

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

BUILDING BLOCKS (6 Hours)
3D space- 3D objects- viewports and cPlane basics- selecting objects- solid object creation- outputting images- Boolean modeling and figured space- object snaps and transforms- Boolean modeling- Clipping plane.

OBJECT AND SURFACE MODELING (6 Hours)
Profile modeling – surface- cPlane- revolve- object modeling- project and pull- curves from objects- trimming surfaces- surface modeling – lofting- surface filleting and blending- surface from edge curves- patch surfaces.

GAME OBJECTS AND ASSETS (6 Hours)
Native Game Objects -Manipulating Game Objects - Components in the Game engine –Fundamentals working concept - Materials- Defining the Role of the Prefab - Textures: UV Mapping and Texturing Techniques - Discovering the Standard Shader.

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IMPLEMENTATION OF ASSETS WITH PHYSICS AND LIGHTING (6 Hours)

Creating Hierarchies - Using Empty Game Objects as Pivots -Understanding the Physics System – Rigid body Components - Colliders - Scripting Collision Events - Lighting in Games-Analyzing the Different Lights and Properties.

NAVIGATION AND ANIMATIONS (6 Hours)

Animation in Game Development - Creating Animation in the Editor-Refining Animation- NavMesh - NavMesh Agent - NavMesh Obstacle-Creating the Player Controller Game Object- Particles in Video Games-Analyzing Existing Particle Effects-Audio in Game Development -Audio Effects.

REFERENCES

1. "The Ultimate Guide to Game Development with Unity" by Unity Technologies,2023.
2. The Art of Game Design: A Book Of Lenses, THIRD EDITION, Jesse Schell, CRC Press; 3rd edition , 2019.
3. Paris Buttfield-Addison, Jon Manning, Tim Nugent, “Unity Game Development Cookbook”, O'Reilly Media, Inc. 2019.
4. 3D Modeling for Beginners: Learn Everything You Need to Know About 3d Modeling!, Danan Thilakanathan,2016.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/introduction-to-3d-modeling
2. https://www.coursera.org/specializations/game-design-and-development
3. https://www.coursera.org/learn/game-design
4. Control physics with C# in Unity (coursera.org)
5. Create basic behavior with C# in Unity (coursera.org)
6. The Complete Guide to 3D Modeling with Blender | Udemy

PROJECT:

Projects involving 3D modeling using Blender and design simple games with effective audio, light, animation and appropriate understanding of physics in Real time environment.

Theory: 30	**Tutorial: 0**	**Practical: 0**	**Project: 30**	**Total: 60 Hours**

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U18CSE0315 **AUGMENTED REALITY AND VIRTUAL REALITY APPLICATION DEVELOPMENT**

L	T	P	J	C
2	0	0	2	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Attain a foundational understanding and difference of Augmented and Virtual reality technologies[K3].

CO2: Develop skills in placing assets, managing scale, addressing occlusion, and implementing realistic lighting in AR and VR projects. [K6]

CO3: Apply AR and VR in practical scenarios and conducting AR/VR based visualization case studies for product development. [K3]

Pre–requisite: U18ITI3203- Object Oriented Programming

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S		M		S							M	S		
CO2	M	M	S	S			M	M							M
CO3			S	S		S		M	S	S	W				S

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

AUGMENTED AND VIRTUAL REALITY BASICS **(8 Hours)**

Introduction to Augmented Reality -MAR Market, Actors, and Value Chain - Application vs. Browser -MAR System Architecture- Difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, enhancing interactivity in AR environments, evaluating AR systems. Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.

AR AND VR TECHNOLOGIES **(8 Hours)**

Placing and positioning assets - Scale and size of assets - Occlusion -Lighting for increased realism - Solid augmented assets – context awareness - tracking in AR - outside-in tracking - motion tracking - environmental understanding - feature points - plane finding – light estimation - anchors - interface issues and lack of UI metaphors -technical constraints – 3D barriers - computer vision limitations -constraints of occlusion and shading. Levels of Immersion in VR Systems - Sensorimotor Contingency -Sensorimotor Contingency in VR - Introduction to the Three

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Illusions: Place Illusion (PI), Plausibility Illusion (Psi) - Necessary Conditions for Psi - Break of Presence - Presence, Immersion, PI, and Psi - The Pinocchio Illusion - The Rubber Hand Illusion - Psychological Effects of Embodiment Illusion - Visual-Tactile and Visual-Motor Synchrony.

AR CORE (7 Hours)

Android OS - limitations of low light conditions on AR on mobile -simple surfaces challenge AR – user flow - working with tech limitations - preparing your tools - design draft. surface detection and creating plane - user interaction - placing with anchor points - occlusion between virtual assets - light estimation - virtual light to real light - multiplane detection and spatial mapping - processing needs in mobile AR - breaking immersion - framing as a creative device.

VR SYSTEMS AND HARDWARES (7 Hours)

The Virtual world space-positioning the virtual observer- perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory. Illumination models- Reflection models- Shading algorithms, Radiosity, Hidden Surface Removal- Realism -Stereographic image. VR Hardware- sensor hardware, Head-coupled displays, Acoustic hardware.

REFERENCES

1. Linowes, J., &Babilinski, K. (2017). Augmented Reality for Developers: Build Practical Augmented Reality Applications with Unity, ARCore, ARKit, and Vuforia. Packt Publishing Ltd.
2. XR Development with Unity-A beginner's guide to creating virtual, augmented, and mixed reality experiences using Unity by Anna Braun, Raffael Rizzo(2022).
3. Mastering Augmented Reality: A Comprehensive Guide to Learn Augmented Reality by by Cybellium Ltd, Kris Hermans (2023)
4. Peddie, J. (2017). Augmented Reality: where we will all live. Springer.
5. Ong, S. (2017). Beginning windows mixed reality programming. Berkeley, CA: Apress. Doi, 10, 978-1.
6. "The VR Book: Human-Centered Design for Virtual Reality (ACM Books)"by Jason Jerald (2015).

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/ar |Coursera
2. https://www.coursera.org/professional-certificates/meta-ar-developer |Coursera
3. https://www.coursera.org/specializations/extended-reality-for-everybody|Coursera
4. https://www.coursera.org/specializations/virtual-reality
5. https://www.coursera.org/learn/introduction-virtual-reality
6. https://www.coursera.org/learn/making-virtual-reality-game
7. https://www.coursera.org/learn/3d-models-virtual-reality
8. https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues

PROJECT 30 Hours

To Design and Integration of 3D Spatial audio and sound effects to the objects developed and exploring creative possibilities with AR Core, implement AR/VR navigation system (UX), AR/VR interaction system (UX), Applying AR/VR technologies in real time applications.

Theory: 30	**Tutorial: 0**	**Practical: 0**	**Project: 30**	**Total: 60 Hours**

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U18CSE0016 ADVANCED METAVERSE TECHNOLOGIES

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Acquire knowledge to differentiate various Extended reality technologies in Metaverse.
CO2: Apply Metaverse Experiences with depth understanding on devices and interoperability.
CO3: Analyze Metaverse in various application domains.
CO4: Develop the Metaverse environment with the integration of other technologies.

Pre–requisite: Nil

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S		M									M			
CO2	M	M	S	S			M	M				S	M	M	M
CO3		S	S	M	S	M									
CO4	S		S			S		M	S	S	W		M		S

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Assignment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

THE FOUNDATION OF XR & METAVERSE (7 Hours)

The Brain Science behind VR - Understanding Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), Web XR - Differences & Similarities of VR/AR/MR-XR in Metaverse.

EXPERIENCE WITH METAVERSE (8 Hours)

Metaverse-Experiences in metaverse-Avatars in metaverse-Interoperability in the metaverse-connections and communications-Devices to access the metaverse.

APPLICATIONS OF METAVERSE (8 Hours)

Educational potential in metaverse-Learning in the metaverse-Health and architecture in metaverse-Arts, entertainment, and sports in the metaverse-Building a safe metaverse.

TECHNOLOGIES IN METAVERSE (11 Hours)

Web 3.0-Artificial Intelligence (AI) in Metaverse- Cyber Security aspects / How safe is Metaverse - Blockchain, NFT (non-fungible token) and crypto currency -Metaverse and NFTs - Metaverse Use Cases - Top Metaverse platforms - Current Challenges in Mass adoption of XR - Impact of 5G in XR - Role of Microsoft, Apple and Facebook in Metaverse

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INTERACTING IN METAVERSE **(11 Hours)**

On-premise/Local hosting - Cloud Hosting & Streaming services - Distribution via Application Stores - Understanding UI & UX Design Essentials for AR/VR - Types of Navigation - Types of interaction (Understanding Hand controllers, gesture, gaze and voice controls) - Avatar implementations in VR (Torso/Full body) - AR/VR/Metaverse 3D Assets creation Tools Overview - 3D assets creation for VR/AR (Native polygonal modeling, Converting CAD models, 3D Scanning, Photogrammetry)

Theory:45	**Tutorial:0**	**Practical:0**	**Project:0**	**Total: 45 Hours**

REFERENCES

1. "The Metaverse: And How it Will Revolutionize Everything" by Matthew Ball. published in 2022.
2. Metaverse for Beginners: The Ultimate Guide to Understanding and Investing in Web 3.0, NFTs, Crypto Gaming, and Virtual Reality by Donn Newman in 2022
3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything by Robert Scoble, Shel Israel published in 2016

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/what-is-the-metaverse| Coursera
2. Metaverse Web 3.0 and DeFi: A Fintech Masterclass| Udemy

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U18CSE0228 GAME PROGRAMMING

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Develop a solid understanding of game programming by writing and executing basic scripts, and implementing Object Oriented Programming concepts.

CO2: Implement game mechanics and interactions, including player controls, physics, and scoring systems.

CO3: Design and script user-friendly UI elements and menus, handling user input and events effectively, by creating an interactive game interface.

CO4: Apply advanced programming techniques, including AI behaviors, serialization, and coroutines, to develop complex gameplay systems

Pre–requisite: U18ITI3203 - Object Oriented Programming

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S		M									M			
CO2	M	M	S	S			M	M				S	M	M	M
CO3		S	S	M	S	M									
CO4	S		S			S		M	S	S	W		M		S

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

OVERVIEW OF C# PROGRAMMING LANGUAGE 6 HOURS

Introduction to the Game Editor and C# scripting environment, Setting up editor for C# development , Basic syntax and data types in C# ,Writing and executing simple scripts ,OOPS concepts, Implementing OOP concepts , Design patterns and best practices in C# programming.

SCRIPTING GAME MECHANICS AND INTERACTIONS 6 HOURS

Implementing player controls and character movement, Collision detection and physics interactions, Handling user input for game interactions, Scripting game mechanics such as scoring, health and inventory systems, Debugging and optimizing scripts for better performance.

SCRIPTING UI ELEMENTS AND MENUS 6 HOURS

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Introduction to UI system, Scripting UI elements such as buttons, text fields, and sliders, Creating interactive menus and user interfaces, Handling UI events and user input, Designing and implementing user-friendly UI for games.

ADVANCED C# PROGRAMMING TECHNIQUES 6 HOURS
Delegates, events, and lambda expressions in C#, Exception handling and error management, Working with collections and LINQ queries, Serialization and data persistence, Introduction to coroutines and asynchronous programming.

SCRIPTING GAMEPLAY SYSTEMS AND AI 6 HOURS
Implementing AI behaviours using finite state machines and behaviour trees, Scripting gameplay systems for enemy behaviour, pathfinding, and decision-making, Creating dynamic and interactive game environments, Integrating audio, animations, and visual effects with C# scripts, Testing, debugging, and optimizing gameplay scripts

LAB CONTENTS: 30 Hours

1. Basic Script Setup and Syntax
2. Understanding Unity's Component System
3. Basic Player Movement
4. Understanding and Using Collections
5. Creating and Managing GameObjects
6. Handling Collisions and Triggers
7. Scriptable Objects for Data Management.
8. Advanced Player Interaction
9. Physics and Forces
10. Final Project: Integrating All Concepts

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. Joe Hocking ,”Unity in Action: Multiplatform Game Development in C#”, Manning Publications 2018.
2. Simon Jackson ,”Mastering Unity 2D Game Development”, Packt Publishing ,2014
3. Paris Buttfield-Addison, Jon Manning, and Tim Nugent,” Unity Game Development Cookbook: Essentials for Every Game”, O'Reilly Media, 2019.
4. Harrison Ferrone,” Learning C# by Developing Games with Unity”, Packt Publishing, 2018.

ONLINE LEARNING MATERIALS

1. https://learn.unity.com/
2. https://community.unity.com/

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U18CSE0229 ADVANCED MODELLING IN GAME DESIGN

L	T	P	J	C
2	0	2	0	3

Course Overview

This course offers a comprehensive introduction to 3D modeling, texturing, lighting, rigging, and rendering using Blender. Students will learn Blender's interface and workflow fundamentals, enabling efficient scene organization and object manipulation. It covers advanced modeling techniques including sculpting, modifiers, and curve-based modeling, along with rigging and skinning for animation. The course also explores realistic lighting, shading, and material creation using Blender's rendering engines. Finally, students will learn how to texture and export 3D scenes for Virtual Reality deployment, building immersive VR-ready environments.

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Explain the Blender interface and workflow fundamentals to organize and manage 3D game scenes effectively. [K2]

CO2: Apply advanced 3D modelling techniques to develop detailed game-ready models using curves, sculpting, and modifiers. [K3]

CO3: Illustrate rigging and skinning concepts to demonstrate character animation using bones and weight painting. [K3]

CO4: Analyze various lighting and rendering setups to identify their impact on the visual quality and performance of game environments. [K4]

CO5: Compare texturing and shading methods for VR deployment to assess their suitability and optimize materials for immersive gameplay experiences. [K4]

Pre-requisite: NIL

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	M				S								S		
CO2			S		S								S		
CO3			M		S								S		
CO4			M		S								S		
CO5			S		S								S		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

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THEORY COMPONENT CONTENTS

BLENDER INTERFACE AND WORKFLOW FUNDAMENTALS **6 Hours**

Overview of Blender's user interface - Understanding the layout of workspaces and editors - Navigating the 3D viewport - Object selection and transformation tools- Organizing scenes using collections, parenting, and layers - Customizing shortcuts and creating efficient workflows - Saving and managing Blender projects and preferences - Introduction to topology: vertices, edges, faces, and how topology affects modelling and animation.

ADVANCED 3D MODELLING TECHNIQUES **6 Hours**

Curves and surface modelling using Bezier and NURBS - Lofting, extruding, and converting curves to mesh - Hard surface modelling using Boolean operations and edge control – Modifiers and its uses - Organic modelling using sculpting tools - Sculpting with Dyntopo and Multi resolution modifier - Non-destructive modelling techniques using modifier stacks.

RIGGING AND SKINNING **6 Hours**

Introduction to rigging and armatures - Creating bone structures and hierarchies - Forward Kinematics and Inverse Kinematics concepts - Skinning and automatic weight assignment - Manual weight painting for better control - Basic posing and deformation testing.

LIGHTING AND RENDERING IN BLENDER **6 Hours**

Types of lights: Point, Spot, Area, Sun, Emission - Importance of realistic lighting: shadows, reflection, refraction - Render engines: Eevee vs. Cycles - Render settings: resolution, samples, denoising - HDRI lighting and environment maps - Light probes and global illumination - Basic post-processing: color grading, bloom, glare using Blender compositor.

TEXTURING, SHADING, AND VR DEPLOYMENT **6 Hours**

Shader Editor and node-based material system - PBR materials: Diffuse, Roughness, Metallic, Normal Maps - Procedural texturing: Noise, Gradient, Voronoi - UV mapping techniques and texture painting - Creating complex materials: Glass, Metal, Fabric - Using Blender's material libraries - Exporting scenes for VR platforms - Building a basic VR environment in Blender.

LAB CONTENTS: **30 Hours**

1. Organize a scene by grouping objects into collections and setting up basic parent-child relationships for objects.
2. Create a simple object using Bezier curves and convert it to mesh for further editing.
3. Model a mechanical object using modifiers and NURBS.
4. Sculpt a simple organic object using basic sculpting brushes and the Dyntopo feature.
5. Create a basic armature for a simple object and apply it to the mesh.
6. Assign automatic weights to a simple model and test the deformations by posing the rigged object.
7. Apply Inverse Kinematics to a simple armature and test the control by rotating bones in the chain.
8. Set up a scene with different light types and test their effects on shadows.
9. Render a simple scene using both Eevee and Cycles, adjusting settings such as samples and resolution.
10. Apply an HDRI environment map to a scene and adjust the settings for realistic lighting and reflections.
11. Create a simple PBR material for an object using the Shader Editor.
12. Create a basic procedural texture using noise and Voronoi in the Shader Editor.

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13. Create a 3D object and apply a realistic Glass, Metal, and Fabric Materials

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES:

4. Allan Brito (2022). Blender 3.0: The Beginner’s Guide. Blender Institute.
5. Williamson, B. (2021). Blender 3D: Noob to Pro. WikiBooks.
6. Chris Totten (2021). Game Character Creation with Blender and Unity.
7. Hess, R. (2019). Blender Foundations: The Essential Guide to Learning Blender 2.6. Focal Press

ONLINE LEARNING MATERIALS

1. https://studio.blender.org/welcome/
2. https://cgcookie.com/courses_

ONLINE COURSES:

1. https://www.udemy.com/course/blendertutorial/

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U18CSE0230 **AI AND ML IN GAMES**

L	T	P	J	C
2	0	2	0	3

Course Overview

This course introduces the fundamentals of Artificial Intelligence and Machine Learning in game development, focusing on how intelligent behavior enhances gameplay. Students will explore key techniques such as pathfinding, decision-making systems, and machine learning models including supervised, unsupervised, and reinforcement learning. The course covers AI-driven character behavior, dynamic world generation, and procedural content creation. Real-world case studies and applications in automated testing, optimization, and player data analytics are also discussed.

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Understand the fundamentals of AI/ML techniques and explain the different types of AI used in game design. [K2]

CO2: Apply pathfinding algorithms like A* and Dijkstra, and decision-making systems such as state machines and behavior trees in game scenarios. [K3]

CO3: Analyze the use of supervised, unsupervised, and reinforcement learning techniques in player behavior prediction and procedural content generation. [K4]

CO4: Apply machine learning to develop dynamic game worlds, NPC behaviors, and natural language processing systems in game environments. [K3]

CO5: Analyze the effectiveness of AI/ML techniques in automated game testing, performance optimization, and in-game analytics. [K4]

Pre-requisite: NIL

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S				M								M		
CO2			S		S								S		
CO3					S								S		
CO4			S		S								S		
CO5			M		S								S		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT

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1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO AI/ML IN GAMES 6 Hours

Overview of Artificial Intelligence and Machine Learning - Role of AI and its importance in games- Types of AI: Reactive AI, Proactive AI, and Hybrid AI -Role of ML in games-Types of ML: Supervised, Unsupervised, and Reinforcement Learning - Key algorithms in game AI: Pathfinding, decision trees, finite state machines, and utility-based AI - The difference between classical AI and AI/ML in gaming.

PATHFINDING AND DECISION MAKING 6 Hours

Introduction to pathfinding: A* and Dijkstra algorithms - Heuristic-based search and cost-based search - Decision-making systems in games: State machines and behavior trees - Utility-based AI for NPCs: Simple decision-making models - AI for dynamic environments and procedural generation in games - Case studies: Pathfinding in action games.

MACHINE LEARNING FOR GAME DESIGN 6 Hours

Introduction to ML techniques in game development - Supervised learning for player behavior prediction - Unsupervised learning for procedural content generation - Reinforcement learning: Training agents to play games - Neural networks and deep learning in game AI - Case study: DeepMind's AlphaGo and its application in strategy games.

AI FOR GAME CHARACTERS AND DYNAMIC WORLDS 6 Hours

AI-driven character behavior: Dialogue systems, emotion recognition, and adaptive NPC interactions - Machine learning for dynamic game world generation - Procedural content generation using AI: Levels, items, quests - Natural language processing in games: AI-driven conversation systems - Machine learning for creating realistic AI-driven animations.

AI/ML IN GAME TESTING AND OPTIMIZATION 6 Hours

AI and ML for automated game testing: Simulating player behavior for QA - AI for testing gameplay balance: Evaluating game difficulty - Machine learning for bug detection and pattern recognition in game code - AI-based optimization for game performance: Load balancing, AI decision-making speed - Using ML for analyzing player data: In-game analytics and personalized content.

LAB CONTENTS: 30 Hours

1. Exploring AI Applications in Popular Video Games
2. Implementing a basic finite state machine or pathfinding algorithm
3. Implementing A* pathfinding for NPC navigation in a simple game environment
4. Building a basic decision tree for an NPC in a simple game scenario
5. Using a supervised learning model to predict player behavior
6. Implementing a reinforcement learning agent that learns to navigate a game environment.
7. Implementing a basic AI-driven NPC interaction system
8. Using ML techniques to generate random game levels or content
9. Experimenting with procedural animation or behavior generation
10. Developing an AI-driven testing agent to simulate a variety of player strategies
11. Implementing basic performance optimizations using machine learning insights
12. Collecting player data for feedback and adaptive game design

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

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REFERENCES:

1. Millington, I., & Funge, J. (2009). Artificial Intelligence for Games (2nd ed.). CRC Press.
2. Laird, J. E., & van Lent, M. (2001). Learning from Experience in Game AI. IEEE Intelligent Systems, 16(2), 27–35.
3. Shaker, N., Togelius, J., & Nelson, M. J. (2016). Procedural Content Generation in Games. Springer.
4. Brockington, P., & Montague, L. (2017). Game AI Pro: Collected Wisdom of Game AI Professionals. CRC Press.

ONLINE LEARNING MATERIALS

1. https://www.gamedeveloper.com/programming
2. https://towardsdatascience.com/tagged/game-development
3. https://deepmind.com/research/highlighted-research/alphago
4. https://www.gameaipro.com/

ONLINE COURSES:

1. https://www.edx.org/course/artificial-intelligence-ai
2. https://www.udemy.com/course/artificial-intelligence-in-unity/

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U18CSE0534 GAME DESIGN AND DEVELOPMENT USING UNREAL ENGINE

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- Explain the key principles of game design, including mechanics, dynamics, aesthetics, and documentation required for conceptualizing games.
- Identify the essential Unreal Engine tools and workflows needed for world building, lighting, sound, and team collaboration.
- Implement level layouts, Blueprint logic, and core gameplay interactions for character and camera systems.
- Demonstrate the use of visual design, audio elements, and UI/UX principles to enhance player experience.
- Construct a complete game prototype by integrating assets, systems, and deployment processes.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Understand the basic principles of game design, game mechanics, and the iterative design process to create interesting game ideas.[K2]

CO2: Apply Unreal Engine tools to build game worlds with proper lighting, sound, and collaboration features.[K3]

CO3: Develop game logic, character controls, and camera systems using Blueprint visual scripting.[K3]

CO4: Integrate 3D models, animations, audio, and user interface elements to develop cohesive and engaging game scenes.[K3]

CO5: Develop a complete game project by building a prototype, testing it iteratively, and preparing it for deployment.[K3]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes(POs)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2		M	S	S								
CO3			S	S								
CO4			S	S								
CO5			S									

COURSE ASSESSMENT METHODS:

DIRECT

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1. Project 2. Project presentation/Report 3. Lab Assignments 4. Demo presentations 5. Quiz/peer review(optional)
INDIRECT
1. Course-end survey

INTRODUCTION TO GAME DESIGN LAB **18 Hours**

- Game Design: Principles, core mechanics, and aesthetics
- Designing Your First Game: Ideation, concept creation, pitching
- Iterative Process: Prototyping, testing, refining
- Documentation: Creating Game Design Documents (GDD)

Lab Tasks:

1. Create a simple game concept sheet including core mechanics and game goals.
2. Develop multiple game ideas and pitch one in a short presentation.
3. Build a paper prototype and conduct a brief playtest to gather feedback.
4. Create a structured Game Design Document (GDD) for the selected game idea.

UNREAL ENGINE FUNDAMENTALS LAB **18 Hours**

- Unreal Engine interface, navigation, and project setup
- World Building: Level layout, environment creation, asset placement
- Lighting & Sound: Shadows, ambience, SFX
- Collaboration: Version control workflow, asset sharing
- Core Engine Tools and Components
- Creating a basic playable scene

Lab Tasks :

1. Set up a new Unreal Engine project and explore the interface, tools, and navigation.
2. Design a small environment using terrain, meshes, foliage, and basic level layout.
3. Add lighting systems and ambient sound effects to create mood and atmosphere.
4. Build a simple playable scene and share the project using version control (Git/LFS).

LEVEL DESIGN & BLUEPRINT SCRIPTING LAB **18 Hours**

- Level Design: Pacing, spatial storytelling, player guidance
- Grayboxing: Blockout layouts using basic geometry
- Blueprint Basics: Interface, nodes, logic flow
- Blueprint Communication
- Character, Controls, and Cameras
- Gameplay Mechanics: Triggers, pickups, interactions

Lab Tasks:

1. Build a grayboxed level layout focusing on player flow and exploration.
2. Implement basic Blueprint logic for player movement and camera control.

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3. Create Blueprint events to enable object interactions (doors, switches, triggers).
4. Develop collectible or pickup mechanics using Blueprint communication.

VISUAL, AUDIO, UI & UX DESIGN LAB **18 Hours**

- Visual Art Styles, 3D Models, Animations, VFX
- Audio Design: SFX, ambience, music
- UI: HUDs, menus, modular components
- UX: Accessibility, feedback, game loop principles

Lab Tasks :

1. Apply materials, textures, and simple animations to objects in the game scene.
2. Integrate audio elements such as footsteps, ambient loops, and interaction sounds.
3. Design and implement a HUD (health bar, score, prompts) and a basic main menu UI.
4. Conduct a UX evaluation and refine UI/UX based on player feedback.

GAME DEVELOPMENT, PROTOTYPING & DEPLOYMENT LAB **18 Hours**

- Preproduction: Scope, planning, task breakdown
- Implementation: Integrating levels, Blueprints, visuals, audio, UI
- Game Modes: Rules, scoring, objectives
- Building a final playable prototype

Lab Tasks:

1. Create a production plan and asset list for the final game prototype.
2. Assemble all assets (levels, characters, UI, audio) into a cohesive game build.
3. Implement game rules, scoring system, and objectives using Blueprints.
4. Package and deploy the final playable build for testing and feedback.

Theory: 0	Tutorial: 0	Practical: 90	Project: 0	Total: 90 Hours

REFERENCES

1. Jesse Schell, The Art of Game Design: A Book of Lenses, Fourth Edition, CRC Press, 2023.
2. Andrew Rollings & Ernest Adams, Fundamentals of Game Design, Third Edition, Pearson, 2013.
3. David Nixon, Blueprints Visual Scripting for Unreal Engine, Packt Publishing, 2021.
4. David Kim & Clinton Crumpler, Unreal Engine 5 Game Development: Essential Guide to Building Games, Packt Publishing, 2022.
5. Ashish Amresh & Alex Okita, Unreal Game Development, Cengage Learning, 2010.

ONLINE COURSES

1. https://www.coursera.org/specializations/game-design
2. https://dev.epicgames.com/community/learning
3. https://docs.unrealengine.com
4. https://www.coursera.org/professional-certificates/epic-games-game-design-professional-certificate

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Specialization Track: IOT, EDGE AND UAV

U18CSE0217 EMBEDDED SYSTEMS FOR IOT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Identify the internal architecture and programming of an embedded processor. [K3]

CO2: Utilize the basic architecture of Internet of Things based Devices [K3]

CO3: Make use of hardware platforms and AI Enabled Boards for application development. [K3]

CO4: Choose the software platforms to process the IoT Data. [K3]

CO5: Build an embedded and IoT Solution for real world scenarios[K5]

Pre-requisite: U18ITI2201- Digital Logic and Microprocessor

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S		S	M								S	M	
CO2	S		S										S		
CO3	S	M	M	M									S		
CO4	S		S		S	M		M		M				S	
CO5	S	S		M	M	S			M				M		S

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

EMBEDDED AND MICROCONTROLLER CONCEPTS 7 Hours

Introduction to embedded processors-Categories of embedded processors-Architecture- Introduction to PIC microcontrollers, architecture and memory organization, registers, I/O ports, interrupts, timer, instruction sets, Embedded Communication Protocols – UART, USART,I2C, SPI, Modbus-Introduction to Real-Time Operating Systems (RTOS)- RTOS Architecture: Layered Architecture of an RTOS -Kernel Components and Their Functions- Real-Time Operating System Services

INTERNET OF THINGS 5 Hours

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Introduction to Internet of Things (IoT), Functional Characteristics, IoT building blocks - Architecture and working - Elements of an IoT ecosystem-IOT Application Development Cycle-Technology drivers, Business drivers, Trends and implications -Recent Trends in the Adoption of IoT, Role of cloud in IoT. IoT Enabling Technologies

HARDWARE PLATFORMS FOR IOT **6 Hours**

Development Boards -Arduino, Raspberry Pi, ESP8266, AI Enabled Boards (Jetson Boards for IoT development), Sensors and actuators -Types-Functions, and applications: Gateways- connectivity options for Short range/Long range Communication- IoT device communication protocols Overview.

SOFTWARE DEVELOPMENT FOR IOT **6 Hours**

IDEs for IoT prototyping- Arduino Programming - Arduino functions- Interfacing with sensors and actuators- Libraries -Input/Output From Pins - Raspberry Pi platform -Environmental -Programming and interfacing with basic hardware components. Open Platforms- Platforms Overview- IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT

APPLICATION DEVELOPMENT **6 Hours**

Development of IoT Applications - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services. IOT Prototyping - Home Automation –Smart Agriculture – Smart Cities – Smart Healthcare.

LAB CONTENTS: **30 Hours**

To understand the IoT tools and Platforms. Build a basic home automation system. IoT solution for agriculture, IoT-based smart parking system, Smart Cities - Smart Waste Management, Smart Street Lights, Healthcare - Baby Monitoring.

Sample Experiment:

1. Embedded C Programming and Interfacing with various peripherals
2. Integration of Actuators with node MCU (Servo motor/Relay).
3. Capture Image with node MCU.
4. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).
5. Make use of cloud platform to log the data.
6. Build a basic home automation system using IoT devices.
7. Develop an IoT solution for agriculture.
8. Design an IoT-based smart parking system.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES:

1. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed, 1119363993, Wiley, First Edition, 2018.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill.2nd edition June 2022.
4. Arduino Programming in 24 hours, Richard Blum, 1st Edition, ISBN: 978-0672337123, Sams Tech Yourself Publishing.2014
5. Adrian Mcewen, Hakin Cassimally, "Designing the Internet of Things", First Edition, Wiley, 2014

ONLINE COURSES:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://www.coursera.org/learn/iot-wireless-cloud-computing
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/

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U18CSE0318 **IOT SYSTEM DESIGN**

L	T	P	J	C
2	0	0	2	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Explain the core concepts, challenges, and opportunities in the design and deployment of Internet of Things (IoT) systems [K2].

CO2: Analyze suitable hardware components such as sensors, microcontrollers, and power sources for specific IoT applications [K4].

CO3: Design energy-efficient IoT architectures using appropriate energy harvesting and power management techniques [K3].

CO4: Develop IoT applications using relevant communication protocols such as MQTT, CoAP, and AMQP for efficient data transmission [K3].

CO5: Evaluate IoT system performance in terms of scalability, reliability, and security through case studies and prototype demonstrations [K3].

Pre-requisite: Nil

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M										M			
CO2	M			M									M		
CO3			M		M									M	
CO4			M		M					M					
CO5		M		M										M	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

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THEORY COMPONENT CONTENTS

Fundamentals of IoT and Challenges **6 Hours**

Introduction to IOTs - Improving Quality of Life. Challenges to solve in IOTs - Energy / Power, Data Explosion, Security

IoT System Architecture and Design **6 Hours**

System design of an IOT System - Power supply, Processor, Memory Sensor Interface. Wireless Interfaces - LAN - BLE, Wi-Fi, RFID, LP WAN - LORA, LTE-M, Sigfox, NB-IOT.

Power Management and Energy Harvesting **6 Hours**

Power supply design - LDOs, Switching regulators - BuckBoost Converters, Energy Measurements. Energy harvesting and battery life calculation - PV, RF, Kinetic Energy, TEGs, aeroelastic flutter, Harvesting ICs in silicon.

Communication Protocols for IoT **6 Hours**

IOT Protocols - loT MAC, REST based COAP, Publish subscribe- MQTT, AMQP, MDNS, Building an IOT System - Application based Microcontroller selection.

IoT Case Studies and Applications **6 Hours**

Joule Jotter, Cloud Based Systems

Project Component: Integrated IoT System Design **30 Hours**

To design and implement a complete IoT system addressing a real-world problem. It involves conceptualizing the architecture, selecting appropriate sensors, power sources, and wireless technologies, and ensuring efficient energy management and harvesting.

To implement core IoT communication protocols and integrate the system with a cloud platform for data visualization and interaction. A functional prototype will be developed, emphasizing usability, scalability, and low-power design.

Theory Hours:	**30**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**30**	**Total Hours:**	**60**

REFERENCES

1. James, A. (2020). IoT system design: Project-based approach. Springer.
2. Agarwal, D., Verma, K., & Urooj, S. (2022). Energy harvesting: Enabling IoT transformations. CRC Press.
3. Shabaz, M., & Suhaib, M. (2021). Building IoT systems: Design scalable IoT systems from edge to cloud. Springer.
4. Madan, J., Yadav, D., & Gupta, A. (2023). IoT system design: Measurement, instrumentation, and smart systems. Springer.
5. Vasseur, J.-P., & Dunkels, A. (2010). Interconnecting smart objects with IP: The next Internet. Morgan Kaufmann.
6. Rowland, C., Goodman, E., Charlier, M., Light, A., & Lui, A. (2015). Designing

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connected products: UX for the consumer Internet of Things. O'Reilly Media.

Web Links

1. https://link.springer.com/book/10.1007/978-3-030-85863-6
2. https://www.routledge.com/Energy-Harvesting-Enabling-IoT-ransformations/Agarwal-Verma-Urooj/p/book/9781032349251
3. https://link.springer.com/book/10.1007/979-8-8688-1212-5?utm_
4. https://www.amazon.in/IoT-System-Design-Measurement-Instrumentation/dp/3030858626?utm_
5. https://www.oreilly.com/library/view/designing-connected-products/9781491922197/

Online Resources

1. https://nptel.ac.in/courses/108108098
2. https://www.coursera.org/learn/iot-architecture
3. https://www.coursera.org/learn/iot-communications
4. https://www.coursera.org/learn/iot-software-architecture
5. https://www.coursera.org/learn/advanced-iot-systems-and-industrial-applications-course-3

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U18CSE0219 IOT APPLICATION DEVELOPMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Apply the fundamentals of IoT to design basic embedded systems using microcontrollers, circuit components, and data-encoding techniques. [K3]

CO2: Implement communication and modulation techniques for low-power IoT devices. [K3]

CO3: Configure wired and IP-based network architectures and device discovery protocols for IoT systems. [K3]

CO4: Implement cloud SDKs, CLI tools, IAM configurations to deploy and monitor IoT applications on Cloud. [K3]

CO5: Apply security mechanisms for IoT hardware, firmware, sensors, and cloud services to build secure end-to-end IoT systems. [K3]

Pre-requisite: Nil

Cos	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S		M		M								S		
CO2		S	M		M									M	
CO3		S	M		M									M	
CO4	S		M		M				M					M	
CO5	S				M		M						S		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

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THEORY COMPONENT CONTENTS

INTRODUCTION **6 Hours**

Overview of IOT Application Development - Introduction to Internet of Things -IoT Hardware-Circuit Design - IoT Device Architecture: Integrated Circuits- Data Encoding Challenges and approaches- Microcontrollers-Programmable Circuits-IoT Platform Design and Programming

IOT COMMUNICATION **6 Hours**

Radio Frequency Communications-Antenna Design-Signal Propagation- Attenuation-Spectrum Division-Modulation- Media Access protocol: Collision Detection and Resolution-Power Saving Algorithms-Power MAC Algorithms- routing-Service discovery.

IOT NETWORKING **6 Hours**

Wired Networking Overview-Reference Architectures for IoT-Layer 2 and Layer 3 Networking-L2 Switching vs L3 Routing- Ethernet Forwarding-Ethernet Learning Switches-Network Virtualization with VLANs-VLAN Configuration Encapsulation- Ethernet & IPv4 Headers, TCP header-Internet Addressing-Address Discovery Protocols-Dynamic Host Configuration Protocol-Networking Devices-Device Types.

DEPLOYING IOT IN CLOUD **6 Hours**

Cloud APIs -Google Cloud SDK-Google Cloud CLI-Cloud Client Libraries- Cloud Shell and Cloud Code-Cloud Storage and databases: Authorization with Cloud IAM-Authenticating to Google APIs and service Accounts-authentication method-using Secret Manager- Overview of Machine Learning Models-Deploying -Monitoring and performance Tuning

DEVELOPING SECURE IOT APPLICATION **6 Hours**

IOT security basics- Device security -Network security for IOT devices- IoT Application security -Secure hardware design for IoT devices- Firmware development -Secure sensors Integration and data Processing -Secure IoT Services and Cloud Platform

LAB COMPONENT

Create a real-time IoT application using IoT hardware programming, communication, network configuration, cloud deployment, and secure device integration. Deploy the IoT project to make it operational and accessible by users.

Sample Experiments:

- Interface and programming IoT hardware and circuits
- Implement communication and MAC techniques
- Configure wired and wireless IoT networks
- Deploy IoT workloads using Google Cloud SDK and APIs
- Apply secure design, authentication, and firmware security practices (e.g., Smart Home Control, smart framing)

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Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz, ISBN: 978-1-119-28568-7, 2016.
2. "IOT Deployment Handbook: A practical Guide to Implementing Successful IOT Projects" By Richard G. Brown, 2022
3. "Internet of Things: A Hands-On Approach",Arshdeep Bahga, Vijay Madisetti,Publisher Universities Press, 2016
4. "The Internet of Things: Key Applications and Protocols", Olivier Hersent, David Boswarthick, Omar Elloumi,Wiley Publication, 2012
5. "Computer Networking: A Top-Down Approach", James F. Kurose, Keith W. Ross: Pearson Publication, 2021
6. "Google Cloud IoT: End-to-End Implementation Guide",Balaji Chattopadhyay, Packt Publishing: 2021

Online Course Links:

1. Developing Applications with Google Cloud: Foundations | Coursera
2. Hands-on Internet of Things | Coursera
3. https://www.coursera.org/learn/developing-secure-iot-applications?msockid=3de4fc32da0261e02866ef3ddbaf6034#modules

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U18CSE0220	SOFTWARE SYSTEMS FOR 3D PRINTING

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Make use of 3D printing technologies and realize the applications[K3]
CO2: Identify 3D printing process chain in additive manufacturing. [K3].
CO3: Develop proficiency in using 3D modelling software. [K3]
CO4: Identify various issues involves in common 3D printing techniques [K3]
CO5: Apply the concepts of advanced 3D printing techniques to develop applications [K3]

Pre-requisite: Nil

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S												S		
CO2		S			M							M	S		
CO3		M			M							M	M		
CO4	S				M					M			S		
CO5	S	M			M					M					M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO 3D PRINTING **(5 Hours)**

Overview of 3D Printing technology - Historical background and advancements – 3D printers- Workflow of 3D Printing – Modelling Software for 3D printers – Materials used for 3D printing – Application in 3D printing - Case Studies of 3D printing:

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Normal 3D printed Ear Buds, Shapes 3D printed marketplace, Francis Bitonti 3D printed Dress – Paul Braun 3D Printed Battery.

3D PRINTING PROCESS CHAIN & PHOTOPOLYMERIZATION PROCESSES (7 Hours)

Introduction to Additive Manufacturing – Formative vs Subtractive vs Additive Manufacturing – Additive Manufacturing Process – Classification of Additive Manufacturing – Steps in 3D printing : Modelling , Tessellation , Slicing , Support , Tool pathway , Manufacturing and Post- Processing - Material Extrusion in FDM vs Composite Materials – Introduction to Photopolymerization: Material Jetting vs Stereolithography – Reaction Rates – Resin Curing and Scan Patterns – Vector Scan & Micro Stereolithography – Mask Projection and Two- Photon Photopolymerization Technologies.

3D DESIGNING (7 Hours)

Introduction to 3D modelling software – Creating 3D models and basic geometric shapes – CAD tools and parametric modelling – Developing complex structures and assemblies – File formats and Reverse Engineering concepts; Preparing models for 3D printing – Design considerations, mesh repair, and STL file handling – Model slicing, support generation, and tool path creation – Layer height, resolution, and print bed adhesion techniques – Orientation and surface finish optimization; Overview of 3D printers and essential software tools such as Creality, Ultimaker Cura , PrusaSlicer, Slic3r, MeshLab MeshLab, and OctoPrint.

TROUBLESHOOTING AND CALIBRATION (6 Hours)

Components and systems of FDM and SLA printers – Motion system coordination and control mechanisms – Electronics interface and calibration menus – Extrusion process and build plate adhesion methods – Material handling and storage practices – Identifying and resolving common print issues – Adjusting print settings for accuracy and surface quality – Performing hardware and software calibration – Troubleshooting procedures and preventive maintenance for reliable printing.

ADVANCED 3D PRINTING TECHNIQUES (5 Hours)

Overview of advanced 3D printing methods – Multi-Material Unit (MMU) and multi-color printing – 3D scanning and digital reconstruction techniques – Point cloud generation and mesh refinement using Cloud Compare – Techniques for high-resolution and large-scale printing – Optimization of print accuracy, surface finish, and material efficiency

LAB CONTENTS: 30 Hours

This lab component focuses on teaching students the fundamentals of 3D printing and design, using various printing techniques, materials, and post-processing methods. Students will engage in hands-on experiments to understand the complete process of 3D printing, from design to troubleshooting.

Sample Experiments:

1. 3D Modeling with Basic Shapes: Introduction to 3D modeling software

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and creation of basic geometric shapes.

2. FDM Printing Basics and SLA Comparison: Use an FDM printer for a simple model, then print the same model with an SLA printer for comparison.
3. Calibrating and Optimizing 3D Printers: Learn to calibrate FDM printers, including bed leveling and extruder settings. Also, cover basic SLA printer settings.
4. Model Correction and Preparation: Identify and correct common 3D model issues, preparing the model for efficient printing.
5. Orientation and Support Structure Analysis: Experiment with model orientations and support structures for both FDM and SLA printing.
6. Choosing the Best Printing Method: Analyze a 3D model to determine the most
suitable printing method, considering the model's geometry and application.
7. Post-Processing Techniques: Learn post-processing techniques for both FDM (like sanding and painting) and SLA prints (including resin curing and support removal).
8. Troubleshooting 3D Printers: Identify and resolve common issues in both FDM and SLA printing.
9. Material Analysis and Application: Study different printing materials for FDM and SLA, understanding their properties, strengths, and use cases.
10. Efficiency and Precision in 3D Printing: Focus on recreating a provided 3D model with precision and optimizing print settings for efficiency within a time limit.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. "Mastering 3D Printing:A Guide to Modeling,Printing and Prototyoing" by Joan Horvath,Rich Camerona,published in May 2020.
2. "3D Printing Failures: How to Diagnose and Repair ALL Desktop 3D Printing Issues" by Sean Aranda and David Feeney published in January 2020.
3. "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Ian Gibson, David W Rosen, Brent Stucker published in 2010.

4 "Rapid Prototyping: Principles & Applications" by Chua Chee Kai, Leong Kah Fai published in January 2010

ONLINE REFERENCE

1. An overview of the advances in the 3D printing technology - ScienceDirect
2. Exploring Advanced Techniques in 3D Printing - 3D Printing News
3. Additive Manufacturing (3D Printing) - Student Guide | Prep4Uni.online
4. Advanced 3D Printing Techniques | Formlabs
5. From 3D points to 3D mesh using CloudCompare

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ONLINE COURSES

1. https://www.coursera.org/specializations/rapid-prototyping-using-3d-printing
2. https://www.coursera.org/specializations/3d-printing-additive-manufacturing
3. https://www.udemy.com/course/3d-printing-for-beginners/
4. https://www.udemy.com/course/3d-printing-from-start-to-finish/
5. https://www.udemy.com/course/learn-3d-printing/
6. https://www.futureskillsprime.in/pathways/multi-material-d-printing/
7. https://onlinecourses.nptel.ac.in/noc22_me130/preview

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U18CSE0221 **ROBOTIC OPERATING SYSTEMS**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Apply the concepts of ROS to enable the development of robotic system [K3]

CO2: Implement ROS topics and messages for efficient data transfer between nodes. [K3]

CO3: Utilize ROS visualization tools, such as RViz, to analyze and debug ROS applications. [K3]

CO4: Develop ROS perception packages for object detection, recognition, and tracking. [K3]

CO5: Apply ROS drivers for tasks such as sensor data acquisition, robot navigation, and object manipulation [K3]

Pre-requisite: U18ITT4001- Operating Systems

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S				M								S		
CO2		S			M									M	
CO3					S								M		
CO4		S			M										M
CO5	S				M									M	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION **6 Hours**

Introduction to ROS-Installation of ROS on different platforms-ROS basic concepts-Components: Nodes, topics, messages, and services- ROS communication architecture-ROS Packages and Ecosystem

ROS TOOLS AND ENVIRONMENT **6 Hours**

ROS Tools and Environment- command-line tools- ROSIDEs- ROS Integrated Development Environments (IDEs)- graphical tools for visualization and debugging- Rviz, Rqt, and Gazebo-Creating and managing ROS workspaces-Version control with ROS

ROS COMMUNICATION **6 Hours**

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ROS nodes and communication - ROS Topics - Publishing and subscribing to topics-Working with ROS topics and messages-ROS services and parameters-ROS launch files for managing multiple nodes-ROS Middleware-ROS Libraries

ADVANCED ROS TOPICS **7 Hours**

Perception in ROS- Perception libraries (OpenCV, PCL)- Integration of sensors: Cameras, Lidar, IMU - Basic computer vision techniques in ROS Robot Navigation and Control
- ROS navigation stack-Path planning algorithms-Simulating and executing robot navigation- ROS control stack

ROS AND ROBOT DRIVERS **5 Hours**

ROS and Robot Drivers-Writing drivers to interface hardware with ROS-Interfacing Sensors and Actuators-Connecting sensors and actuators to the ROS ecosystem-Integration with Robot Platforms-Working with popular robot platforms.

LAB COMPONENT

Create a simple ROS package with a publisher and a subscriber node-Extend the package to include a service, Expand the package to include an action server that moves a robot forward for a specified duration- Computer Vision with ROS- Integration with Hardware -Use RViz to visualize the movement of a robot as it receives commands from the publisher.

Sample Experiments:

1. Installation and Create a ROS workspace.
2. Create and run a simple ROS node-Publish and subscribe to ROS topics.
3. ROS Tools-Use Rviz for visualization.-Experiment with Rqt tools.
    a. Working with Launch Files:-Create a launch file to start multiple nodes-Pass parameters through launch files.
4. Design a simple robot using URDF
    a. Simulate the robot in Gazebo
    b. ROS Services and Actions:
5. Implement a simple ROS service
    a. Create and use a ROS action server.
    b. Navigation in ROS
    c. Set up the ROS Navigation Stack
    d. Implement basic path planning
6. Computer Vision with ROS
    a. Use OpenCV with ROS for image processing.
7. Integration with Hardware:
    a. Interface with a real-world sensor (e.g., Lidar or IMU) using ROS.
    b. Control actuators or motors using ROS commands.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hour**

REFERENCES

1. Programming Robots with ROS: A Practical Introduction to the Robot Operating System, O'Reilly Media; by Morgan Quigley , Brian Gerkey , William D. Smart ,1st edition, 2015
2. Robot Operating System (ROS): The Complete Beginner's Guide" - Morgan Quigley, Apress; 1st edition, 2018
3. Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy,Lentin Joseph,Apress, 1st edition ,2018,

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4. ROS Robotics By Example , Carol Fairchild , Dr. Thomas L. Harman, Packt Publishing Limited,2016

ONLINE COURSES:

1. https://www.edx.org/learn/robotics/delft-university-of-technology-hello-real-world-with-ros-robot-operating-system
2. https://www.udemy.com/course/ros-essentials/
3. https://www.udemy.com/course/self-driving-and-ros-learn-by-doing-odometry-control/
4. https://www.udemy.com/course/ros-for-beginners/
5. https://www.coursera.org/learn/intro-self-driving-cars?specialization=self-driving-cars

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U18CSE0022 **SOFTWARE DEFINED VEHICLE**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Describe the architecture, ecosystem, and components of Software Defined Vehicles [K2].

CO2: Demonstrate middleware and service-oriented frameworks for SDV communication [K3].

CO3: Integrate edge and cloud computing models for SDV deployment [K3].

CO4: Evaluate safety, cybersecurity, and compliance standards for SDVs [K3].

CO5: Design simulation or prototype SDV environments using digital twin and container- based architectures [K3].

Pre-requisite: Nil

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S												M		
CO2	S	S	M	M	S								M		
CO3	S	S		M	S		M		M					S	
CO4		S	M	M	S				M			M		M	
CO5		S										M		S	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO SOFTWARE DEFINED VEHICLES 9 Hours

Evolution from ECU-based to centralized computing; zonal and domain controller architectures; SDV stack and digital lifecycle; components of SDV ecosystem; industry use cases.

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SDV ARCHITECTURE AND MIDDLEWARE **9 Hours**

AUTOSAR Classic vs. AUTOSAR Adaptive; ROS2 and DDS communication; Service-Oriented Architecture (SOA) in vehicles; middleware abstraction and data exchange; deployment of adaptive applications.

CONNECTIVITY AND CLOUD INTEGRATION **12 Hours**

In-vehicle communication networks (CAN, Ethernet, SOME/IP); edge-to- cloud connectivity; SDV orchestration with AWS IoT FleetWise; edge data processing; real-time data pipelines and telemetry.

SOFTWARE UPDATES, SAFETY, AND SECURITY **6 Hours**

Software Over-the-Air (SOTA/FOTA) updates; DevOps pipelines; functional safety (ISO 26262); cybersecurity (ISO 21434); secure boot, encryption, and intrusion detection.

SIMULATION, DIGITAL TWIN & FUTURE TRENDS **9 Hours**

Digital twin simulation and virtual ECU; HIL/SIL test environments; predictive maintenance; AI-enabled analytics; future trends in SDV ecosystems and mobility-as-a-service.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total:45 Hours**

TEXTBOOKS

1. Jörg Schäuffele & Thomas Zurawka, Automotive Software Engineering, SAE International, 2016.
2. Miroslaw Staron, Automotive Software Architectures: An Introduction, Springer, 2021.
3. Rajesh Rajamani, Vehicle Dynamics and Control, Springer, 2022.

REFERENCES

1. Colt Correa, John Simon, Martin Gubow, Samir Bhagwat, "Automotive Ethernet: The Definitive Guide", Intrepid Control Systems, 2nd edition, 2023.
2. Marco Di Natale, Haibo Zeng, Paolo Giusto, Arkadeb Ghosal, "Understanding and Using the Controller Area Network Communication Protocol Theory and Practice", Springer New York, NY,2012.

Online Resources

1. Coursera: SDV 101: Introduction to Software Defined Vehicles https://www.coursera.org/learn/sdv101?utm_source=chatgpt.com
2. Coursera: Internet of Things and AI Cloud Specialization (UC San Diego) https://www.coursera.org/specializations/internet-of-things?utm_source=chatgpt.com
3. Coursera: Introduction to AutoSAR https://www.coursera.org/learn/introduction-to-autosar?utm_source=chatgpt.com

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U18CSE0532 INTELLIGENT IOT SYSTEMS WITH CLOUD AND AI INTEGRATION

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- Provide hands-on experience in configuring and integrating IoT devices with major cloud platforms.
- Develop practical skills in data acquisition, storage, and visualization using cloud-based IoT dashboards and APIs.
- Apply artificial intelligence and machine learning techniques for IoT data analytics and intelligent decision-making.
- Implement secure IoT communication using authentication, encryption, and privacy-preserving mechanisms.
- Design, integrate, and deploy complete IoT Cloud - AI solutions using edge computing and cloud optimization techniques.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Configure IoT devices to leading cloud platforms using standard communication protocols. [K3]

CO2: Analyze IoT data using AI/ML tools and cloud-based analytics platforms. [K4]

CO3: Implement robust IoT security mechanisms, including authentication, encryption, and access control. [K3]

CO4: Analyze edge cloud integration strategies to improve performance, minimize latency, and enhance energy efficiency. [K4]

CO5: Apply IoT Cloud and AI technologies to develop a basic real-time intelligent and secure application for real-world use cases [K3]

Pre-requisites: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	**Programme Outcomes (POs)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S		M								
CO2			S	M								
CO3	S		S	S								
CO4		S	S									
CO5	S			S	S				M			M

COURSE ASSESSMENT METHODS:

DIRECT
1. Lab Assignments, 2. Project presentation, 3. Demo presentations,

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4. Quiz/peer review(optional)
INDIRECT
1. Course-end survey

PRACTICAL COMPONENTS:

CLOUD IOT PLATFORMS - CONFIGURATION AND CONNECTIVITY 15 Hours

- Configure IoT cloud accounts on AWS IoT Core, Google Cloud IoT, and IBM Watson IoT.
- Connect Raspberry Pi / NodeMCU to AWS IoT Core using MQTT over TLS.
- Stream sensor data from a local device to Google Cloud IoT via MQTT bridge.
- Visualize real-time data using IBM Watson IoT Dashboard.
- Compare latency and message throughput across platforms

AI-ENABLED IOT DATA ANALYTICS 20 Hours

- Collect time-series IoT data (temperature, humidity, light) and store it in cloud databases (Firebase / DynamoDB).
- Use Google Cloud AutoML or Azure ML Studio to build predictive models (e.g., temperature anomaly detection).
- Deploy a trained ML model on cloud to classify real-time data from IoT devices.
- Integrate TensorFlow Lite on edge devices for on-device inference.
- Build a Python dashboard to compare edge vs. cloud inference results.

CLOUD APIS AND IOT APPLICATION DEVELOPMENT 15 Hours

- Access IoT data via RESTful APIs (AWS API Gateway or IBM Cloud Functions).
- Create a Flask / Node.js web app to control IoT devices remotely via cloud APIs.
- Build a simple Android app to visualize IoT data.
- Implement alert notifications using Twilio or AWS SNS based on sensor thresholds.
- Deploy the IoT control application on a cloud server.

IOT SECURITY AND PRIVACY IMPLEMENTATION 20 Hours

- Configure TLS/SSL certificates for device authentication.
- Implement role-based access control for IoT devices in IBM Watson IoT.
- Encrypt sensor data using AES/RSA before transmission.
- Detect and prevent replay or spoofing attacks using secure timestamps and tokens.

EDGE - CLOUD INTEGRATION AND OPTIMIZATION 10 Hours

- Set up an edge gateway using Raspberry Pi for pre-processing and local decision-making.
- Use AWS Greengrass or Azure IoT Edge for cloud-managed edge computing.

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- Compare latency, bandwidth usage, and energy consumption of edge vs. direct cloud upload.
- Implement message filtering and compression at edge level before cloud upload.

CAPSTONE CLOUD - AI - SECURITY PROJECT **10 Hours**

Example:

- Smart Energy Management System with Cloud AI Prediction
- Intelligent Waste Segregation System with Cloud Analytics Dashboard
- Secure Smart Agriculture System using IoT Edge and Blockchain
- Cloud-Based Air Quality Monitoring with ML-Driven Alerts
- Smart Vehicle Tracking System with Encrypted Cloud Logging

Theory: 0	Tutorial: 0	Practical: 90	Project: 0	Total: 90 Hours

REFERENCES:

1. Bahga, A., & Madisetti, V. (2015). Internet of Things: A Hands-on Approach. Universities Press, 1st Edition. ISBN: 978-8173719547.
2. Anand, R., Juneja, S., Juneja, A., Jain, V., & Kannan, R. (Eds.). (2023). Integration of IoT with Cloud Computing for Smart Applications. 1st ed., Chapman & Hall/CRC. ISBN: 978-1032333434.
3. Mohanty, S. N., Chatterjee, J. M., Mangla, M., Satpathy, S., & Potluri, S. (Eds.). (2021). Machine Learning Approach for Cloud Data Analytics in IoT. 1st ed., Wiley-Scrivener. ISBN: 978-1119785804.

ONLINE COURSES:

1. Internet of Things and AI Cloud Specialization (University of California, Irvine) - https://www.coursera.org/specializations/internet-of-things
2. Developing Secure IoT Applications https://www.coursera.org/learn/developing-secure-iot-applications? (EDUCBA)
3. Programming with Cloud IoT Platforms - https://www.coursera.org/learn/cloud-iot-platform (Pohang University of Science and Technology(POSTECH))

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Specialization Track: Cyber Security

U18CSE0223 ETHICAL HACKING AND NETWORK DEFENCE

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Illustrate the legal and ethical requirements related to ethical hacking (K3)

CO2: Interpret the vulnerabilities, mechanisms to identify vulnerabilities, threats, attacks (K3)

CO3: Perform penetration & security testing to identify the vulnerabilities in the application (K4)

CO4: Examine the different tools and techniques that ethical hackers employ (K4)

Pre-requisite: U18ITI4204- Computer Networks

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O 2**	**PS O 3**
CO1	S	M											M		M
CO2	S	M			M	M	M								
CO3	S	M			M	M	M	M							
CO4	S	M			M										M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

ETHICAL HACKING OVERVIEW & VULNERABILITIES (6 Hours)

Understanding the importance of security, Concept of ethical hacking and essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking.

FOOTPRINTING & PORT SCANNING (6 Hours)

Foot printing - Introduction to foot printing, Understanding the information gathering methodology of the hackers, tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, enumerating windows OS & Linux OS

SYSTEM HACKING (6 Hours)

Aspect of remote password guessing, Role of eavesdropping, Various methods of password cracking, Keystroke Loggers, Understanding Sniffers, Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing. Side-channel Attacks on Cryptographic Hardware: Basic Idea, Current-measurement based Side-channel Attacks. Hardware Trojans: Hardware

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Trojan Nomenclature and Operating Modes, Countermeasures Such as Design and Manufacturing Techniques to Prevent/Detect Hardware Trojans.

HACKING WEB SERVICES & SESSION HIJACKING (6 Hours)

Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools

HACKING WIRELESS NETWORKS (6 Hours)

Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing Wireless Networks

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

SAMPLE LAB EXPERIMENTS:
1. Working with Trojans, Backdoors
2. Foot Printing & port scanning
3. Password guessing and Password Cracking.
4. Understanding Data Packet Sniffers
5. Implement the SQL injection attack.
6. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
7. Wireless and mobile hacking and security

REFERENCES

1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2013
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2016
3. Rajat Khare, "Network Seuciryt and Ethical Hacking", Luniver Press, 2006
4. Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner’s Guide (3rd ed.). Packt Publishing, 2011
5. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003
6. Debdeep Mukhopadhyay and Rajat Subhra Chakraborty, "Hardware Security: Design, Threats, and Safeguards", CRC Press, 2015

ONLINE LEARNING MATERIALS
1. https://www.coursera.org/learn/ethical-hacking-essentials-ehe

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U18CSE0024 **CYBER ETHICS AND LAWS**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Demonstrate a comprehensive understanding of electronic business models, including e-commerce, mobile commerce and its legal issues (K3)

CO2: Interpret Cyber Ethics and its significance in the context of technology and information systems. (K3)

CO3: Develop a solid foundation in the principles and concepts of cyber laws (K3)

CO4: Illustrate information Technology act and legislation addressing cybercrime, including laws pertaining to unauthorized access, hacking, identity theft, and online fraud station. (K3)

Pre-requisite: Nil

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M														
CO2	M					M									M
CO3	M														
CO4	M					M									M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

ELECTRONIC BUSINESS AND LEGAL ISSUES **9 Hours**

Evolution and development in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C, E security. Business, taxation, electronic payments, supply chain, EDI,E-markets, Emerging Trends.

CYBER ETHICS **9 Hours**

The Importance of Cyber Law, Significance of cyber-Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

INTRODUCTION TO CYBER LAW **9 Hours**

Evolution of computer Technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace- eb space, Web hosting and web

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Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access

INFORMATION TECHNOLOGY ACT **9 Hours**

Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

CYBER LAW AND RELATED LEGISLATION **9 Hours**

Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet,Alternative Dispute Resolution , Online Dispute Resolution (ODR).

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Cyber Laws: Intellectual property & E Commerce, Security- Kumar K, dominant Publisher, 2011
2. Cyber Ethics 4.0, Christoph Stuckelberger, Pavan Duggal, by Globethics, 2018.
3. Information Security policy & Implementation Issues, PHI, 2003.
4. Legal Dimensions of Cyber Space, Verma S, K, Mittal Raman, Indian Law Institute, New Delhi, 2004.
5. Cyber Law- The law of Internet, Jonthan Rosenoer, Springer, 2011.
6. The right to Information Act 2005, S. R. Bhansali, Sudhir Naib, OUP India, 2011.
7. Cyber Crimes and Law Enforcement, Vasu Deva, Commonwealth Publishers, New Delhi, 2017.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/videos/business-of-cybersecurity-capstone/ OxfpG?query= CYBER+LAWS+AND+ETHICS
2. https://www.coursera.org/learn/business-of-cybersecurity-capstone/
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/-security-principles

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U18CSE0225 SECURE SOFTWARE DEVELOPMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Demonstrate various vulnerabilities related to memory attacks. (K3)
CO2: Apply security principles in software development. (K3)
CO3: Evaluate the extent of risks. (K3)
CO4: Apply security principles in the testing phase of software development. (K3)
CO5: Use tools for securing software. (K3)

Pre-requisite: U18ITI4204- Computer Networks

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M											M		
CO2	S	M			M								M		M
CO3	S	M			M										
CO4	S	M			M								M		M
CO5	S				S										

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS (6 Hours)

Introduction - Software Assurance and Software Security –Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Secure SDLC- Memory-Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

SECURE SOFTWARE DESIGN (7 Hours)

Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

SECURITY RISK MANAGEMENT (5 Hours)

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

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SECURITY TESTING **(8 Hours)**
Traditional Software Testing – Comparison - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

SECURE PROJECT MANAGEMENT **(4 Hours)**
Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

SAMPLE LAB EXPERIMENTS:
1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, then
5. initiate XSS and SQL injection attacks using tools like Kali Linux.
6. Develop and test the secure test cases
7. Penetration test using kali Linux

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

REFERENCES:

1. Julia H. Allen, “Software Security Engineering”, Pearson Education, 2009
2. Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006
4. Robert C. Seacord, “Secure Coding in C and C++ (SEI Series in Software Engineering)”, Addison-Wesley Professional, 2005.
5. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.
6. Mike Shema, “Hacking Web Apps: Detecting and Preventing Web Application Security Problems”, First edition, Syngress Publishing, 2012
7. Bryan Sullivan and Vincent Liu, “Web Application Security, A Beginner's Guide”, Kindle Edition, McGraw Hill, 2012
8. Lee Allen, “Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)”, Kindle Edition, Packt Publishing,2012.

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U18CSE0226 **NETWORK SECURITY ADMINISTRATION**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Identify types of security attacks, services and mechanisms (K3)

CO2: Interpret the implementation of Internetwork security model and its standards (K3)

CO3: Illustrate Email privacy system and compare Pretty Good Privacy (PGP) and S/MIME (K3)

CO4: Interpret the primary components of a Three-Tier Architecture and explain how they work together firewall environment. (K3)

CO5: Explain how communication is secured and how traffic is routed in firewall environment (K3)

Pre-requisite: U18ITI4204 - Computer Networks

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	S			S										M
CO2	S	M	M												
CO3	S	M													M
CO4	S	S			S										
CO5	S	M			S										M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

NETWORK SECURITY BASICS **6 Hours**

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

NETWORK SECURITY ALGORITHM **6 Hours**

Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC

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EMAIL SECURITY **6 Hours**

Email privacy: Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

NETWORK SECURITY MANAGEMENT **6 Hours**

Deploying Smart Console - Security Management Server - Security Gateway - Configuring Objects in Smart Console-Establishing Secure Internal Communication - Managing Administrator Access - Managing Licenses - Creating a Security Policy -Configuring Order Layers.

NETWORK SECURITY CONFIGURATION **6 Hours**

Configuring a Shared Inline Layer - Configuring NAT - Integrating Security with a Unified Policy - Elevating Security with Autonomous -Threat Prevention - Configuring a Locally Managed Site-to-Site VPN - Elevating Traffic View - Monitoring System States - Maintaining the Security Environment.

SAMPLE LAB EXPERIMENT:

1. Deploying Smart Console
2. Installing a Security Management Server and Security Gateway
3. Managing Administrator Access
4. Configuring Objects in Smart Console
5. Creating a Security Policy
6. Configuring NAT
7. Integrating Security with a Unified Policy
8. Elevating Security with Autonomous Threat Prevention
9. Configuring a Locally Managed Site-to-Site VPN
10. Elevating Traffic View
11. Monitoring System States and Maintaining the Security Environment

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education 2018.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W.Manzuik and Ryan Permeh, Wiley Dreamtech Published by Syngress, 2002
3. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning, 2010
4. Network Security - Private Communication in a Public World by Charlien Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI 2002
5. Cryptography and network Security, Third edition, Stallings, PHI/Pearson 4. Principles of Information Security, Whitman, Cengage Learning, 2006

ONLINE LEARNING MATERIALS

1. https://www.checkpoint.com/mind/secureacademy#

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U18CSE0227 DIGITAL FORENSICS

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Illustrate the digital forensics process and digital evidence acquisition. (K3)
CO2: Explain file systems and data recovery procedures. (K3)
CO3: Demonstrate computer, network and mobile forensics with specialized tools. (K3)
CO4: Analyze malware and report the relevant incident. (K3)
CO5: Utilize the forensics toolkit for efficient investigation and understand the legal aspects of digital forensics. (K3)

Pre-requisite: U18ITI4204 - Computer Networks

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	M	M			M										
CO2	M	M													
CO3	M	M			M										M
CO4	M	M		M	M										
CO5	M				M										M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

OVERVIEW OF DIGITAL FORENSICS (6 Hours)

Understanding the role of digital forensics in investigations. Legal and Ethical Considerations: Adhering to legal and ethical standards in digital investigations. Digital Forensics Process: Introduction to the forensic investigation process.

Digital Evidence Acquisition: Types of Digital Evidence: Identifying and classifying digital evidence. Evidence Acquisition Tools: Using tools for acquiring data from different devices. Forensic Imaging: Creating forensic images of storage media

FILE SYSTEMS AND DATA RECOVERY (6 Hours)

File System Analysis: Understanding file systems and their structures. Deleted File Recovery: Techniques for recovering deleted files. File Carving: Extracting files from unallocated space.

COMPUTER, NETWORK AND MOBILE DEVICE FORENSICS (6 Hours)

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Computer Forensics: Investigating computers for evidence- Network Forensics: Analysing network traffic and logs- Memory Forensics: Examining volatile memory for evidence.
Mobile Device Investigation: Extracting evidence from smartphones and tablets. App and Cloud Forensics: Investigating applications and cloud-based services. Challenges in Mobile Forensics: Addressing unique challenges in mobile investigations.

MALWARE ANALYSIS **(6 Hours)**

Introduction to Malware - Understanding different types of malware- Static and Dynamic Analysis: Analysing malware behaviour and code. Responding to malware incidents- Incident Response and Forensic Tools- Incident Response Planning: Preparing for and responding to security incidents. Introduction to bug bounty – Working of bug bounty - Bug bounty program examples – Setting up bug bounty program.

AUTOMATED FORENSICS **(6 Hours)**

Introduction to popular forensic tools- Automated Forensics: Leveraging automation for efficient investigations-Automated Forensics: Leveraging automation for efficient investigations.
Legal Aspects of Digital Forensics: Expert Witness Role: Preparing for and testifying in court- Digital Forensics Laws and Regulations: Understanding legal frameworks - Case Studies: Analysing legal cases involving digital forensics.

SAMPLE LAB EXPERIMENT:

1. Use Autopsy tools to Identify and classify the digital evidence.
2. Demonstrate the data recovery techniques.
3. Demonstrate the process of analysing the network traffic and logs.
4. Demonstration of extracting the evidence from mobile phone.
5. Analyse the malware behaviour and its code.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. Digital Forensics by André Årnes, Released July 2017,Publisher(s): Wiley, ISBN: 9781119262381.
2. Digital forensics and cybercrime : 10th International EAI Conference, ICDF2C 2018, New Orleans, LA, USA, September 10-12, 2018, Proceedings.
3. Cybercrime and Digital Forensics : An cybercrime And Digital Forensics : An Introduction, 3rd Edition May 2022 by Adam M. Bossler, Kathryn C. Seigfried-Spellar, Thomas J. Holt.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/digital-forensics-concepts
2. https://www.udemy.com/course/ifci-expert-cybercrime-investigators-course/?gad_source=1&gclid=CjwKCAiApuCrBhAuEiwA8VJ6JtQFDivymnmlFeE1agIwADZlrJE8xv8piHikMZLKreNBO9e0AlAL-hoCVbsQAvD_BwE&matchtype=b&utm_campaign=LongTail_la.EN_cc.INDIA&utm_content=deal4584&utm_medium=udemyads&utm_source=adwords&utm_term=_._ag_84769189328_._ad_670210149092_._kw_digital+forensics+course_._de_c_._dm__._pl__._ti_kwd-323936302499_._li_9298970_._pd__._
3. https://www.open.edu/openlearn/science-maths-technology/digital-forensics/content-section-0?active-tab=content-tab
4. https://www.edx.org/learn/computer-forensics/rochester-institute-of-technology-computer-forensics
5. What Is a Bug Bounty? [3 Bug Bounty Program Examples] (hackerone.com)

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U18CSE0533 **DIGITAL EVIDENCE AND CYBER INVESTIGATION**

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- Gain knowledge on digital investigation lifecycle, emphasizing evidence handling, documentation and use of forensic methodologies for identifying and analyzing digital incidents.
- Impart practical skills in forensic data acquisition, imaging, and verification from diverse storage media and file systems while maintaining evidence integrity.
- Ability to extract, analyze, and interpret operating system artifacts from Windows and Linux environments for reconstructing user activities and identifying system misuse.
- Enable students to perform malware analysis through static and dynamic techniques, identify Indicators of Compromise (IOCs), and document forensic findings effectively.
- Develop proficiency in reverse engineering tools, disassembly, and threat intelligence to classify and counteract malware.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Apply forensic methodologies to perform a basic digital investigation on a simulated crime scene. (K3)

CO2: Construct a forensic report summarizing acquired data, integrity verification and recovery process. (K4)

CO3: Examine an automated script or workflow for extraction and correlation of operating system artifacts. (K4)

CO4: Analyze network traffic patterns to identify intrusion attempts, data exfiltration or malware communication. (K4)

CO5: Analyze malware behavior by monitoring system, file and network activities during execution.(K4)

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes(POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1				M								
CO2					S							
CO3			M		S							
CO4					S							
CO5					S							

COURSE ASSESSMENT METHODS:

DIRECT
1. Online Course Certification

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2. Multiple Choice Questions 3. Lab Continuous Evaluation
INDIRECT
1. Reflective Essays or Journals

PRACTICAL COMPONENTS:

DIGITAL FORENSICS AND INVESTIGATION PROCESS **18 Hours**

- Analysis of Browser History, Cache & Cookies + Event Log.
- Demonstrate write-blocker tools and their use during data acquisition.
- Simulate a digital crime scene and document the investigation steps.
- Analyze USB device usage and related artifacts from a system.

DATA ACQUISITION FROM FILE SYSTEM **18 Hours**

- Modify the Windows Registry to prevent data from being written to a USB storage device.
- Identify the file systems of forensic images with fsstat, which is included with The Sleuth Kit.
- Recovering Files from Forensic Images with FTK Imager.
- Organize the Registry files and focus on them rather than performing a physical acquisition of a multi-terabyte drive.

OPERATING SYSTEM FORENSICS **18 Hours**

- Demonstrate privilege escalation vulnerabilities and mitigation.
- Demonstrate patch management - apply and verify system updates in a secure test environment.
- Create and analyze OS security baselines using tools like CIS-CAT or Microsoft Security Compliance Toolkit.

NETWORK FORENSICS **18 Hours**

- Examine packets to identify signs of ARP spoofing or MITM (Man-in-the-Middle) attacks.
- Examine captured SMTP/POP3 traffic to retrieve message contents and attachments.
- Analyze IDS alerts and verify attack patterns in the captured network data.
- Demonstrate procedures for network evidence acquisition, preservation, and chain of custody.

MALWARE FORENSICS **18 Hours**

- Detect and remove malware using OS-level tools (Windows Defender, ClamAV).
- Examine malware strings and metadata using tools such as strings, PEview, or Resource Hacker.

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Theory: 0	Tutorial: 0	Practical: 90	Project: 0	Total: 90 Hours

REFERENCES:

1. Joakim Kävrestad, Marcus Birath & Nathan Clarke, Fundamentals of Digital Forensics, Springer, 3rd Edition, 2024.
2. Brian Carrier, File System Forensic Analysis, Addison-Wesley Professional, 1st Edition, 2005.
3. Ric Messier, Operating System Forensics, Syngress, 1st Edition, 2015. Elsevier Shop.
4. Sherri Davidoff & Jonathan Ham, Network Forensics: Tracking Hackers Through Cyberspace, Pearson, 1st Edition, 2012.
5. Devangi Patel, Meghna Patel & Satyen M. Parikh, Dark Web Forensics, Chapman & Hall/CRC, 1st Edition, 2024.
6. Michael Sikorski & Andrew Honig, Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software, No Starch Press, 1st Edition, 2012

ONLINE COURSES:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/digital-forensics-essentials-dfe
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/packt-digital-forensics-for-pentesters-hands-on-learning-f4gfm?source=search
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/ibm-incident-response-digital-forensics?source=search
4. https://www.coursera.org/specializations/computerforensics

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Specialization Track: Automation and Artificial Intelligence

U18AIE0211 **COMPUTER VISION**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Apply the fundamentals of computer vision to the formation and transformation of images [K3]

CO2: Apply feature extraction Techniques in image and segmentation [K3]

CO3: Ability to perform smoothing and image equalization [K4]

CO4: Compare various projection and object recognition methods [K4]

CO5: Evaluate performance of computer vision algorithms in various applications[K4]

Pre–requisite: U18MAI1201/Linear Algebra and Calculus, U18MAT3102/Discrete Mathematics

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S										S		
CO2		S		S	S										
CO3				S				M				M			
CO4	S		M										S		
CO5			S					S		M			S		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION **6 Hours**

Image Processing, Computer Vision - Low-level, Mid-level, High-level, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

FEATURE EXTRACTION AND FEATURE SEGMENTATION **6 Hours**

Feature Extraction -Edges - Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and

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DWT. Image Segmentation -Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation.

IMAGES, HISTOGRAMS, BINARY VISION **6 Hours**

Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing – 1D and 3D histograms - Histogram/Image Equalisation - Histogram Comparison - Back-projection - k-means Clustering.

3D VISION AND MOTION **6 Hours**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion–spline-based motion-optical flow – layered motion.

APPLICATIONS **6 Hours**

Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Virtual Reality and Augmented Reality-Pretrained models- VGG-16- ResNet50.

LAB COMPONENT

Sample List of Experiments:

1. Detect the RGB color from a webcam using Python – OpenCV
2. Face Detection using Python and OpenCV with a webcam
3. Face and Hand Landmarks Detection using Python – Media pipe, OpenCV
4. Real-Time Edge Detection using OpenCV
5. Implement Canny Edge Detector in Python using OpenCV
6. Gun Detection using Python-OpenCV
7. Real-time object color detection using OpenCV

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hour**

REFERENCES

1. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education.2 nd Edition ,2015.
2. Joseph Howse , Joe Minichino " Learning OpenCV 4 Computer Vision with Python 3: Get to grips with tools, techniques, and algorithms for computer vision and machine learning, Packt Publishing Limited 3rd Edition , 2020.
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011.
4. Sonka M, Hlavac V, Boyle R, Image processing, analysis, and machine vision, Cengage Learning; 2014.

ONLINE LEARNING MATERIALS

1. https://archive.nptel.ac.in/courses/106/105/106105216/
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/introduction-computer-vision-watson-opencv

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L	T	P	J	C
2	0	2	0	3

U18AIE0212 INTELLIGENT AUTOMATION SYSTEM

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Analyze and articulate the benefits of implementing automation in production systems [K4]

CO2: Identify industries best-suited for RPA adoption and evaluate case studies showcasing successful RPA implementations [K4]

CO3: Develop automation solutions with practical examples using Sequence and Flowchart activities [K3]

CO4: Implement best practices in recording and selector strategies to optimize automation workflows [K3]

Pre–requisite: U18MAI1201/Linear Algebra and Calculus, U18MAT3102/Discrete Mathematics

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	S	M	S			M	M				M	S		S
CO2	M	S	M	S	M		M	M				M	S		S
CO3	S	M	S	M								M			
CO4	S	M	S	M								M			

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

INTRODUCTION TO AUTOMATION 7 Hours

Automation in production system-Automation principles and strategies-Basic elements of an automated system-advanced automation Functions-levels of Automation-Hardware components for automation-sensors and actuators- Benefits of Automation -Limitations to Automation.

RPA AND ITS PLATFORMS 7 Hours

Introduction to Robotic Process Automation- Benefits of RPA- Overview of Industries Best-Suited for RPA- Advancements in RPA and Its Integration with AI. Components of RPA- RPA Platforms-About Ui Path- The future of automation.

WORKFLOW AND CONTROL FLOW 8 Hours

Sequencing the workflow Activities-Control flow, various types of loops, and decision-making using Sequence and Flowchart-Data Manipulation-Variables and Scope Collections-Arguments -Data table usage with examples -Clipboard Management-File operation mouse and keyboard activities- Working with UiExplorer- Handling events- Screen Scraping.

RECORDERS, SELECTORS **8 Hours**

UiPath Studio Recording -Recorder Overview-Components of Recording Wizard-Comparison of Recording Types-Automatic Recording Activities-Manual Recording activities -Basic Recorder-Desktop Recorder-Web Recorder-Selector-Selector Editor-Selectors with wild cards-UI Explorer in Selector-UI Explorer Window-Full Selectors and Partial Selectors-Errors, Exception and Debugging.

LAB CONTENTS

Sample list of Experiments:

1. Study on UI path Tool
2. Recording Modes
3. Notepad/Word Automation
4. Screen Scrapping Techniques to extract text from Images/Web/Document
5. YouTube Search Engine-BMI Calculator Robot-Excel Automation Basics
6. Fees Concession Robot
7. PDF Automation
8. Invoice Automation Robot
9. Exception Handling / Running Multiple Robots
10. Data Scrapping (Web) with AI Techniques in UiPath
11. Gmail Automation Robot
12. Orchestrator - UiPath Dashboard

Theory: 30	**Tutorial:0**	**Practical: 30**	**Project :0**	**Total:60 Hours**

REFERENCES

1. M.P.Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, 4th edition, Pearson Education, 2016.
2. Tom Taulli, The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher : A press,
3. Frank Casale, Rebecca Dilla, Heidi Jaynes ,Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation.2015.
4. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant,2018.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/specializations/roboticprocessautomation
2. https://www.coursera.org/professional-certificates/google-it-automation.

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L	T	P	J	C
2	0	2	0	3

U18AIE0214 GENERATIVE AI

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Acquire insights into the key technological trends driving generative AI models [K3]

CO2: Acquire the ability to apply effective prompt engineering techniques to enhance the performance and control the behaviour of generative AI models [K4]

CO3: Build, train and apply generative models and develop familiarity with platforms [K4]

CO4: Ability to comprehend ethical issues and limitations of generative AI models[K3]

Pre–requisite: U18MAI1201/Linear Algebra and Calculus, U18MAT3102/Discrete Mathematics

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	M	M							M			M			
CO2		S	S	M	S	M	S	S	M	M	S	M	S	M	M
CO3			S	M	S	M	S	S	M	M	S	M	S	M	M
CO4				M		M	S	S	M			M			M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

INTRODUCTION TO GENERATIVE AI **5 Hours**

Capabilities - History and Evolution -Benefits- Challenges - Applications of Generative AI – Tools for Text, Image Code, Audio and Video generation– Economic Potential of Generative AI - Use cases

PROMPT ENGINEERING TECHNIQUES AND APPROACHES **6 Hours**

Prompt Creation -Writing effective prompts -Techniques for using text prompts: Zero shot and few-shot prompt techniques – Prompt engineering approaches: Interview pattern, Chain-of Thought, Tree-of Thought - Benefits of using text prompts - Challenges in generating meaningful and coherent prompts.

MODELS FOR GENERATIVE AI **7 Hours**

Basics of Sequential data processing – Building blocks of Generative AI - Discriminative modelling – Generative modelling –Recurrent Neural Networks – Long Short-Term Memory (LSTM) Networks - Generative Adversarial Networks (GANs) - Variational Autoencoders (VAEs) – Transformer–based Models - Diffusion models- Applications

PLATFORMS FOR GENERATIVE AI **7 Hours**

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Introduction to Platforms – Features of platforms – Capabilities -Applications - Pre-trained Models - Challenges – Generation of Text to Text – Generation of Text to Image – Text to Code Generation – Explainable AI – Benefits – Use cases.

ETHICAL ISSUES AND LIMITATIONS OF GENERATIVE AI **5 Hours**

Limitations of Generative AI – Issues and concerns – Considerations for Responsible Generative AI – Economic Implications – Social Implications – Future and professional Growth of Generative AI.

LAB COMPONENT

Sample List of Experiments:

1. Generate text using Generative AI
2. Text Generation using ChatGPT and Bard
3. Image Generation using GPT and Stable Diffusion
4. Code Generation
5. Experimenting with Prompts
6. Approaches in Prompt Engineering
    - Chain-of-Thought Approach
    - Interview Pattern Approach
    - Tree-of-Thought Approach
7. Effective Text Prompts for Image Generation
8. Develop AI Applications with the Foundation Models
9. Develop AI Applications for Code Generation

Theory: 30	**Tutorial:0**	**Practical: 30**	**Project :0**	**Total:60 Hours**

REFERENCES

1. Deep Learning: Teaching Machines to Paint, Write, Compose and Play, David Foster, 2023. 2nd edition. O'Reilly Media, Inc.
2. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.
3. Hands-on Generative Adversarial Networks with Keras, Rafael Valle. Packt Publisher, 2019

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/generative-ai-introduction-and-applications?specialization=generative-ai-for-everyone
2. https://www.coursera.org/learn/generative-ai-prompt-engineering-for-everyone?specialization=generative-ai-for-everyone
3. https://www.coursera.org/learn/generative-ai-foundation-models-and-platforms?specialization=generative-ai-for-everyone
4. https://www.coursera.org/learn/generative-ai-ethical-considerations-and-implications?specialization=generative-ai-for-everyone

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U18AIE0015	**RESPONSIBLE AI**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Comprehend the fundamental concepts of AI, recognize ethical considerations, and analyze biases and limitations through real-world case studies. [K3]

CO2: Apply ethical theories and principles to implement responsible AI practices, emphasizing accountability, responsibility, and transparency.[K3]

CO3: Evaluate the importance of interpretability, categorize methods, and apply them to models, ensuring effective communication of results [K3]

CO4: Attain a comprehensive understanding of data privacy principles, employ effective privacy-preserving techniques in AI applications, and critically assess real-world instances emphasizing the equilibrium between privacy and utility[K4]

CO5: Assess ethical reasoning approaches, design moral agents, and implement ethical deliberation, governance, and inclusion for responsible AI practices [K4]

Pre–requisite: U18MAI1201/Linear Algebra and Calculus, U18MAT3102/Discrete Mathematics

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	S	M	M	M	S		S		S		S	S	S	S
CO2	S	S	M	M	M	S		S		S		S	S	S	S
CO3	S	S	M	M	M	S		S		S		S	S	S	S
CO4	S	S	M	M	M	S		S		S		S	S	S	S
CO5	S	S	M	M	M	S		S		S		S	S	S	S

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Assignment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

INTRODUCTION **11 Hours**

Autonomy – Adaptability – Interaction – Need for Ethics in AI - Fairness and Bias: Sources of Biases – Exploratory data analysis, limitations of a dataset – Group fairness and individual fairness – Counterfactual fairness - AI harms – AI risks: Case Study

ETHICAL DECISION MAKING **8 Hours**

Seven Principles of Responsible AI - Ethical theories – Values - Ethics in practice – Implementing Ethical Reasoning – The ART of AI: Accountability, Responsibility, Transparency

INTERPRETABILITY AND EXPLAINABILITY **10 Hours**

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Importance of Interpretability – Taxonomy of Interpretability Methods – Scope of Interpretability – Evaluation of Interpretability – Interpretable Models: Linear Regression – Logistic Regression – Decision Tree.

PRIVACY PRESERVATION **8 Hours**

Introduction to data privacy - Methods of protecting data - Importance of balancing data privacy and utility - Attack model – Privacy Preserving Learning - Differential Privacy – Federated Learning – Case Study.

ENSURING RESPONSIBLE AI **8 Hours**

Approaches to Ethical Reasoning by AI – Designing Artificial Moral Agents – Implementing Ethical Deliberation – Levels of Ethical Behaviour – The ethical status of AI system – Governance for Responsible AI – Codes of Conduct – Inclusion and Diversity

Theory: 45	Tutorial:0	Practical: 0	Project :0	Total:45 Hours

REFERENCES

1. Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way" Springer Nature, 2019.
2. Christoph Molnar "Interpretable Machine Learning" Lulu, 1st edition, 2019.
3. Beena Ammanath, "Trustworthy AI", Wiley, 2022.
4. Adnan Masood, Heather Dawe, Dr. Ehsan Adeli, "Responsible AI in the Enterprise", Packt Publishing, 2023.

ONLINE LEARNING MATERIAL

1. https://www.coursera.org/programs/coursera-for-campus-faculty ovg1y/learn/introduction-to-responsible-ai?source=search.
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/responsible-ai-in-generative-ai?source=search

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U18AIE0227 **INTRODUCTION TO LARGE LANGUAGE MODELS**

L	T	P	J	C
2	0	2	0	3

COURSE OBJECTIVES:

- Understand the basic ideas of NLP and deep learning and how they are used to process language.
- Learn how words, sequences, and transformer models are represented and built.
- Apply prompting and retrieval methods to improve the performance of language models.
- Explore knowledge graphs, simple model-tuning methods, and ways to interpret LLMs.
- Recognize the uses, challenges, ethics, and future trends of modern NLP and language models.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to

CO1: Understand foundational NLP and deep learning concepts to analyze and process text data using basic neural models. [K2]

CO2: Implement word representations, sequence models, and transformer-based architectures for various NLP tasks. [K3]

CO3: Apply prompting, instruction tuning, and retrieval-augmented generation techniques to enhance LLM performance. [K3]

CO4: Apply knowledge graph methods, parameter-efficient adaptation techniques, and model interpretability tools to improve and analyze LLMs. [K3]

CO5: Analyze NLP and LLM systems in terms of applications, limitations, ethical considerations, and emerging technological trends. [K4]

Pre-requisite courses: Not applicable

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes (POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	S	M										
CO2	S	S	M	M								
CO3	M	S	S						M			
CO4	S	M	M	M					M			
CO5	M				S							

Course Assessment methods:

DIRECT

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1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test, Cooperative Learning Report, Assignment
3. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
4. Model Examination (lab component)
5. End Semester Examination (Theory and lab components)
INDIRECT
1. Course-end survey

THEORY COMPONENTS:

FOUNDATIONS OF NLP AND DEEP LEARNING **6 Hours**

Introduction to NLP - NLP Pipeline – Applications of NLP – Introduction to Statistical Language Models – Statistical Language Models: Advanced Smoothing and Evaluation – Introduction to Deep Learning - Perceptron – ANN – Backpropagation – CNN – Introduction to PyTorch

WORD REPRESENTATIONS AND NEURAL LANGUAGE MODELS **6 Hours**

Word Representation– Tokenization Strategies – Neural Language Models – Sequence-to-Sequence Models – Greedy and Beam Search – Decoding Strategies – Attention in Seq2Seq Models – Introduction to Transformers - Self and Multi-Head Attention – Positional Encoding – Layer Normalization –

PROMPTING, AND RETRIEVAL-AUGMENTED GENERATION **6 Hours**

Pre-Training Strategies – Introduction to HuggingFace – Instruction Tuning – Prompt-based Learning – Advanced Prompting Techniques and Prompt Sensitivity – Alignment of Language Models with Human Feedback (RLHF) – Open-book Question Answering – Retrieval-Augmented Inference and Generation – Retrieval Augmentation Techniques - Key-value Memory Networks – HotPotQA Solvers – Pointer Networks – REALM – RAG – FiD – Unlimiformer – KGQA including EmbedKGQA and GrailQA

ADAPTATION, AND ETHICS IN LLMS **6 Hours**

Knowledge Graphs - Representation – Completion – Alignment – Isomorphism – Graph Neural Networks vs. Neural KG Inference – Parameter-efficient Adaptation - Prompt Tuning – Prefix Tuning – LoRA – Residual Stream Perspective of Transformers – Interpretability Techniques – Overview of Recent Models - GPT-4 – Llama-3 – Claude-3 – Mistral – Gemini – Ethical NLP

APPLICATIONS & FUTURE DIRECTIONS IN LLMS **6 Hours**

Quantum-safe NLP Concepts – Cross-domain NLP Applications – Role of LLMs in Healthcare, Education, Finance – Large-Scale NLP Deployment Challenges – Trends

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in Multimodal LLMs – Open- source vs Proprietary LLM Landscape – Future Research Directions in NLP and LLMs

Theory: 30 **Tutorial: 0** **Total: 60 Hours**

LAB EXPERIMENTS:

1. Text Cleaning, Tokenization, and NLP Pipeline Implementation
2. Word Embedding Generation Using Word2Vec and GloVe
3. Building a Sequence-to-Sequence Model with Attention for Machine Translation
4. Prompt-based Learning Using Zero-shot, One-shot, and Few-shot Prompting
5. Implementation of a Retrieval-Augmented Generation (RAG) Pipeline
6. Parameter-Efficient Fine-Tuning Using LoRA for Downstream NLP Tasks

Practical: 30 **Tutorial:0** **Total: 30 Hours**

REFERENCES:

1. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O’Reilly Media, 2022.
2. Palash Goyal, Sumit Pandey, and Karan Jain, Deep Learning for Natural Language Processing, Apress, 2018.
3. Denis Rothman, Transformers for Natural Language Processing, 2nd Edition, Packt Publishing, 2022.
4. Sebastian Raschka and Vahid Mirjalili, Machine Learning with PyTorch and Scikit-Learn, Packt Publishing, 2022.
5. Delip Rao and Brian McMahan, Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning, O’Reilly Media, 2019.

ONLINE COURSES:

1. https://onlinecourses.nptel.ac.in/noc25_cs45/preview
2. https://www.coursera.org/learn/introduction-to-large-language-models

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U18AIE0528 **AI AND ML INFRASTRUCTURE ENGINEERING**

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- Set up basic AI/ML environments in Azure and manage data pipelines and model deployments.
- Build and test machine learning and deep learning models using real-world datasets.
- Create simple troubleshooting agents by fine-tuning LLMs and adding NLP components.
- Apply MLOps practices to automate model training, deployment, and monitoring.
- Develop advanced and responsible AI systems using techniques like transfer learning, federated learning, and explainable AI.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Understand the components and workflows of AI/ML infrastructure including data pipelines, frameworks, and deployment environments. [K2]

CO2: Implement various machine learning and deep learning algorithms using suitable metrics and architecture. [K3]

CO3: Design intelligent troubleshooting agents using LLM fine-tuning, NLP techniques, and multi-agent systems. [K3]

CO4: Develop AI/ML solutions using Microsoft Azure with automated deployment, monitoring, and troubleshooting capabilities. [K3]

CO5: Analyze advanced ML architectures and apply ethical, explainable, and responsible AI principles in end-to-end system design. [K4]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes (POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	S				S							
CO2	S		S		S							
CO3	S	S							M			
CO4	S				M						M	
CO5	S		S			S		S				

COURSE ASSESSMENT METHODS:

DIRECT
1. Project 2. Project presentation/Report 3. Lab Assignments,

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4. Demo presentations, 5. Quiz/peer review(optional)
INDIRECT
1. Course-end survey

PRACTICAL COMPONENTS:

AZURE AI/ML INFRASTRUCTURE LAB **16 Hours**

- Set up and manage the AI/ML workspace and resources in Microsoft Azure.
- Develop and automate data pipelines for model training and deployment.
- Apply version control and security measures for reliable, reproducible workflows.

Lab tasks:

- Create and connect an Azure ML workspace with an automated data pipeline for model training.
- Deploy and secure a machine learning model ensuring reproducibility and version control.

MACHINE LEARNING & DEEP LEARNING LAB **18 Hours**

- Implement and compare supervised, unsupervised, and deep learning algorithms using real-world datasets.
- Apply model evaluation and optimization techniques such as cross-validation and feature selection.
- Deploy and interpret AI/ML models following ethical and engineering best practices.

Lab tasks:

- Build and evaluate multiple ML and DL models (e.g., Decision Trees, K-Means, Neural Networks) using a selected dataset.
- Optimize and interpret model performance using cross-validation and key evaluation metrics.

INTELLIGENT TROUBLESHOOTING AGENT LAB **20 Hours**

- Fine-tune language models (LLMs) using techniques such as LoRA or QLoRA for domain-specific troubleshooting tasks.
- Design and develop intelligent agents using NLP techniques and decision-making architectures.
- Evaluate and optimize agent performance using relevant metrics and automated testing.

Lab tasks:

- Fine-tune an LLM and integrate NLP modules (intent detection, sentiment analysis) into a troubleshooting agent.
- Test, optimize, and document the agent’s performance for automated support scenarios

AI/ML OPERATIONS AND AUTOMATION LAB **20 Hours**

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- Configure and manage Azure Machine Learning workspaces, data storage, and automated pipelines.
- Implement CI/CD workflows, authentication, and monitoring for AI/ML model deployment.
- Apply troubleshooting and diagnostic tools to ensure reliable and scalable ML operations.

Lab tasks:

- Create an automated ML pipeline in Azure with data ingestion, training, and deployment.
- Implement monitoring and alerting systems, troubleshoot issues, and document performance findings.

ADVANCED AND RESPONSIBLE AI SYSTEMS LAB **16 Hours**

- Implement and compare advanced AI techniques such as transfer learning, federated, and ensemble models.
- Apply responsible and explainable AI methods to ensure ethical and transparent outcomes.
- Develop distributed and privacy-preserving AI systems using differential privacy or data sharding.

Lab tasks:

- Build and evaluate advanced models using techniques like transfer learning, federated, and ensemble approaches.
- Apply XAI and privacy-preserving methods to assess model behavior and document findings in a technical report

Theory: 0	**Tutorial: 0**	**Practical: 90**	**Project: 0**	**Total: 90 Hours**

REFERENCES:

1. Miroslaw Staron, Machine Learning Infrastructure and Best Practices for Software Engineers, O'Reilly Media, 2023.
2. Scott Burk and Kinshuk Dutta, Data for AI: Data Infrastructure for Machine Intelligence, Technics Publications, 2021.
3. Kaushik Thummarakoti, Vamshi Vududala, and Madapati Kaushik, The AI Cloud Infrastructure Blueprint: Practical Designs and Configurations for Scalable AI, Routledge, 2024.
4. Sriram Parthasarathy, MLOps Engineering at Scale: Building Robust, Reliable, and Reproducible Machine Learning Systems, Packt Publishing, 2023.
5. Mark Treveil and Alok Shukla, Introducing MLOps: How to Scale Machine Learning in the Enterprise, O'Reilly Media, 2020.

ONLINE COURSES:

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1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/professional-certificates/microsoft-ai-and-ml-engineering
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/foundations-of-ai-and-machine-learning
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/ai-and-machine-learning-algorithms-and-techniques
4. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/building-intelligent-troubleshooting-agents
5. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/microsoft-azure-for-ai-and-machine-learning
6. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/advanced-ai-and-machine-learning-techniques-and-capstone

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U18AIE0530 **AGENTIC AI**

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- Build basic Generative AI applications using LLMs, prompts, and simple RAG workflows.
- Use vector databases and embedding models to perform similarity search and improve retrieval.
- Create intelligent agents that can call tools, use memory, and solve tasks through reasoning.
- Develop multi-step agent workflows using LangGraph for structured and collaborative tasks.
- Implement multi-agent systems using frameworks like CrewAI or AutoGen, including simple multimodal tasks.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Apply foundational Generative AI techniques to build LLM-based applications. [K3]

CO2: Develop Retrieval-Augmented Generation systems using vector databases and advanced retrievers. [K3]

CO3: Design agentic systems using LangChain agents, tool calling, and multi-step reasoning frameworks. [K3]

CO4: Build stateful, multi-agent RAG and reasoning workflows using LangGraph and other agentic orchestration frameworks. [K3]

CO5: Analyze multimodal reasoning with advanced agentic frameworks to design and justify intelligent end-to-end applications. [K4]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes (POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M		S									W
CO2	S		S	M								W
CO3	S	S	S						M			
CO4	S		S	M					M			
CO5	M	S	M		S							

COURSE ASSESSMENT METHODS:

DIRECT
1. Project 2. Project presentation/Report 3. Lab Assignments 4. Demo presentations 5. Quiz/peer review(optional)

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INDIRECT
1. Course-end survey

PRACTICAL COMPONENTS:

FOUNDATIONS OF GENERATIVE & RAG APPLICATIONS LAB 18 Hours

- Build foundational GenAI applications using LLMs, prompt engineering, and in-context learning.
- Implement Retrieval-Augmented Generation (RAG) workflows using LangChain and LlamaIndex.
- Evaluate retrieval accuracy, context relevance, and hallucination reduction.

Lab tasks:

- Build a document-based RAG chatbot using LangChain with custom embeddings and chunking.
- Create a Gradio interface to test prompt variations, retrieval methods, and LLM responses.

VECTOR DATABASES & ADVANCED RETRIEVERS LAB 18 Hours

- Implement vector databases for similarity search and retrieval optimization.
- Experiment with embedding models, metadata filtering, and hybrid retrieval.
- Apply advanced retrievers such as contextual compression, parent document retrievers etc.

Lab tasks:

- Perform similarity search on text datasets using Chroma DB and evaluate retrieval accuracy.
- Build and compare basic vs. advanced retriever pipelines using LangChain or LlamaIndex.
- Develop a small recommendation system using vector embeddings.

LANGCHAIN AGENTS & TOOL CALLING LAB 20 Hours

- Design and implement agent workflows using LangChain's tool calling, memory, and LCEL chaining.
- Build intelligent agents that interact with external tools (SQL, Python, APIs).
- Evaluate and optimize agent reasoning using ReAct, self-consistency, and structured output.

Lab tasks:

- Build a tool-using Math or Data Analysis Agent that solves queries with live tool execution.
- Develop an LLM-powered SQL Agent and a data visualization agent using LangChain.
- Create a small multi-agent collaborative workflow (planner + executor).

LANGGRAPH & AGENTIC RAG WORKFLOW LAB 20 Hours

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- Implement LangGraph for stateful, multi-step agent workflows and control flows.
- Build ReAct, Reflection, and Reflexion-based agents for reasoning and self-improvement.
- Develop multi-agent RAG pipelines integrating retrievers, knowledge bases, and agent collaboration.

Lab tasks:

- Create an automated ML pipeline in Azure with data ingestion, training, and deployment.
- Implement monitoring and alerting systems, troubleshoot issues, and document performance findings.

ADVANCED MULTI-AGENT SYSTEMS LAB **14 Hours**

- Develop AI systems using advanced agentic frameworks (CrewAI, AutoGen, BeeAI).
- Design orchestration and evaluator–optimizer patterns for complex workflows.
- Integrate multimodal reasoning (text, image, audio) into multi-agent pipelines.

Lab tasks:

- Build a CrewAI multi-agent workflow (e.g., Meal Planner, Research Assistant, or Code Reviewer).
- Create an AutoGen or BeeAI-based multi-agent system using custom tools and structured outputs.
- Develop a multimodal agent that performs image captioning, document inspection, or visual QA.

Theory: 0	**Tutorial: 0**	**Practical: 90**	**Project: 0**	**Total: 90 Hours**

REFERENCES:

1. Srinivasan Venkataraman and Harrison Chase, Building Agentic AI Systems: A Developer’s Guide to LLM Agents, LangChain and LangGraph, O’Reilly Media, 2024.
2. Olivier Blais, Practical GenAI: Building Real-World Generative AI Products with LLMs, RAG, Agents, and Workflows, O’Reilly Media, 2024.
3. Sinan Ozdemir, LLM Engineers’ Handbook: Retrieval-Augmented Generation, Prompting, Agents, and Production AI, Packt Publishing, 2024.
4. Elbert Gale, Mastering AI Agents: From Design to Deployment of Autonomous Systems, January 18, 2025. ISBN-13: 979-8307403822.
5. Natenapis Faraksa, Building AI Agent: A Practical Guide for Building Intelligent Agents, March 2, 2024.
6. Sujai G. Pillai, Build Your Own AI Agent: A Hands-On Guide for Beginners, January 13, 2025. ISBN-13: 979-8306885971.

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ONLINE COURSES:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/professional-certificates/ibm-rag-and-agentic-ai
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/specializations/ai-agents-python

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Specialization Track: Data Science, Analytics and Visualization

U18AIE0217 **DATA PROCESSING TECHNIQUES**

L	T	P	J	C
2	0	2	0	3

Course Objectives:

- Understand how large-scale data is processed using batch, streaming, and incremental methods.
- Use distributed and in-memory techniques to handle data efficiently.
- Apply tools like Hadoop, Kafka, and Spark to process and analyse data.

Course Outcomes:

After successful completion of this course, the students will be able to

CO1: Analyze the data processing concepts in data science. (K4)

CO2: Apply the Real time data processing in machine learning model. (K3)

CO3: Analyze the Data capture Techniques and Strategies in Incremental Processing. (K4)

CO4: Apply the Learning algorithms for incremental processing in data. (K3)

CO5: Analyze the concepts of traditional disk system with In-Memory Database. (K4)

Pre-requisite courses: Not applicable

CO/PO Mapping (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcome (POs)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S				M			S		S	S
CO2	S	S		S								
CO3	S		S									
CO4	S		S									
CO5	S		S									

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product 3. Demonstration etc (as applicable) (Theory component) 4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component) 5. Model Examination (lab component) 6. End Semester Examination (Theory and lab components)
INDIRECT
1. Course-end survey

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Topics covered:

DATA PROCESSING **8 Hrs**

Overview of Data processing in Datascience–Importance of Efficiency and Scalability –, challege in Big Data Processing– Parallel and Distributed Processing – Apache hadoop– Map reduce – Integration of Data mining system with a Data warehouse–Major issues in Data Mining–Data Preprocessing.

REAL TIME DATA PROCESSING **7 Hrs**

Streaming Data Architectures–Message Brokers –Pub/Sub Systems– Queues– Apache-kafka for Real Time Data streaming– Producers-consumers-Kafka connect for Data Integration-stream processing-Frame works-Real Time analytics

INCREMENTAL PROCESSING **7 Hrs**

Incremental processing in Data science–Change Data Capture Techniques (CDC)-Strategies-Delta Processing for incremental updates- Incremental Learning algorithms.

IN- MEMORY PROCESSING **8 Hrs**

Principles of In-Memory Processing-comparisons Of Traditional Disk based systems -In-Memory database and data structures-In-Memory computing in spark-Resilient Distributed datasets (RDD) And Data frames-In-Memory analytics with SAP HANA-Performance Tuning and optimisation.

Theory: 30 Hrs **Tutorial:0** **Total Hours: 30 Hrs**

Lab Experiments:

1. Install and configure Apache Spark standalone mode and a single-node Apache Kafka cluster
2. Implement basic Kafka producers and consumers to send/receive messages from various topics.
3. Perform data transformations and actions on static datasets using Spark DataFrames
4. Develop a Spark Structured Streaming application to consume real-time data from a Kafka topic.
5. Perform real-time aggregations, windowing, and fundamental analytics on the Kafka stream using Spark Structured Streaming.
6. Implement a scenario where Spark processes incremental updates from a Kafka topic (e.g., simulating CDC or log processing).
7. Develop an application using Spark Structured Streaming to consume Kafka data and apply a pre-trained basic MLlib model for real-time predictions or classifications.
8. Use Spark UI to analyze basic job execution plans, identify common bottlenecks, and apply fundamental optimization techniques (e.g., caching, repartitioning). (Optional: Explore basic cloud deployment concepts for Spark/Kafka).

Practical: 30 Hrs **Tutorial:0** **Total Hours: 30 Hrs**

Text Books:

1. Practical Real-time Data Processing and Analytics: Distributed Computing and Event Processing using Apache Spark, Flink, Storm, and Kafka by shilpi Saxena and sharub gupta 1st Edition, Kindle Edition 2017
2. "Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data" by Ralph Kimball and Joe Caserta 1st Edition 2004
3. Building a Scalable Data Warehouse with Data Vault 2.0" by Dan Linstedt 2015
4. High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark by Holden karau,Rachel warren 2017 1st edition

Online Resources:

1. https://www.coursera.org/videos/big-data-integration-processing/zBKt2 query=IN+MEMEORY+DATA+PROCESSING&source=search
2. https://www.coursera.org/videos/machine-learning-accounting-python/j3M5H source=search&source=search&query=data%20preprocessing

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U18AIE0218	DATA MODELING	L	T	P	J	C
		2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Apply MySQL Workbench to design database model(K3)

CO2: Apply logical Data model to design Patterns(K3)

CO3: Design Geospatial data models for applications involving location-based analytics(K6)

CO4: Analyze and choose appropriate NoSQL and NewSQL databases for specific modeling requirements. (K4)

Pre-requisite: U18ITI4303- Database Management Systems

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1					S								S		
CO2					S								S		
CO3	S	S	S			S							S		
CO4	S	S	S		S										

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

INTRODUCTION TO ADVANCED DATA MODELING (6 Hours)

Overview of Data Modeling in Data science– Importance of Advanced data Modeling – Types of data Model – Dimensional modelling-Design-MySQL Workbench- Build Data model using MySQL workbench– Forward Engineering Feature-Converting Data model into Database schema, MySQL to reverse Engineering schema.

LOGICAL DATA MODEL (6 Hours)

Cross enterprise Analysis- Modern Driven Analysis-Baseline data patterns-complex data Patterns-Generation of Entity types-Transition from meta data to data-static vs dynamic Entity types-data coupling -cohesion.

ADVANCED DATA PATTERNS (6 Hours)

Advanced subtype variations-Multi recursive networks-conditional Recursions-Rules based entity types-state Transition rules-Meta patterns.

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GRAPH AND TEMPORAL DATA MODELING **(6 Hours)**

Graph Databases – Nodes – Edges – Properties– Graph query Languages – Understanding Temporal Databases – Valid time vs Transition Time– Temporal Datamining Techniques – Temporal query languages; No-SQL-New SQL: CAP theorem – Document-based: MongoDB data model and CRUD operations.

GEOSPATIAL AND METADATA MODELING **(6 Hours)**

Representing geospatial data in models-Geospatial Query Language-Applications in Mapping and Location-based Analytics-Metadata Definition and Importance-Encryption and Masking in Data Models-Access Controls and Authorization

SAMPLE LAB CONTENTS **30 Hours**

1. Explore a sample dataset and identify dimensions and facts.
2. Design and Implement schema for a dataset using MySQL workbench.
3. Design and implement a graph Data model for any dataset.
4. Implement a temporal data model for historical dataset
5. create Geospatial data models for location analyses
6. Explore the GEOJSON to represent spatial data.
7. create and manage a metadata for given dataset

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling". Authors: Ralph Kimball and Margy Ross 2013 3rd Edition
2. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems (Greyscale Indian Edition) 2017.
3. Data Modeling Made Simple: A Practical Guide for Business & IT Professionals Authors:Steve Hoberman: 2nd Edition.2009

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/lecture/advanced-data-modeling/introduction-to-advanced-data-modeling-eqENZ
2. https://www.coursera.org/learn/sql-data-science
3. https://www.coursera.org/learn/advanced-data-modeling
4. https://www.coursera.org/learn/nosql-databases
5. https://www.coursera.org/specializations/databases-for-data-scientists

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L	T	P	J	C
2	0	2	0	3

U18AIE0219 DATA ANALYSIS AND VISUALIZATION

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Use the Exploratory data analysis concepts over the data(K3)

CO2: Apply the data visualization using Matplotlib. (K3)

CO3: Illustrate univariate data exploration and analysis. (K4)

CO4: Apply bivariate data exploration and analysis. (K3)

CO5: Use Data exploration and visualization techniques for multivariate and time series data. (K3)

Pre-requisite: U18ITI4303- Database Management Systems

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S		M							M		M		M	
CO2	S		M							M		M			
CO3		S		M										M	
CO4		S		M											
CO5	S														

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

EXPLORATORY DATA ANALYSIS FUNDAMENTALS (6 Hours)

Overview – Significance of Exploratory Data Analysis (EDA) – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques - Grouping Datasets - data aggregation – Pivot tables and cross-tabulations.

VISUALIZING USING MATPLOTLIB (6 Hours)

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

DASHBOARD CREATION USING POWERBI (6 Hours)

Creating Reports-table Visualization-Bar –Pie-column-donut –Navigation and accessibility- Bringing data to the user-Identifying Patterns and trends-case study.

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UNIVARIATE & BIVARIATE ANALYSIS (6 Hours)

Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series. Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations.

MULTIVARIATE AND TIME SERIES ANALYSIS (6 Hours)

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

LAB CONTENTS 30 Hours

1. Implementation of Descriptive statistics for a dataset.
2. Implementation of Inferential statistics for a Dataset.
3. Implementation of data charts – Univariate analysis
4. Implementation of data visualization techniques – Bivariate Analysis
5. Implementation of data visualization techniques –multivariate Analysis
6. Implementation the Handling outliers and missing values
7. Implement Visual encoding of data
8. Develop a Dashboard for various domain

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020.
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 1st Edition, 2016.
3. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/specializations/data-analysis-visualization-foundations
2. https://www.coursera.org/learn/data-analysis-and-visualization-with-power-bi
3. https://onlinecourses.nptel.ac.in/noc22_cs32/preview.

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U18AIE0220 **BUSINESS INTELLIGENCE FOR DECISION MAKING**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Analyze real-world business problems and models with analytical solutions. (K4)

CO2: Evaluate the business processes for extracting Business Intelligence(K4)

CO3: Apply predictive analytics for business forecasting. (K3)

CO4: Apply analytics for supply chain and logistics management(K3)

CO5: Use analytics for marketing and sales. (K3)

Pre Requisite: U18CSI2201/ Python Programming

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO3
CO1	S	S			S	S				S		S			
CO2				S											
CO3			S			S									
CO4			S		S								S		
CO5			S		S								S		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO BUSINESS ANALYTICS **(6 Hours)**

Analytics and Data Science – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

BUSINESS INTELLIGENCE **(6 Hours)**

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions.

BUSINESS FORECASTING AND COMPETITIVE ANALYSIS **(6 Hours)**

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive Analytics-Industry analysis-Profit Frontier, Risk vs Return, Competition Positioning- Enterprise Diagnosis

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HR ANALYTICS **(6 Hours)**

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR- Applying HR Analytics to make a prediction of the demand for talent.

MARKETING & SALES ANALYTIC **(6 Hours)**

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

SAMPLE LAB CONTENTS **30 Hours**

1. Explore the interface and basic features of the BI tool (Qlik)
2. Load and visualize a sample dataset.
3. Import a dataset into the BI tool. And Cleanse data by handling missing values, outliers, and inconsistencies.
4. Transform data to suit BI reporting requirements and design a dashboard with key performance indicators (KPIs).
5. Develop interactive dashboards for dynamic data exploration.
6. Integrate data from various sources for comprehensive analysis
7. Implement advanced chart types (treemaps, heatmaps, etc.).
8. Apply BI tools for forecasting and predictive analytics.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, "Operations Management -Theory and Practice", 3^{rd} Edition, Pearson Education,2018.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/data-analytics-business
2. https://www.coursera.org/learn/foundations-of-business-intelligence
3. https://www.coursera.org/specializations/bi-foundations-sql-etl-data-warehouse

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U18AIE0021	**DATA ETHICS AND PRIVACY**													**L**	**T**	**P**	**J**	**C**
														3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Develop an awareness of the impact of data-related decisions on individuals and society

CO2: Identify the challenges and consequences of Biased datasets. (K4)

CO3: Examine the importance of Data Security and Accuracy (K3)

CO4: Apply the aspects of distributed data and associated risks(K3)

CO5: Apply the knowledge of encryption for data(K3)

Pre Requisite: U18ITI4303- Database Management Systems

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PSO3**
CO1	S		M							M		M	S		S
CO2	S		M							M		M	S		S
CO3		S		M											
CO4		S		M											

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

DATA BIAS **(8 Hours)**

Introduction - Data vs Information vs Facts- Algorithmic Bias- Privacy- Biased Datasets- Purpose of Corporation/AI- Fairness, Predictive Analytics & Mistakes- Surveillance & Power- Disparate Treatment/Impact

ETHICS IN DATA SCIENCE **(9 Hours)**

Ethics in data management- Role of AI Ethics in Corp- Privacy & Shared Responsibility-Surveillance/Power and Shared Responsibility- Disparate Treatment/Impact- Economics of Trust-Transparency vs accountability.

ACCURACY AND PRIVACY **(10 Hours)**

Creating & Measuring Accuracy- Data Science Ethics- Data Science Hate Privacy- Respecting Data Science- Misconceptions About Data Science Ethics- Accountability and Governance- Data Provenance and Aggregation

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PRIVACY ATTACKS **(9 Hours)**

Defining Differential Privacy- Privacy Loss- Privacy attacks- Types of privacy attacks- Privacy-Aware Machine Learning and Data Science- Architecting Privacy in Data and Machine Learning- Open-Source Libraries for PPML Projects- Distributed Data- Federated Learning

DATA ENCRYPTION FOR PRIVACY **(9 Hours)**

Encrypted Computation- Types of Encrypted Computation- Real-World Encrypted Computation- Navigating the Legal Side of Privacy- GDPR: An Overview- Privacy and Practicality Considerations- Getting Practical: Managing Privacy and Security Risk

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours

REFERENCES

1. Katharine Jarmul, Practical Data Privacy Released April 2023 Publisher(s): O'Reilly Media, Inc. ISBN: 9781098129460
2. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O’Reilly Media.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/data-science-ethics
2. https://www.coursera.org/learn/northeastern-data-privac

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U18AIE0226 **DIGITAL TWIN ANALYTICS**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Apply techniques for ingesting, cleaning, storing, and managing time-series sensor data relevant to Digital Twins. [K3]

CO2: Apply machine learning algorithms such as anomaly detection, forecasting to analyse Digital Twin data streams for prediction or diagnostics. [K3]

CO3: Analyse the data flow, integration points, synchronization challenges, and fidelity requirements within a Digital Twin architecture linking physical and digital components. [K4]

CO4: Analyse the suitability and trade-offs of different modelling approaches for representing physical asset behaviour within a Digital Twin. [K4]

CO5: Analyze the effectiveness, potential ROI, scalability, security, and implementation considerations of a Digital Twin solution by examining its predictive accuracy and impact on operational KPIs. [K4]

Pre-requisite: NIL

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PSO3**
CO1		M			M									M	
CO2		M	M		M								M		
CO3		S		M	M								M	M	
CO4		S	M		M									M	
CO5		M	M		M	M								M	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION AND TIME-SERIES DATA MANAGEMENT **6 Hours**

Digital Twin Definition, Evolution, Value, Applications. Enabling Technologies Overview -IoT, Cloud, AI,

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Simulation. Sensor Data Characteristics: Time-series nature, frequency, noise, missing values. IoT Protocols for Data Ingestion: MQTT, CoAP overview. Time-Series Databases: Need, Examples - Influx DB, Timescale DB, Data modeling, Querying. Data Acquisition & Preprocessing: Ingesting data, Cleaning, Resampling, Filtering, Basic feature extraction from time-series.

MACHINE LEARNING FOR DT DATA STREAMS **6 Hours**

Feature Engineering for Time-Series Data: Windowing, Statistical features, Domain-specific features. Anomaly Detection Techniques: Statistical methods, Distance-based LOF, ML-based Isolation Forests, Autoencoders. Forecasting & Predictive Maintenance Basics: Time-series forecasting models -ARIMA concept, basic ML regression, Remaining Useful Life (RUL) estimation concept, Failure prediction using classification. Applying ML Models: Training/testing on time-series data, Handling temporal aspects.

DIGITAL TWIN ARCHITECTURE AND INTEGRATION ANALYSIS **6 Hours**

Digital Twin Architecture Deep Dive: Physical Asset, Sensors/Actuators, Communication Layer, Digital Model, Data Store, Analytics, Interface. Levels of Integration. Data Flow Analysis: Tracking data from sensor to decision, identifying bottlenecks and integration points. Synchronization Challenges: Aligning real-time data with models and latency issues. Model Fidelity Requirements: Understanding the necessary accuracy and detail level of the digital model for specific use cases. Data requirements for model calibration. Integration Technologies: APIs, Middleware, IoT Platforms -AWS IoT Core, Azure IoT Hub roles.

MODELING APPROACHES AND ANALYSIS **6 Hours**

Modeling Approaches: Physics-based Models -FEM, CFD - Data-driven Models (ML-based), Hybrid Models. Simulation Software Overview: Role in DT -Ansys, Simulink, - conceptual inputs/outputs. Model Calibration & Validation: Using sensor data to tune/validate models. Assessing model fit. Surrogate Modeling: Creating faster, approximate models using ML from complex simulations. Analyzing Trade-offs: Comparing modeling approaches based on accuracy, computational cost, data requirements, and interpretability. Suitability analysis for different physical assets/processes.

PLATFORM DESIGN AND IMPLEMENTATION **6 Hours**

Commercial DT Platforms Overview: AWS IoT TwinMaker, Azure Digital Twins, Siemens MindSphere, key features, ontology concepts like DTDL. Evaluating DT Effectiveness: Defining KPIs, measuring predictive accuracy, assessing impact on operations-downtime reduction, efficiency gain, Calculating potential ROI. Implementation Challenges & Considerations: Scalability, Interoperability, Security & Privacy, Cost, Organizational adoption. Visualization for DT: Dashboards for monitoring status, predictions vs. reality. Ethical Considerations: Data ownership, privacy implications, potential for misuse. Case Studies & Future Trends.

LAB CONTENTS: **30 Hours**

1. Explore IoT platform concepts. Set up/use a time-series DB- Influx DB/Timescale DB-Ingest sample time-series data. Apply preprocessing -cleaning, resampling using Pandas.
2. Implement feature engineering on time-series data-Apply anomaly detection algorithms -Isolation Forest, basic Autoencoder to sensor data-Implement a basic forecasting or RUL prediction model using ML regression.
3. Diagram the data flow for a sample DT scenario-Analyze synchronization issues conceptually or with simulated data - Discuss fidelity requirements for different DT applications and Explore IoT platform connectivity options.
4. Train a simple data-driven surrogate model based on simulated physics data-Compare outputs from

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different model types (if available) or conceptually analyze their trade-offs for a given problem. Discuss model validation strategies using real/simulated sensor data for energy consumption.

5. Explore Azure Digital Twins/AWS IoT TwinMaker console/tutorials. Define a simple model graph-Develop evaluation criteria for a hypothetical DT project-Discuss implementation challenges-Mini-Project.: Design a conceptual DT for a chosen system, focusing on architecture, data flow, chosen modeling/analytics approach, and evaluation plan. Present findings.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES:

1. Digital Twin: Manufacturing Excellence through Virtual Factory Replication, Michael Grieves (McGraw Hill, 2019 - Foundational concepts).
2. Hands-On Industrial Internet of Things, Giacomo Veneri & Antonio Capasso (Packt, 2018)
3. Time Series Analysis and Its Applications, 4th Edition, Robert Shumway & David Stoffer (Springer, 2017) - Statistical foundation.

ONLINE COURSES:

1. Official Documentation for AWS IoT TwinMaker: https://aws.amazon.com/iot-twinmaker/
2. Official Documentation for Azure Digital Twins: https://azure.microsoft.com/en-us/products/digital-twins/
3. IEEE international conference on Digital Twins and Parallel Intelligence (DTPI): https://2025.ieee-dtpi.org/
4. Whitepapers from major industrial players (Siemens, GE,Microsoft, AWS).
5. https://www.siemens.com/global/en/products/automation/products-for-specific-requirements/tunnel-automation/whitepaper-tunnel-digital-twin.html
6. https://www.ge.com/digital/lp/predictive-diagnostics-digital-twin-blueprints
7. https://azure.microsoft.com/en-us/services/digital-twins/
8. https://aws.amazon.com/solutions/guidance/industrial-digital-twin-on-aws/
9. Introduction to Time Series and Forecasting, 3rd Edition, Peter Brockwell & Richard Davis (Springer, 2016). https://link.springer.com/book/10.1007/b97391

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Specialization Track: Network and Distributed Computing

U18ITE0333 **CRYPTOCURRENCY AND BITCOINS**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Illustrate Bitcoin principles and cryptographic foundations to demonstrate secure transaction validation [K3].

CO2: Apply Bitcoin network and wallet structures to organize transaction flow and privacy techniques [K3].

CO3: Analyze trading models and market behavior to interpret pricing trends and strategy outcomes [K4].

CO4: Analyze economic and legal aspects of cryptocurrency to examine their influence on adoption and compliance [K4].

CO5: Apply concepts of altcoins and consensus methods to illustrate improvements in blockchain performance [K3].

Pre-requisite: U18ITI4204 - Computer Networks

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PSO3**
CO1	S	M					M							M	
CO2	M	M				S	M							M	
CO3	M	S				M	M							M	
CO4	M	S				M	M							M	
CO5	M					M	S							M	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Assignment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

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THEORY COMPONENT CONTENTS

FUNDAMENTALS OF BITCOIN AND CRYPTOGRAPHY **9 Hours**

Origin and evolution of Bitcoin - Blockchain structure and Proof-of-Work consensus - Cryptographic techniques: Hashing, Digital Signatures, Merkle Trees - Bitcoin mining: Mining pools and incentives - Bitcoin scripting language and transaction verification - Case Study: Genesis Block and Satoshi Nakamoto's Whitepaper

BITCOIN ECOSYSTEM AND WALLETS **9 Hours**

Bitcoin network architecture: Nodes, wallets, mempool - Types of wallets: Hot vs Cold, Hardware wallets, Hierarchical Deterministic wallets - Bitcoin transactions and UTXO model - SegWit, Lightning Network, and scalability - improvements - Privacy techniques: CoinJoin, Mixing services - Case Study: Real-world Bitcoin transaction tracing

CRYPTOCURRENCY TRADING AND MARKET DYNAMICS **9 Hours**

Crypto trading concepts: Order types, Exchanges, Order Books - Centralized vs Decentralized Exchanges (CEX vs DEX) - Trading strategies: Spot, Margin, Arbitrage, HODLing - Stablecoins and algorithmic currencies - Market indicators and volatility analysis - Case Study: Historical Bitcoin price fluctuations and crashes

ECONOMIC, LEGAL, AND REGULATORY ASPECTS **9 Hours**

Cryptocurrency and global financial systems - Merits and demerits of cryptocurrency adoption - Regulatory frameworks across the globe (USA, EU, India) - Taxation and anti-money laundering (AML) concerns - Legal status of Bitcoin: Security or commodity? - Case Study: FTX, Mt. Gox, and Terra - UNA collapses

ALTERNATIVE CRYPTOCURRENCIES AND FUTURE TRENDS **9 Hours**

Overview of altcoins: Ethereum, Litecoin, Monero, Ripple - Crypto forks: Hard vs Soft - Proof-of-Stake and energy-efficient consensus - DAOs, DeFi, and NFTs - Case Study: Bitcoin vs Ethereum vs New-gen coins

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours

TEXT BOOKS:

1. A. Narayanan, J. Bonneau, E. Felten, A. Miller, & S. Goldfeder, Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016.
2. M. Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.
3. P. Franco, Understanding Bitcoin: Cryptography, Engineering and Economics, Wiley, 2014.
4. C. Dannen, Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners, Apress, 2017.

REFERENCES:

1. Antonopoulos, A. M. Mastering Bitcoin: unlocking digital cryptocurrencies, 2017, 2ndedition, OReilly Media, Inc, United States.
2. Lewis, Antony, The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and The Technology That Powers Them., 2018, 1st edition, Mango Media Inc., United States.
3. Bitcoin: Programming the Open Blockchain, Andreas M. Antonopoulos, Mastering, Second edition, 2017, O'Reilly Media.

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ONLINE COURSES:

Web Links:

1. Ripple Labs Documentation: https://ripple.com/build/
2. Bitcoin Whitepaper: https://bitcoin.org/bitcoin.pdf
3. Bitcoin Core Documentation: https://bitcoin.org/en/developer-documentation
4. CoinMarketCap (for Cryptocurrency Market Analysis): https://coinmarketcap.com/
5. CoinGecko (for Market Trends and Trading Data): https://www.coingecko.com/

MOOC Resources:

1. https://www.coursera.org/learn/cryptocurrency
2. https://www.edx.org/learn/bitcoin/university-of-california-berkeley-bitcoin-and-cryptocurrencies
3. https://nptel.ac.in/courses/106106175

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U18ITE0333 **WEB3 AND DAPP DEVELOPMENT**

L	T	P	J	C
2	0	0	2	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Apply Web3 principles and essential tools to demonstrate the setup of a fundamental blockchain development environment [K3]

CO2: Apply the concepts of decentralized application frontend creation to demonstrate the preparation of interactive user interfaces that connect with smart contracts [K3]

CO3: Analyze various backend and storage integration methods to select appropriate decentralized solutions for specific application requirements [K4]

CO4: Design full-stack DApps by integrating authentication and decentralized identity to construct deployable applications with event monitoring [K5]

Pre-requisite: U18ITI4204 - Computer Networks

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO3
CO1	M				S		M		M				S	M	
CO2	M				S		M		M					M	
CO3		S			M		M		M					M	
CO4			S		M		M		M					S	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

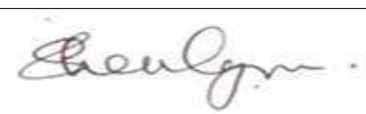
THEORY COMPONENT CONTENTS

WEB3 FUNDAMENTALS AND TOOLING **8 Hours**

Evolution of Web1, Web2, Web3 – Decentralization principles – Wallets and identity – JSON-RPC and provider models – Setting up Node.js, Web3.js, Ethers.js, and IPFS.

Practical Component **6 Hours**

Setup Full Development Environment – Node.js, Hardhat, React.js/Next.js, MetaMask



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FRONTEND FRAMEWORKS FOR DAPPS **8 Hours**
Smart Contract Creation, Front-End Creation, Connecting Smart Contract with Front-End Application - React.js basics for DApp UI – State management in DApps – Connecting to wallets.
Practical Component **8 Hours**
Deploy a Basic Smart Contract Locally – Hardhat, Ethers.js - Integrate Wallet Connection in Frontend – Wagmi, RainbowKit, MetaMask
BACKEND AND STORAGE INTEGRATION **7 Hours**
Using IPFS and Filecoin for decentralized storage – Pinning services – Web3 storage SDKs – GraphQL with The Graph – Data indexing and querying from smart contracts.
Practical Component **8 Hours**
Upload and Retrieve Files from IPFS – Web3.Storage, Pinata - Query Blockchain Events via Indexing – The Graph Protocol, GraphQL
FULL-STACK DAPP DEVELOPMENT **7 Hours**
Authentication via Sign-In with Ethereum – Decentralized Identity (DID) - Building full-stack DApp – Project structuring, deployment and testing Dapp - Working with testnets and Etherscan APIs
Practical Component **8 Hours**
Integrative application of Experiments 1 to 5 in building a full-stack Dapp – Additional hands-on practice for DApp deployment, DID integration, and testnet verification using Etherscan APIs – Mini Project

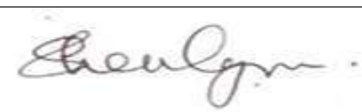
Sample Mini Projects
1. NFT Marketplace: Mint, list, and buy NFTs with IPFS storage and on-chain metadata indexing.
2. Decentralized Voting Platform: Wallet-based authentication; cast votes; real-time results using the Graph.
3. Decentralized Blogging Platform: Authors upload posts to IPFS; frontend pulls posts dynamically.
4. Token Gated Community DApp: Access to content/features only if user holds specific tokens.
5. Crowdfunding DApp: Smart contract-based funding campaigns with milestone payments.

Theory: 30	Tutorial: 0	Practical: 0	Project: 30	Total: 60 Hours

REFERENCES:
1. El Hattab, N. (2023). Full Stack DApp with Web3, React, Ethereum & Solidity. Leanpub.
2. Zhang, X. (2022). Build Your First Web3 App: A Developer's Guide. Independently published.

ONLINE COURSES:
Web Links:
1. https://docs.ethers.org/
2. https://thegraph.com/docs/
3. https://docs.ipfs.io/
4. https://developers.ceramic.network/
5. https://www.rainbowkit.com/docs/introduction

MOOC Resources:
1. nptel.ac.in/courses/106105184
2. https://www.coursera.org/courses?query=blockchain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U18ITE0334 ADVANCED NETWORKING TECHNOLOGIES

L	T	P	J	C
2	0	0	2	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Apply wireless and mobile networking principles to demonstrate protocol behavior and network performance in diverse communication environments. [K3]

CO2: Apply 4G and 5G architectures and technologies to evaluate performance, deployment use cases, and capabilities of modern cellular networks. [K3]

CO3: Apply SDN and NFV paradigms to design programmable, scalable, and manageable network infrastructures. [K3]

CO4: Analyze edge and IoT-integrated networking to propose context-aware, latency-sensitive solutions for real-time applications. [K4]

CO5: Analyze future networking trends and technologies to interpret their potential in transforming next-generation communication systems. [K4]

Pre-requisite: U18ITI4204 - Computer Networks

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PSO3**
CO1	S	M	M											M	
CO2	M	S	M											M	
CO3	M	M			S									M	
CO4	M	S			M									M	
CO5		M	S		M									M	

COURSE ASSESSMENT METHODS

DIRECT
4. Continuous Assessment Test I, II 5. Lab Assignment, Lab assessment, Written tests (Theory) 6. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

FUNDAMENTALS OF WIRELESS AND MOBILE NETWORKS **6 Hours**

Wireless network architecture: WLAN – WWAN - WPAN - Cellular concepts - Spectrum allocation - Handoff strategies - Mobility management: Mobile IP - Mobile TCP - IEEE 802.11 - 802.15, and 802.16 standards

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MOBILE DATA NETWORKS AND 4G/5G SYSTEMS **6 Hours**

LTE and LTE-A Architecture and protocol stack – OFDMA – MIMO - Carrier aggregation - 5G architecture: gNB - Control/user plane split - Network slicing - 5G NR - Use cases: eMBB – URLLC - mMTC – Integration of SDN/NFV in 5G core

SOFTWARE-DEFINED NETWORKING (SDN) AND NETWORK FUNCTION VIRTUALIZATION (NFV) **6 Hours**

SDN architecture and components – OpenFlow – SDN Controllers: Floodlight - ONOS - NFV: virtualization of routers – Firewalls - Load balancers – Tools: Mininet for SDN emulation - Wireshark for SDN packer analysis - SDN-NFV 5G Integration

EDGE COMPUTING AND IOT - INTEGRATED NETWORKS **6 Hours**

Fog and edge computing Architecture and protocols – Use cases - IoT protocols: MQTT – CoAP - 6LoWPAN – Key Issues: Security, scalability, and energy efficiency – Edge Intelligence - Real Interoperability and real-time analytics at the edge

FUTURE TRENDS IN NETWORKING **6 Hours**

6G vision and technologies: THz communication - AI-native networks - Satellite internet: LEO constellations - Starlink - Blockchain in networking - Quantum communication basics - AI and ML for network: Predictive analysis – Network optimization and anomaly detection.

30 Hours

LAB CONTENTS:

Scenario: Select a wireless networking scenario (e.g., campus, IoT, vehicular) and simulate topology and routing feasibility using tools like Cisco Packet Tracer or GNS3 - Conduct a comparative study of 4G and 5G architecture and performance using simulation or real-world deployments. Design and simulate a basic SDN topology in Mininet - Demonstrate controller-switch interaction and capture OpenFlow messages (e.g., FLOW_MOD, PACKET_IN, PACKET_OUT) using Wireshark. -Develop a simple SDN application using Python or REST APIs that programs flow table rules for scenarios like Layer-2 learning switch, basic firewall, or traffic engineering.

List of Sample Projects:

1. Simulation and Performance Analysis of a Campus-Based Wireless Network Using GNS3
2. Design and Routing Feasibility Study of an IoT-Enabled Smart City Network
3. 4G vs. 5G: A Comparative Study with Use Case Prototype for Smart Traffic Management
4. Building and Simulating a Basic SDN Topology with OpenFlow Protocol in Mininet
5. Developing an SDN-Based Firewall Using Northbound APIs and Python
6. Latency-Aware Sensor Data Communication in Smart Agriculture Using MQTT and Raspberry Pi
7. Blockchain-Based Network Management System for Decentralized IoT Security

Theory: 30	Tutorial: 0	Practical: 0	Project: 30	Total: 60 Hours

TEXTBOOKS

1. F Kurose, James. Computer networking: a top-down approach. Pearson Education, 2021.
2. W. Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, Pearson, 2018.
3. Saad Z. Asif, “5G Mobile Communications Concepts and Technologies” CRC press - 2019.

REFERENCE BOOKS

1. Erik Dahlman, Stefan Parkvall, Johan Skold, “4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013
2. K. Salah, Software-Defined Networking with OpenFlow, Packt, 2019.

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3. Molisch, Andreas F. Wireless communications. Vol. 34. John Wiley & Sons, 2012.
4. Schwartz, Mischa. Mobile wireless communications. Cambridge university press, 2005.

ONLINE RESOURCES

1. https://opennetworking.org/
2. https://onlinecourses.swayam2.ac.in/ntr25_ed44/preview

MOOC REFERENCES:

1. https://www.classcentral.com/course/swayam-advanced-computer-networks-119393
2. https://www.my-mooc.com/en/mooc/computer-networking--ud436

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U18ITE0218 SMART CONTRACT DEVELOPMENT

L	T	P	J	C
2	0	2	0	3

<u>COURSE OUTCOMES</u>

After successful completion of this course, the students should be able to

CO1: Interpret Ethereum components required to design a smart contract [K3]
CO2: Design and develop smart contracts using Solidity programming. [K3]
CO3: Create and deploy a DApp on a Ethereum test network. [K3]
CO4: Deploy and manage Ethereum blockchain networks using Ganache and Truffle. [K3]

Pre-requisite: U18ITE0007 - Blockchain Technology

Cos	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S					M							M		
CO2	S		M			S	M						M		
CO3	S	M	M		M	M	M	S		M		S	M		
CO4	S	S	S		M	M	M	S	S	S	M	S	M		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

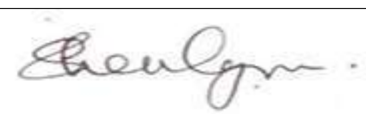
THEORY COMPONENT CONTENT

ETHEREUM FOUNDATIONS 8 Hours

Ethereum Eco System – Components – Ethereum Virtual Machine (EVM) – Ethereum and Turing Completeness – Smart Contract Basics – Smart Contract Lifecycle – Structure of Smart Contract. Ether currency units - Ethereum wallets – Ethereum accounts – Ethereum Tokens – Transactions, Gas and Fees – Ethereum mining - Externally owned accounts and contracts.

SMART CONTRACT DEVELOPMENT 11 Hours

Building a smart contract with Solidity – Ethereum Contract ABI – Programming with Solidity: Data Types & Variables – Operators – Control Structures - Predefined Global variables – Storage & Memory -



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Contracts – Functions – Function Modifiers - Constructor – Inheritance - Events and logs – Error handling - Inter-contract execution - Libraries and Ethereum package manager – Tokens - Introduction to Ethereum Name Service (ENS) – Designing Smart Contracts.

BUILDING DAPP AND WEB 3 **11 Hours**

Running an Ethereum Client: Go Ethereum (Geth) - Processing and deploying smart contracts in Remix IDE. Introduction to Web3 - Using the web3.js javascript library - Generating Ethereum accounts. Truffle Framework & Ganache: Environment Setup for Truffle & Ganache, Truffle Project Creation, – Truffle Compile – Migrate and Create Commands - Decentralized App Creation: Smart Contract Creation, Front-End Creation, Connecting Smart Contract with Front-End Application – Deploying DApp – Validation – Testing of DApp.

Sample List of Experiments **30 Hours**

1. Getting Started with MetaMask
    a. Creating a Wallet
    b. Interacting with Remix IDE
    c. Switching Networks
    d. Getting some Test Ethers
    e. Sending Ether from MetaMask
    f. Exploring the transaction details of an account
2. Building smart contract using Solidity, compiling and deploying it on Remix IDE
3. Use of setter and getter functions to interact with the contracts.
4. Smart contract to withdraw funds from a contract to a restricted account, preferably the owner's, with different levels of security restrictions.
5. Build a DApp and deploy a smart contract on an external blockchain by using Ganache and Truffle. Interact with a front end developed using Web 3.js.

Theory:30	Tutorial:0	Practical:30	Project:0	Total: 60 Hours

REFERENCES

1. Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos, Gavin Wood, 2018, O'Reilly Media
2. Modi, Ritesh, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and Blockchain, 2018, Packt Publishing Ltd, United Kingdom
3. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/decentralized-apps-on-blockchain?specialization=blockchain
2. https://www.coursera.org/learn/smarter-contracts#syllabus
3. https://101blockchains.com/course/smart-contracts-development
4. https://www.tcsion.com/courses/industry-honour-course/ethereum-smart-contracts/
5. https://onlinecourses.swayam2.ac.in/aic21_ge01/preview
6. https://trufflesuite.com/docs/truffle/

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L	T	P	J	C
3	0	0	0	3

U18ITE0019 **DECENTRALIZED FINANCE**

<u>COURSE OUTCOMES</u>

After successful completion of this course, the students should be able to

CO1: Interpret the features of decentralized finance required to build its infrastructure. [K3]
CO2: Examine key trends and basic primitives of decentralized finance to design innovative financial solutions. [K3]
CO3: Apply diverse DeFi operations for providing blockchain-based financial solutions. [K3]
CO4: Identify the risks associated with decentralized finance. [K3]
CO5: Analyse ethical and regulatory issues associated with Decentralized Finance. [K4]

Pre-requisite: U18ITI4204-Computer Networks

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M												M		
CO2	S	M										M	M		
CO3	S	M					M		M	M				M	
CO4	M			M		M		M	M	M				M	
CO5	M			M		M		M	M	M				M	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Assignment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

DECENTRALIZED FINANCE(DEFI) INFRASTRUCTURE **8 Hours**

Issues in Centralized Finance – History and Overview of Decentralized Finance - Overview of Cryptocurrency – Cryptographic hashing – Proof of work – Smart Contracts – Gas - Stable coins – Tokenomics – Altcoins - Blockchain and DeFi

DEFI PRIMITIVES **8 Hours**

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Transactions – Fungible tokens – Non-Fungible tokens – custody – Supply adjustment – Incentives – Swap – Collateralized loans – Flash loan - Problems solved by DeFi- Ineffeciency – Limited Access – Opacity – Centralized control and lack of Interoperability

DEFI OPERATIONS **10 Hours**

Credit /Lending and borrowing protocols – Decentralized Exchanges – Derivatives – Tokenization – Hot and cold wallets – Moving centralized exchanges funds to blockchain - Automated market makers – Bridging – Staking - Oracles

DECENTRALIZED IDENTITY AND SECURITY **10 Hours**

Decentralized Identity (DID) – Security risks and measures in DeFi – Smart contract risk - Governance risk – Oracle risk – scaling risk – DEX risk – Custodial risk – Regulatory risk. Smart Contract Auditing – Yield Farming strategies – Liquidity mining

REGULATORY AND ETHICAL CONSIDERATIONS **9 Hours**

Global Regulations – Ethical issues – DAO – Government mechanisms – Crypto hackers – DeFi Usecases -Case study: Crypto Exchange Platforms and Gitcoin

Theory:45	**Tutorial:0**	**Practical:0**	**Project:0**	**Total: 45 Hours**

REFERENCES

1. Campbell R. Harvey, Ashwin Ramachandran, Joey Santoro, Vitalik Buterin, "DeFi and the Future of Finance", Wiley 1st Edition.
2. Melanie Swan, Blockchain: Blueprint for a new economy, Shroff Publisher/O'Reilly Publisher.
3. Ron Quaranta, Blockchain in Financial Markets and Beyond: Challenges and Applications, Risk Books Publisher.
4. Richard Hayen, Blockchain & FinTech: A Comprehensive Blueprint to Understanding Blockchain & Financial Technology - Bitcoin, FinTech, Smart Contracts, Cryptocurrency, Risk Books Publisher.

ONLINE LEARNING MATERIALS

1. https://www.udemy.com/course/masteringdefi/
2. https://www.coursera.org/specializations/decentralized-finance-duke
3. https://101blockchains.com/ebooks/decentralized-finance-defi-guide/

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Specialization Track: Cloud Computing

U18ITE0220 VIRTUALIZATION AND RESOURCE MANAGEMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Analyze the use of different resource virtualizations used in cloud environment [K4].

CO2: Apply the factors of cloud economics on migration and development [K3].

CO3: Develop applications in different public cloud platform [K3].

CO4: Select appropriate service model for an application[K3].

CO5: Choose a suitable cloud service provider based on application domain[K3].

Prerequisite: U18ITI4204-Computer Networks

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S				M			M			M	S			
CO2	S	M									M	S			
CO3	S			M			M	M	M			S			M
CO4	S	M			M						M	S			M
CO5	S		M	M				M			M				M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

VIRTUALIZATION **4 Hours**

Roles of Virtualization, Hypervisor, Types of Virtualization – Server virtualization – Storage virtualization – Network virtualization – Desktop virtualization – Application Virtualization.

CLOUD ECONOMICS AND MIGRATION **5 Hours**

Cost models and optimization, Economies of Scale, Resource Optimization, Reduced Capital Expenditure

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- Total Cost of Ownership (TCO), Cost Transparency and Management, Risk Mitigation and Security, Performance vs. Cost Trade-offs. Cloud Migration Strategies, Iterative Seven-step Model of Migration into the Cloud, Assessment and Planning, Choosing the Right Cloud services and Provider, Change Management and Training, Performance and Monitoring, Testing and Validation, Backups, Post-Migration Optimization.

INFRASTRUCTURE AS A SERVICE **7 Hours**

Compute: AWS EC2, Azure Virtual Machines, Google Compute Engine. Containers – Microservices, Docker, Kubernetes containers. Storage: Amazon EBS, Amazon S3, Azure disk storage, Google cloud storage. Autoscaling – AWS autoscaling, Azure app service, Google compute engine. Load balancing – AWS ELB, Azure traffic manager, Google cloud load balancer.
Network: Amazon VPC, Azure virtual network, Google cloud VPN.

PLATFORM AS A SERVICE **7 Hours**

PaaS: Serverless computing - AWS Lambda, Azure functions, Google Cloud functions, AWS Apprunner, Elastic beanstalk, Google App engine, Google Cloud Functions, Amazon RDS, DynamoDB, Azure SQL database, Azure CosmosDB, Google cloud SQL, Google cloud database.

SOFTWARE AS A SERVICE **7 Hours**

Amazon chime, Workmail, Workdocs, Microsoft 365, Microsoft power platform, Azure active directory, Azure DevOps, Azure IoT central, Azure cost management, Google Maps platform, Google workspace, Google analytics, Google cloud identity, Google Cloud search, Firebase.

LAB CONTENTS:

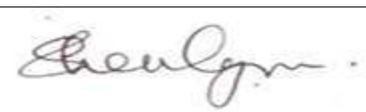
Few exercise related to AWS, Azure, Google platform services that fall under IaaS, PaaaS and SaaS.
Sample Exercises:

1. Demonstrate the virtualization by enabling the OS virtualization on single machine by creating instances oracle virtual box/VMware.
2. Installation of VM Ware/ virtual box and implement multiple OS.
3. Creating VMs in public cloud.
4. Deploying application in Docker/Kubernetes.
5. Static Web site hosting
6. Dynamic Website hosting
7. Balancing network traffic using load balancer
8. Scale the Compute resource with auto scaling
9. E-mail notification using serverless architecture.
10. Configuring a cloud network

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES:

1. Dr. Rajesh Kumar Pathak , “Cloud Computing Fundamentals, Notion Press, 2023.
2. A. B. Lawal, “Cloud Computing Fundamentals: Learn the Latest Cloud Technology and Architecture with Real-World Examples and Applications”, A. B. Lawal publication, 2020.



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3. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing: Foundations and Applications Programming”, Morgan Kaufmann publications, 2013.
4. Cloudonomics: The Business Value of Cloud Computing" by Joe Weinman, John Wiley & Sons Inc, 2012.
5. Mastering AWS Development" by Uchit Vyas, Ingram short title, 2015.
6. Microsoft Azure Essentials - Fundamentals of Azure, Second Edition" by Michael Collier and Robin Shahan, Microsoft Press, 2015.
7. Google Cloud Platform for Developers: Build highly scalable cloud solutions with the power of Google Cloud Platform" by Ted Hunter and Steven Porter, Packt Publishing Limited, 2018.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/cloud-computing-basics
2. https://www.coursera.org/learn/meta-cloud-computing
3. https://www.coursera.org/learn/cloud-computing-foundations-duke
4. https://www.coursera.org/browse/information-technology/cloud-computing
5. https://www.mygreatlearning.com/cloud-computing/courses
6. http://www.infocobuild.com/education/audio-video-courses/computer-science/CloudComputing-IIT-Kharagpur/lecture-12.html
7. https://www.coursera.org/specializations/aws-fundamentals
8. https://www.coursera.org/learn/cloud-azure-intro
9. https://www.coursera.org/learn/gcp-infrastructure-foundation

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U18ITE0221 **CLOUD INFRASTRUCTURE AND ARCHITECTURE**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Construct the architecture for a private cloud [K3]

CO2: Develop a cloud environment at small scale [K3]

CO3: Inspect Security of services and applications in private cloud [K4]

CO4: Make use of concepts and features related to Virtualized datacenter to configure cloud storage [K3].

CO5: Build environment to manage IT resources [K3].

Prerequisite: U18ITI4204 - Computer Networks

Cos	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1			M					M	M		M		M		
CO2			M	M	M		M		M		M		M		
CO3			M		M	M	M		M		M				M
CO4			M						M		M				
CO5			M		M		M		M		M		M		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO CLOUD INFRASTRUCTURE **7 Hours**

Introduction to cloud Infrastructure/virtual infrastructure, General Architecture of virtual infrastructure: Architecture of OpenStack, project, services, mode of deployment, workflow, Openstack Components: Nova, Swift, cinder, Nuetron, Glance, Keystone, Horizon. Virtualization environment with KVM. OpenStack API.

CLOUD COMPUTE ARCHITECTURE **7 Hours**

Configuring Horizon Dashboard, OpenStack CLI client - Create and manage flavors, compute instances, generate and manage SSH keys, accessing instances, configure an instance with a floating IP address,

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create instances with security groups, manage Nova host consoles, instance snapshots. Openstack image service: image repository, manage images, metadata, image types, bundling, exporting, migrating images.

CLOUD STORAGE ARCHITECTURE **8 Hours**

Swift: features, architecture of swift, swift installation and configuration, data management lifecycle, backup and archival, media storage with swift. Use the command line client to upload and manage files to Swift containers, manage permissions on a container in object storage,

Cinder: Architecture of cinder clock storage, Volume provisioning and management- create and manage volumes, attach volumes to instances, manage volume quotas, backup and restore volumes, manage volume snapshots.

CLOUD NETWORK ARCHITECTURE **8 Hours**

Software defined networking, Neutron Architecture, Manage network resources, create external/public networks, create project networks, create project routers, attach routers to public and project networks, manage network services for a virtual environment, manage network quotas, manage network interfaces on compute instances, create and manage project security groups and rules, assign security group to instance, create and manage floating IP addresses, assign floating IP address to instance, detach floating IP address from instance. Identity and access management- keystone: users, roles, groups.

LAB CONTENTS

Deployment of OpenStack components.

Sample Exercises:

1. Configure NOVA compute Node
2. Configure Swift object storage
3. Construct a cinder block node
4. Build a horizon node – Monitor node
5. Launching an instance- Register an account at openstack, Create SSH Key, validate network.
6. Sharing project environment among multiple users.

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

REFERENCES

1. Ben Silverman, Michael Solberg, “OpenStack for Architects :Design Production-ready Private Cloud Infrastructure”, 2nd Edition, Packt Publishing, 2018.
2. Michael Solberg, Ben Silverman, “OpenStack for Architects” , Packt Publishing,· 2017
3. Alok Shrivastwa, Sunil Sarat, Kevin Jackson, Cody Bunch, Egle Sigler, Tony Campbell, “OpenStack: Building a Cloud Environment”, Packt Publishing, 2016
4. James Denton, “Learning OpenStack Networking (Neutron)”, Packt Publishing, 2015.

ONLINE LEARNING MATERIAL

1. https://www.coursera.org/learn/juniper-openstack-and-kubernetes?

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U18ITE0222 **CLOUD STORAGE MANAGEMENT**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Make use of cloud storage technologies in applications [K3].

CO2: Correlate different storage networking technologies [K3].

CO3: Make use of the design principles of virtualization techniques in cloud resource management [K3]

CO4: Analyze different cloud storage life cycle strategies [K4].

CO5: Select appropriate backup and recovery strategies [K3].

Prerequisite: U18ITT3001- Computer Architecture

Cos	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S					M			M		M				M
CO2	M	M	M							M		M			
CO3	M	S	S				M						M		
CO4	M				M								M		
CO5	M	M											M		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

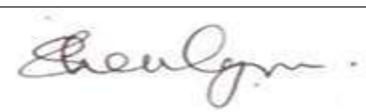
THEORY COMPONENT CONTENTS

INTRODUCTION TO CLOUD STORAGE **7 Hours**

Overview of cloud storage concepts - Advantages and challenges of cloud storage - Comparison of traditional storage vs. cloud storage, Evolution of Storage Architecture, Data Center Infrastructure, Storage Technologies: Block, file, and object storage - Storage protocols (iSCSI, NFS, SMB, etc.) - Data replication, snapshots, and backups in the cloud.

STORAGE NETWORKING TECHNOLOGIES **8 Hours**

Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations,



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NAS File-Sharing Protocols, Factors Affecting NAS Performance, File-Level Virtualization. Fibre Channel Storage Area Networks: Fibre Channel Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, Fabric Services, Switched Fabric Login Types, Zoning, FC SAN Topologies, Virtualization in SAN. IP SAN and FCoE: iSCSI, FCIP, FCoE

LIFE CYCLE MANAGEMENT AND SECURITY **8 Hours**

Introduction to storage tiers **,** Different Storage Classes Offered by Cloud Providers - Choosing the Right Storage Class for Different Use Cases - Access Control and Security - Identity and Access Management (IAM) - Encryption in Transit and at Rest

BACKUP AND DISASTER RECOVERY **7 Hours**

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Archive: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup, Backup in NAS Environments, Backup Targets, Data Deduplication for Backup, Backup in Virtualized Environments, Data Archive, Archiving Solution Architecture

LAB CONTENTS

Attaching volume to instances, Creating snapshots from volumes, Migrating a file among different storage classes, Managing access control over a file/storage, Enabling client and server-side encryption for an object.

Sample Exercise:

1. Attaching volume to instances.
2. Creating snapshots for volumes.
3. Migrating a file among different storage classes.
4. Managing access control over a file/storage.
5. Enabling client and server-side encryption for an object.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. Data Intensive Storage Services for Cloud Environments by Athanasios Voulodimos, Dimosthenis P. Kyriazis, Spyridon V. Gogouvitis, Theodora Varvarigou, Business Science Reference, 2013.
2. Cloud Storage Management in Contemporary IT Environments by Michael O'Dell and Michael Corey, Packt Publishing, 2012.
3. Borko Furht, Armando Escalante Handbook of Cloud Computing, Springer Science+Business Media, LLC 2010
4. Information Storage and Management by Emc Education S, John Wiley & Sons, Incorporated, 2012.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/data-storage-microsoft-azure

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2. https://www.udemy.com/course/introduction-to-cloud-storage-apps-a-beginners-course/
3. https://www.coursera.org/learn/cloud-storage-big-data-analysis-sql
4. https://www.classcentral.com/course/linkedin-learning-learning-cloud-computing-cloud-storage-30444

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U18ITE0323 CLOUD APPLICATION DEVELOPMENT

L	T	P	J	C
2	0	0	2	3

<u>COURSE OUTCOMES</u>

After successful completion of this course, the students should be able to

CO1: Analyse the use cases for cloud application development [K4]

CO2: Compare web and cloud application and analyze appropriate cloud platforms requirements [K3]

CO3: Build applications using APIs and Cloud services [K3]

CO4: Apply agile application development and manage application life cycle using DevOps [K3]

Prerequisite: U18ITI7202-Cloud Computing

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1		M	M										M		
CO2		M	M		S					M					
CO3	M				S							S		M	
CO4		S			M					M					

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

INTRODUCTION TO APLLICATION DESIGN 6 Hours

Business case for implementing cloud application, Requirements, collection for cloud application development, Cloud service models and deployment models, Open challenges in Cloud Computing: Cloud inter-operability and standards, scalability and fault tolerance, security, trust and privacy.

APPLICATION DEVELOPMENT FRAMEWORK 8 Hours

Accessing the clouds: Web application vs Cloud Application, Frameworks: Model View Controller (MVC), Struts, Spring. Cloud platforms in Industry – Google AppEngine, Microsoft Azure, Openshift, CloudFoundry

CLOUD SERVICE DELIVERY ENVIRONMENT AND API 8 Hours

Storing objects in the Cloud, Session management, Working with third party APIs: Overview of interconnectivity in Cloud ecosystems. Facebook API, Twitter API, Google API. Architecting for the Cloud :

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Best practices Best practices in architecture cloud applications in AWS cloud, Amazon Simple Queue Service (SQS), RabbitMQ, Amazon Simple Notification Service (Amazon SNS), multi-player online game hosting on cloud resources, Building content delivery networks using clouds.

DEVOPS IN CLOUD **8 Hours**

Continuous Integration/Continuous Deployment (CI/CD), collaboration among development, operations, and other stakeholders, Agile and lean principles: Embracing agile methodologies and lean practices to enable faster development and delivery cycles. Automating development pipelines, Monitoring and Logging, Implementing monitoring solutions for cloud applications, Containerization: Docker basics and container orchestration with Kubernetes.

PROJECT:

Projects involving Google AppEngine, Microsoft Azure, Openshift, Cloud Foundry services will be done.

Theory: 30	Tutorial: 0	Practical: 0	Project:30	Total: 60 Hours

REFERENCES

1. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud by George Reese, Oreilly Publication, 2021.
2. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble and David Farley, 2020.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/specializations/ibm-cloud-application-development-foundations
2. https://www.udemy.com/course/cloud-computing-development-essentials/
3. https://www.coursera.org/learn/cloud-native-devops-agile-nosql?specialization=ibm-cloud-application-development-foundations
4. https://www.edx.org/certificates/professional-certificate/ibm-cloud-and-application-development-foundations

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L	T	P	J	C
2	0	2	0	3

U18ITE0224 CLOUD SECURITY

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Analyze the security breaches of IaaS, PaaS and SaaS. [K4]

CO2: Apply various data encryption methods and security mechanisms to get the administrative control using IAM service. [K3]

CO3: Inspect compliance, governance and risk management [K4]

CO4: Make use of CI/CD pipeline in application security [K3].

CO5: Analyze security in edge computing [K4]

Pre-requisite: U18ITI7202-Cloud Computing

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1				M											M
CO2			M			M						M			
CO3					S	M		M							
CO4		S		M									M		
CO5		M			M										

COURSE ASSESSMENT METHODS

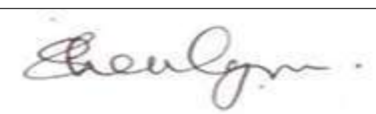
DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO CLOUD SECURITY 6 Hours

Overview of cloud computing and its security challenges - Importance of cloud security for organizations - Shared responsibility model in cloud security. Cloud Service Models and Security: Security considerations for IaaS, PaaS, and SaaS, Risks and security measures specific to each service model, Case studies highlighting security vulnerabilities in cloud services.

CLOUD SECURITY ARCHITECTURE AND DATA PROTECTION 6 Hours



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Designing secure cloud architectures, Identity and access management (IAM) in the cloud Network security in a cloud environment. Encryption techniques for data at rest and in transit Key management best practices, Data loss prevention (DLP) strategies in the cloud

COMPLIANCE, GOVERNANCE, AND RISK MANAGEMENT 6 Hours

Compliance requirements in the cloud (e.g., GDPR, HIPAA), Risk assessment and management in cloud environments, Implementing governance frameworks for cloud security, Cloud-specific threats and vulnerabilities, Security monitoring and logging in the cloud, Incident response planning and execution in cloud environments.

SECURE DEVELOPMENT AND DEVSECOPS 6 Hours

Security considerations in cloud-native application development, Implementing security in CI/CD pipelines, Best practices for DevSecOps in the cloud.

EMERGING TRENDS AND FUTURE OF CLOUD SECURITY 6 Hours

Edge computing and its security implications, Zero-trust security models in the cloud, Future directions and trends in cloud security.

LAB CONTENTS

Securing Free tier account, IAM, account bills, instances within Virtual Private Cloud, Role based access control with cloud platform IAM, Instance with firewall rules , Data encryption and decryption using cloud platforms, restricting access to storage, Configuring networking firewall for an application

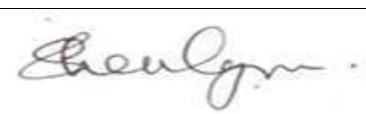
Sample exercises:

1. Securing free tier account in cloud platform
2. Securing free tier account in cloud platform with IAM user
3. Creating IAM role, Group.
4. Securing free tier account setting billing in cloud platform
5. Securing instances in cloud platform within Virtual Private Cloud
6. Implementing role-based access control with cloud platform IAM
7. Securing instances with firewall rules
8. Data encryption and decryption using cloud platforms
9. Securing and restricting access to storage
10. Configuring networking firewall for an application

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

REFERENCES

1. Cloud Security Attacks, Techniques, Tools and Challenges by Preeti Mishra, Emmanuel S Pilli, R C Joshi · 2021
2. Cloud Security: Concepts, Applications and Perspectives by Brij B. Gupta · 2021
3. Securing the Cloud: Cloud Computer Security Techniques and Tactics by Vic (J.R.) Winkler
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz,



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Russell Dean Vines · 2010

5. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice) 1st Edition, by Tim Mather (Author), Subra Kumaraswamy (Author), Shahed Latif (Author) 2009.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/cloud-security-basics
2. https://www.coursera.org/learn/sscp-4th-ed-course-6
3. https://www.coursera.org/learn/cloud-data-security
4. https://www.checkpoint.com/cyber-hub/cloud-security/what-is-cloud-security/
5. https://www.zscaler.com/resources/security-terms-glossary/what-is-cloud-security
6. https://medium.com/@goodycyb/exploring-cloud-security-in-depth-labs-and-insights-for-aws-and-gcp-50ca038478c4
7. https://goodycyb.hashnode.dev/

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U18ITE0325 **CLOUD AUTOMATION**

L	T	P	J	C
2	0	0	2	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Identify appropriate cloud automation tools for an application [K3].

CO2: Take part in automating DevOps using tools [K4]

CO3: Make use of storage automation in an application [K3].

CO4: Apply automation tools in monitoring services [K3]

CO5: Utilize tools for the cloud resource scaling and management [K3]

Prerequisite: U18ITI7202-Cloud Computing

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M		M	M	M				M			M		
CO2	M								M		M				
CO3	S	S										M			
CO4	M				M										M
CO5	M	S			M						M		M		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION CLOUD AUTOMATION **7 Hours**

Benefits of cloud automation - Types of cloud automation tools - Use cases for cloud automation. Managing and provisioning infrastructure through code (using tools like Terraform, Ansible, Puppet, Chef), Automating code integration and verification through tools like Jenkins, GitLab CI, or CircleCI, Automating the deployment process to push code changes into production environments reliably.

CLOUD RESOURCE SCALLING AND STORAGE AUTOMATION **8 Hours**

Automating resource allocation, de-allocation, and right-sizing of resources based on usage. Kubernetes - Salt -CircleCI - Ansible and puppet, AWS DataSync, Azure Data Factory.

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CLOUD AUTOMATION TOOLS FOR DEVOPS **7 Hours**

DuploCloud - Puppet - Heroku -HashiCorp, Monitoring and Logging Tools – Prometheus, Grafana, Docker, Raygun, Splunk, Git, Ansible, Jenkins, Bamboo.

CLOUD DEPLOYMENT AUTOMATION **8 Hours**

NetApp Cloud Volumes ONTAP - CFEngine -VMware vs Realize Automation - Cisco Intelligent - Automation for Cloud - Microsoft Azure Automation - Google Cloud Deployment Manager - AWS CloudFormation - IBM Cloud Schematics

PROJECT

Projects involving different cloud platform services like Puppet, Heroku, HashiCorp and monitoring & Logging Tools – Prometheus, Grafana, Docker, Raygun, Splunk, Git, Ansible, Jenkins, Bamboo.

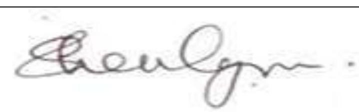
Theory: 30	Tutorial: 0	Practical: 0	Project: 30	Total: 60 Hours

REFERENCES

1. Mikael Krief,, "Learning DevOps: The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps", Packt Publishing; 1st edition, 2019.
2. Marcelo Pinheiro, "Mastering DevOps Automation", Packt Publishing Limited, 2018.
3. Jeff Geerling, "Ansible for DevOps: Server and Configuration Management for Humans", Midwestern Mac, LLC; 1st edition, 2015.
4. John Rhoton and James Stanger, "Cloud Automation and DevOps: Transforming Your IT Environment:, 2015.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/automation-in-aws
2. https://www.coursera.org/learn/gcp-infrastructure-scaling-automation
3. https://www.udemy.com/course/aws-cloud-security-proactive-way/
4. https://www.edx.org/learn/computer-programming/google-cloud-elastic-google-cloud-infrastructure-scaling-and-automation



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U18ITE0535 **CLOUD INFRASTRUCTURE AND SOLUTIONS ARCHITECTURE**

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- To provide a comprehensive understanding of AWS global infrastructure, core services, and security mechanisms essential for building and managing cloud solutions.
- To enable learners to design, deploy, and manage scalable, secure, and cost-efficient compute, storage, database, and networking solutions on AWS.
- To develop the ability to architect serverless, hybrid, and container-based solutions aligned with AWS best practices for governance, management, and automation.
- To impart knowledge and practical skills in building modern data architectures and data lakes using AWS services such as Glue, Athena, Quick Sight, and Lake Formation.
- To prepare learners for the AWS Certified Solutions Architect – Associate examination by reinforcing skills in designing resilient, high-performing, secure, and cost-optimized cloud architectures.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Understanding AWS core services to build a secure and scalable cloud application.[K2]

CO2: Deploy serverless, hybrid, and container-based architectures using AWS services adhering to best practices in scalability and security.[K3]

CO3: Construct modern data lake solutions on AWS utilizing services for efficient data ingestion, processing, and analytics.[K3]

CO4: Apply AWS design principles to develop resilient, cost-effective, and high-performing solutions aligning with AWS Well-Architected Framework guidelines.[K3]

CO5: Analyze and optimize AWS architectures for performance, cost, and sustainability while demonstrating readiness for AWS Certified Solutions Architect – Associate certification. [K4]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes(POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12

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CO1	S											S
CO2		S			S							S
CO3			S						M			
CO4			M				S					
CO5					S						M	

COURSE ASSESSMENT METHODS:

DIRECT
1. Project 2. Project presentation/Report 3. Lab Assignments, 4. Demo presentations, 5. Quiz/peer review(optional)
INDIRECT
1. Course-end survey

PRACTICAL COMPONENTS:

AWS CLOUD TECHNICAL ESSENTIALS LAB **21 Hours**

AWS Overview and Security, Compute and Networking, Storage and databases on AWS, Monitoring & Optimization.

Lab tasks:

- Configure IAM users, groups, and roles with appropriate permissions.
- Implement Multi-Factor Authentication (MFA) for account security.
- Create custom IAM policies for least-privilege access.
- Assign IAM roles to EC2 instances for secure service communication.
- Create, configure, and connect to an EC2 instance using SSH.
- Install and host a sample web application on EC2.
- Set up CloudWatch dashboards to monitor EC2

ARCHITECTING SOLUTIONS ON AWS LAB **21 Hours**

Designing a serverless web backend on AWS, Designing a serverless data analytics solution on AWS, Designing a hybrid solution for container based workload, Designing a solution following account governance and management, IAM Roles

Lab tasks:

- Create a RESTful API backend using Lambda functions triggered by API Gateway
- Integrate AWS Lambda with DynamoDB for data persistence.
- Hosting a Static Website with a Serverless Backend
- Implementing Governance using AWS Organizations and Service Control Policies (SCPs)

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- Automate data processing using S3 event triggers and Lambda.

BUILDING DATA LAKES ON AWS LAB **10 Hours**

Introduction to Data lakes, Data Ingestion, Cataloging and preparation, Building a data lake with AWS lake Formation, Data Processing and Analytics, AWS Lake Formation additional configurations, Modern Data Architecture on AWS.

Creating and Running a Glue Crawler, Querying CSV data with Amazon Athena, Columnar data formats with Amazon Athena - a performance and cost comparison, Building a Data Lake using AWS Lake Formation, Glue Databrew, Glue Studio, LF-Tags, Visualizing Data with QuickSight, Automate Data Lake Creation Using AWS Lake Formation Blueprints, Publishing and Managing Data Product in AWS Lake Formation.

Lab tasks:

- Data Ingestion using AWS Glue and S3.
- Cataloging Data using AWS Glue Crawler
- Querying Data using Amazon Athena
- Columnar Data Formats and Cost Optimization
- Building a Data Lake using AWS Lake Formation
- Data Preparation using AWS Glue Databrew
- Data Visualization using Amazon QuickSight.

EXAM PREP: AWS CERTIFIED SOLUTIONS ARCHITECT – ASSOCIATE LAB **8 Hours**

Designing Resilient Architectures, Designing High-performing Architectures, Designing Secure Applications and Designing Cost-optimized Architectures.

Lab tasks:

- Deploy a fault-tolerant web architecture across multiple Availability Zones.
- Implementing Disaster Recovery using S3 Cross-Region Replication
- Designing a High-Performance Content Delivery Solution using CloudFront
- Implementing Caching Layers for Performance Optimization
- Protect data at rest and in transit using AWS security services.
- Implementing Cost Optimization with AWS Trusted Advisor and Compute Optimizer
- Evaluate and improve an AWS architecture using the AWS Well-Architected Tool

CAPSTONE PROJECT **30 Hours**

- Students form teams to devise and execute a complete cloud services across multiple service categories.
- Each team defines objectives, scope, and expected outcomes of the project.
- Design a high-level cloud architecture diagram including core services (compute, storage, networking, database, security)
- Develop and deploy the cloud solution using appropriate services.

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- Teams present their strategy, results, and learnings at course end.

Theory: 0	Tutorial: 0	Practical: 90	Project: 0	Total: 90 Hours

REFERENCES:

1. Cloud Computing with AWS: Everything You Need to Know to be an AWS Cloud Practitioner by Pravin Mishra, Apress. 2023, ISBN, 1484291719, 9781484291719.
2. Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud by Mark Wilkins, Pearson Education, 2019, ISBN: 9780135301098, 0135301092.

ONLINE COURSES:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/professional-certificates/aws-cloud-solutions-architect?source=search

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Specialization Track: Web and Software Development

U18ITE0226 FULL STACK SOFTWARE DEVELOPMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Create a Web Server with Node.js for a simple application. (K3)

CO2: Develop a Web Application in Express.js Framework. (K3)

CO3: Build an application with Node.js and MongoDB. (K3)

CO4: Deploy the developed application in GitHub repository. (K3)

Prerequisite: U18ITI6203-Web Technology

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M	M		S						M	M	M		
CO2	S	M	M		S						M	M	M		
CO3	S	M	M		S						M	M	M		
CO4					S	M	M	M	M	M	M	M		M	M

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENT

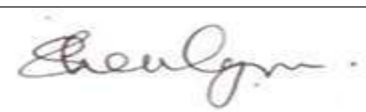
INTRODUCTION TO FULL STACK DEVELOPMENT & VERSION CONTROL **6 Hours**

Overview of HTML, CSS, JavaScript, and Bootstrap.
Web Development Stack - Full Stack – Introduction – Types: MERN, MEAN, MEVN, LAMP, Ruby on Rails, Django, NET, JAMSTACK
Version Control – Need - Popular version control tools like Git - create a GitHub account - Use the GitHub web interface to create a repository - add a file to Git and commit the changes – Git commands.

INTRODUCTION TO NODE.JS **6 Hours**

Introduction to Node.js - Server-Side JavaScript and Node.js - Creating a Web Server with Node.js - Working with Node.js Modules - Overview of Node Package Manager

SERVER-SIDE JAVASCRIPT **6 Hours**



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Asynchronous I/O with Callback Programming - Creating Callback Functions - Using Anonymous Callback Functions in Node.js - Issues with Callbacks - Working with JSON – Handling errors and debugging Node.js applications.

EXPRESS WEB APPLICATION FRAMEWORK 6 Hours

Extending Node.js - Working with Third Party Node.js Extensions - Introduction to Web Frameworks - Express Web Application Framework - Working with Back-end JavaScript Frameworks and Express - Routing, Middleware, and Templating - Authentication in Node JS - Middleware & Routers - HTTP Methods and Rest APIs.

MONGODB AND DEPLOYMENT OF NODE.JS APPLICATIONS 6 Hours

NoSQL databases and MongoDB - Setting up a MongoDB development environment - Building MongoDB schema and models with Mongoose – Connecting Node.js application with MongoDB – Testing and Deploying Node.js applications with server configurations.

LAB CONTENTS

Sample List of Lab Experiments:

1. Create your own Node.js module and import and use modules in your web server application.
2. Develop asynchronous functions with callbacks, error handling, and control flow using callbacks.
3. Demonstrate JSON file data read and write using Node.js.
4. Create a RESTful API to serve JSON data.
5. Demonstrate RESTful endpoints using Express and HTTP methods to handle GET, POST, PUT, and DELETE requests.
6. Integrate a template engine (e.g., EJS or Pug) with Express and Render dynamic HTML views using templates.
7. Implement user authentication in your Express application.
8. Explore and integrate third-party Node.js extensions into your Express app and showcase the benefits of using extensions for specific features.
9. Create a multi-page web application with authentication, routing, and RESTful APIs.
10. Create a simple Employee Management Application with MongoDB and Node.js.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. “Mastering HTML, CSS & JavaScript Web Publishing” by Laura Lemay, Rafe Colburn, Jennifer Kyrnin, BPB Publications, 2016.
2. "Node.js Web Development: Server-side web development " by David Herron, 5th Edition, 2020
3. "Node.js in Action" by Alex Young, Bradley Meck, Mike Cantelon, Tim Oxley, Marc Harter, T.J. Holowaychuk, and Nathan Rajlich, Manning, 2nd Edition, 2017
4. "Node.js Design Patterns" by Luciano Mammino and Mario Casciaro, 3rd Edition, 2022.
5. 5.“Web Development with MongoDB and Node JS” by Mithun Satheesh, Bruno Joseph D'mello, Jason Krol, Packt Publishing Limited; 2nd edition, 2015.

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6. "Web Development with Node and Express" by Ethan Brown, O'Reilly Media, Inc. 2nd Edition, 2019.
7. "Pro Git" by Scott Chacon, Ben Straub, Apress, 2nd edition, 2014.

ONLINE LEARNING MATERIALS

1. Introduction to Web Development with HTML, CSS, JavaScript | Coursera
2. Getting Started with Git and GitHub | Coursera
3. Developing Back-End Apps with Node.js and Express | Coursera
4. Introduction to MongoDB | Coursera
5. [Project] Build a CRUD Node.js and MongoDB employee management web-app | Coursera

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U18ITE0227 **UI AND UX DESIGN**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Understand the difference between UI and UX design to explain the significance of empathy techniques in gathering user insights. [K2]

CO2: Apply UI design principles to implement visual design standards and UI components to enhance user interaction. [K3]

CO3: Understand UX research techniques to align user and business goals with the industry based design process. [K2]

CO4: Apply wireframing and prototyping techniques to create and test responsive designs [K3]

CO5: Apply essential concepts of Figma to create interactive user centered design. [K3]

Prerequisite: U18ITI6203-Web Technology

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S		M							M		M			
CO2	S		M							M		M			
CO3		S		M											
CO4		S		M											
CO5	S		M							M					

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

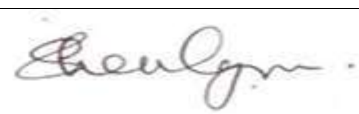
THEORY COMPONENT CONTENTS

INDUSTRY-RELEVANT DESIGN THINKING **6 Hours**

Understanding UI vs. UX Design, Design Thinking Framework, Innovative Thinking Methods, Empathy Techniques for User Insights.

UI DESIGN PRINCIPLES FOR INDUSTRY **6 Hours**

Visual Design Standards, UI Components and Design Patterns, User Interaction and Engagement,



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Branding Integration and Style Guides.

UX RESEARCH AND STRATEGY IN THE INDUSTRY **6 Hours**

UX Fundamentals for Business Impact Design Process, Industry Research Techniques, Aligning User and Business Goals.

WIREFRAMING, PROTOTYPING AND TESTING **6 Hours**

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.

LOW CODE -NO CODE TOOLS **6 Hours**

Low code- No code Tools Essential Concepts of Figma - Setup and Configure Figma - Images, Shapes, and Tools - Working with Figma - Figma Components - Styles and Libraries in Figma - Cards and Layout Grids in Figma.

LAB CONTENTS: **30 Hours**

Sample Experiments:

1. Designing a Responsive layout for a societal application.
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open-source software
5. Exploring various open-source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
10. Identify a customer problem to solve.
11. Designing a User Interface with Figma
12. Creating and Managing Layout Grids and Components in Figma.

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

REFERENCES:

1. Joel Marsh, UX for Beginners, O'Reilly, 2022.
2. Jon Yablonski, Laws of UX: Using Psychology to Design Better Products & Services, O'Reilly, 2021.
3. Don Norman, The Design of Everyday Things: Revised and Expanded Edition, Basic Books, 2013.
4. Steve Krug, Don't Make Me Think: A Common Sense Approach to Web Usability, New

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Riders, 2014.
5. Jeffrey Zeldman and Ethan Marcotte, Responsive Web Design, A Book Apart, 2011.
6. Kim Goodwin, Designing for the Digital Age: How to Create Human-Centered Products and Services, Wiley, 2009.

ONLINE COURSES:

1. https://www.coursera.org/learn/designing-user-interfaces-and-experiences-uiux

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U18ITE0228 **PRINCIPLES OF DEVOPS**

L	T	P	J	C
2	0	2	0	3

<u>COURSE OUTCOMES</u>

After successful completion of this course, the students should be able to

CO1: Apply DevOps principles to meet software development requirements. [K3]

CO2: Understand different actions performed through Version control tools like Git [K2]

CO3: Apply the microservices architecture in the DevOps Environment. [K3]

CO4: Apply continuous integration and continuous deployment using Jenkins and docker[K3]

CO5: Analyze the use of configuration management tools like Ansible to distinguish between different approaches to infrastructure. [K4]

Prerequisite: U18ITI5304-Software Engineering

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S		M							M		M			
CO2	S		M							M		M			
CO3		S		M										S	
CO4		S			M									S	
CO5		S			M				M					S	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

<u>THEORY COMPONENT CONTENTS</u>

INTRODUCTION TO DEVOPS 6 HOURS

Overview of DevOps-DevOps Lifecycle-Essential Characteristics of DevOps- Tools and Technologies- Social Coding Principle-Version control systems: Git and GitHub-Importance of version control in CICD pipeline.

MICROSERVICES 6 HOURS

Monolith vs SOA vs Microservices - Microservices- Microservices Patterns - Introduction to

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Serverless Computing- Introduction to the FaaS Model- The Serverless Framework.

CONTINUOUS INTEGRATION USING JENKINS **6 HOURS**

Essentials of Continuous Integration- Jenkins tool Management- Installing Jenkins- Architecture- Creating a Jenkins Job- Configuration- Customizing Jenkins with plugins- database user creation Creating a Jenkins Build and Jenkins workspace

CONFIGURATION MANAGEMENT **6 HOURS**

Introduction - Infrastructure as Code- Configuration Management Tools- Automating Infrastructure Provisioning-Introduction to Ansible – Installation and Configuration- Ansible Architecture, Ansible and Infrastructure Management

CONTINUOUS DEPLOYMENT **6 HOURS**

Overview of Docker-Benefits of Docker Workflow- Process Simplification-Architecture- Docker Containers-Docker Workflow- Anatomy of Dockerfile-Building an Image-Running an Image-Custom base Images, Storing Images.

LAB CONTENTS: **30 Hours**

1.Version Control with Git and GitHub.
2. Continuous Integration with Jenkins
3. Customizing Jenkins with Plugins
4. Infrastructure as Code with Ansible
5. Creating and Running Docker Containers.
6. Continuous Deployment with Docker and Jenkins.
7. Configuration Management and Infrastructure Provisioning with Ansible
8. Building and Managing Docker Workflows

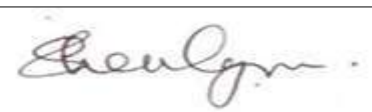
Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES:

1. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019. 6.
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016. 5. Mariot Tsitoara.

ONLINE COURSES:

1. https://www.coursera.org/professional-certificates/devops-and-software-engineering
2. https://www.coursera.org/learn/intro-to-devops?specialization=devops-and-software-engineering



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3. https://www.coursera.org/learn/intro-to-devops?specialization=devops-and-software-engineering
4. https://www.jenkins.io/doc/book/getting-started/

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U18ITE0229 IOS APPLICATION DEVELOPMENT USING SWIFT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Apply Swift programming constructs to develop and execute basic code snippets using playgrounds within a defined timeline[K3]

CO2: Construct Swift programs using operators, conditionals, and loops to solve well-defined programming problems with measurable logic and correctness.[K4]

CO3: Analyze and debug Swift programs in Xcode to ensure error-free execution through systematic testing and validation. [K3]

CO4: Design and implement simple mobile applications using Swift and Xcode to demonstrate understanding of app development fundamentals[K3]

Pre-requisite: Nil

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)												**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1			S	M	M								S		
CO2			S	M	M								S		
CO3			S	S	S								S		
CO4			S	S	S								S		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO SWIFT PROGRAMMING AND CONTROL STRUCTURES 6 Hours

Introduction to Swift and Playgrounds - Constants, Variables - Naming Constants and Variables, Data Types - Type Safety - Type Inference - Operators - Basic Arithmetic - Numeric Type Conversion - Logical and Comparison Operators - Control Flow - If Statements - If Else Statements- Switch Statements.

XCODE ENVIRONMENT AND INTERFACE BUILDER ESSENTIALS 6 Hours

Xcode - Xcode Files Types - Xcode Preference - Building, Running, and Debugging an App - Interface Builder Basics - Storyboards - Interface Builder Layout - Outlets and Actions.

UIKIT FUNDAMENTALS AND USER INTERFACE 6 Hours

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Introduction to UIKit Strings - Concatenation and Interpolation - String Equality and Comparison - Functions - Parameters - Return Values - Structures - Instances - Instance Methods - Classes and Inheritance Collections - Arrays - Dictionaries - Loops - For Loops - While Loops. Common System Views - View Controllers - Displaying Data Controls In Action - Buttons - Switches - Sliders - Text Fields - Actions and Outlets - Auto Layout and Stack Views.

ADVANCED SWIFT CONCEPTS AND NAVIGATION TOOLS **6 Hours**
Optionals - Functions and Optionals - Type Casting and Inspection - Guard - Guard with Optionals - Constant and Variable Scope - Enumerations - Segues and Navigation Controllers.

APP NAVIGATION AND VIEW CONTROLLER LIFECYCLE **6 Hours**
Navigation Controllers - Tab Bar Controllers - View Controller Life Cycle- View Did Load - View Event Management

LAB CONTENTS: **30 Hours**
To understand the fundamentals of iOS application development using Swift and Xcode. Learn to design and develop user interfaces using Interface Builder and UIKit, apply Swift programming concepts, and build simple mobile applications for real-world use cases.

SAMPLE EXPERIMENT:
1. Introduction to Swift Playground: Write basic Swift programs to practice variables, data types, and control structures.
2. Build a simple calculator application using Swift Playground.
3. Explore Xcode environment: Study different file types, preferences, and interface components.
4. Design and develop a basic Light Control App using Interface Builder in Xcode.
5. Develop a Color Picker Application using UIKit views and controls like sliders and buttons.
6. Build a Xylophone Application using sound libraries and interface components.
7. Design and develop a Traffic Light App using Segues and Navigation Controllers.
8. Create a Simple Alarm Application utilizing Tab Bar Controller and managing the View Controller Life Cycle.
9. Implement basic Auto Layout and Stack Views for responsive UI design.
10. Explore advanced Swift features like Optionals, Guard statements, and Type Casting through mini coding tasks.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES:

1. Apple Education, Develop in Swift: Fundamentals, First Edition, Apple Inc., ISBN: 978-1581182804, 2021.
2. Erica Sadun, The Swift Programming Language, Addison-Wesley Professional, First Edition, 2015, ISBN: 978-0321967203.
3. Matt Neumann, Beginning Xcode: Swift Edition, Apress, First Edition, 2015, ISBN: 978-1484206186.
4. Craig Clayton Hoffman, iOS Programming for Beginners: Kickstart your iOS app development journey with a hands-on guide to Swift 5.7 and Xcode 14, Packt Publishing, First Edition, 2022, ISBN: 978-1803237046.

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5. Ray Mark, iOS Apprentice: Beginning iOS Development with Swift, Razeware LLC, Sixth Edition, 2022, ISBN: 978-1950325624.
6. Erica Sadun, Swift Pocket Reference, O'Reilly Media, First Edition, 2015, ISBN: 978-1491900821.

ONLINE COURSES:

1. https://coursera.org/learn/programming-fundamentals-swift
2. https://coursera.org/professional-certificates/meta-ios-developer

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U18ITE0030 **SERVICE ORIENTED ARCHITECTURE**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Understand the fundamentals of Service-Oriented Architecture (SOA) and Microservices Architecture (MSA) along with their evolution and drivers. [K2]

CO2: Apply service-oriented analysis and design methodologies to develop service-based enterprise applications.[K3]

CO3: Analyze patterns and models for designing service-oriented applications, including activity, data, client, and business process services.[K4]

CO4: Apply SOA technologies, governance strategies, and Big Data integration techniques to real-world scenarios.[K3]

CO5: Analyze the role of Microservices Architecture (MSA) in cloud and mobile environments, and its contribution to modern system development. [K4]

Pre-requisite: NIL

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M												M	
CO2	S	S	S												
CO3	S	S	S												
CO4	M	S												S	
CO5	S		M											S	

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Assignment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION **5 Hours**

SOA and MSA Basics- Service Orientation in Daily Life- Evolution of SOA and MSA- Service oriented

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Architecture and Microservices architecture – Drivers SOA- Dimensions of SOA- Conceptual Model of SOA- Standards and Guidelines for SOA-Emergence of MSA.

SERVICE ORIENTED ARCHITECTURE **10 Hours**

Enterprise-Wide SOA-Considerations for Enterprise-wide SOA- Strawman Architecture for Enterprise-wide SOA- Enterprise SOA Reference Architecture- Object-oriented Analysis and Design (OOAD) Process- Service oriented Analysis and Design (SOAD) Process - SOA Methodology for Enterprise. Service-Oriented Applications: Considerations for Service-oriented Applications- Patterns for SOA- Pattern based Architecture for Service-oriented Applications Composite Applications - Programming Model.

SERVICE-ORIENTED ANALYSIS AND DESIGN **10 Hours**

Need for Models- Principles of Service Design- Non-functional Properties for Services- Design of Activity Services - Design of Data Services- Design of Client Services - Design of Business Process Services. Technologies for SOA: Technologies for Service Enablement - Technologies for Service Integration - Service Orchestration - SOA Governance and Implementation: Strategic Architecture Governance - Service Design - Time Governance - Service Run-time Governance- Approach for Enterprise-wide SOA Implementation.

BIG DATA AND SOA **10 Hours**

Concepts - Big Data and its characteristics - Technologies for Big Data -Service-Orientation for Big Data Solutions - Business Case for SOA - Stakeholder Objectives - Benefits of SOA - Cost Savings - Return on Investment (ROI) - Build a Case for SOA - SOA Best Practices: SOA Strategy – Best Practices- SOA Development – Best Practices- SOA Governance – Best Practices- EA and SOA for Business and IT Alignment: Enterprise Architecture- Need for Business and It Alignment- EA and SOA for Business and Its Alignment.

MICROSERVICES ARCHITECTURE **10 Hours**

Trend in SOA: Microservices Architecture (MSA)- Services Model for Cloud and Mobile Solutions - API Adoption on the Rise - Challenges and Takeaways from SOA Implementations- Architecture Trend – Microservices Architecture - Microservices Architecture in Action. Cloud and MSA Cloud Services- Hybrid Cloud Services- Considerations for Hybrid Cloud Services Cloud Services and MSA-MSA for SMAC Solutions. Mobile and MSA: Mobile Technologies Types of Mobile Applications-MSA for mobile solutions.

Theory: 45	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 45 Hours**

REFERENCES:

1. Shankar Kambhampaty; Service - Oriented Architecture & Microservices Architecture: For Enterprise, Cloud, Big Data and Mobile, Wiley,3rd Edition, 2018.
2. Thomas Erl, “Service-Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2016.
3. Gerardus Blokdyk, Service-Oriented Architecture: A Complete Guide – 2020 Edition, 5STARCooks, 2021.
4. Arduino Programming in 24 hours, Richard Blum, 1st Edition, ISBN: 978-0672337123, Sams Tech Yourself Publishing.
5. Chellammal Surianarayanan, Ganapathy S., Pethuru Raj, Essentials of Microservices Architecture: Paradigms, Applications, and Techniques, CRC Press, 2020.

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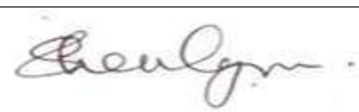
ONLINE COURSES:

1. What is Service-Oriented Architecture (SOA)? | IBM
2. Implementing Microservices on AWS - Implementing Microservices on AWS
3. Service-oriented architecture - .NET | Microsoft Learn
4. Introduction to Big Data | Coursera
5. https://cloud.google.com/learn/what-is-microservices-architecture



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U18ITE0031	SOFTWARE QUALITY MANAGEMENT

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Explain foundational principles of software quality and apply standard software quality models (K2)

CO2: Design and implement a software quality assurance (SQA) plan for a given software project, incorporating appropriate standards, processes, and metrics to ensure software quality. (K3)

CO3: Analyse and compare different software quality control methods and reliability models to determine their effectiveness in ensuring software quality. (K4)

CO4: Apply the principles of software quality management systems to improve the quality processes of a software project. (K3)

CO5: Apply the maturity of software processes using models and assess the relevance of global certification standards for improving software quality and organizational performance. (K3)

Pre-requisite: U18CSI4204 / Software Engineering

Cos	CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1		M			S								S		
CO2		S			S					M			S		
CO3		S			S								S		
CO4		M			S					M			S		
CO5		M			M					S			M		

COURSE ASSESSMENT METHODS

DIRECT
1. Continuous Assessment Test I, II 2. Assignment, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO SOFTWARE QUALITY **9 Hours**

Definition and Evolution of Software Quality - Quality Characteristics of Software Products - Quality Assurance vs. Quality Control - McCall's Quality Model and Boehm's Quality Model- ISO/IEC 25010:2011 Framework Overview - Quality Goals and Customer Focus - Software Quality Metrics: Product and Process

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Metrics.

SOFTWARE QUALITY ASSURANCE AND PLANNING **9 Hours**
Principles and Goals of Software Quality Assurance (SQA) - Components and Organization of SQA - SQA Activities across the Software Lifecycle - Software Reviews: Walkthroughs, Inspections, Audits - Risk Management in SQA - Developing a Software Quality Assurance Plan (SQAP)- Documentation and Change Control.

SOFTWARE TESTING AND RELIABILITY **9 Hours**
Testing Fundamentals: Objectives, Principles, Types - Static vs. Dynamic Testing - Test Planning, Design, Execution, and Reporting - Defect Management and Root Cause Analysis - Software Reliability Engineering Concepts - Reliability Growth Models and Prediction Techniques - Failure Analysis: Fault Tree and FMECA.

SOFTWARE QUALITY STANDARDS AND MODELS **9 Hours**
ISO 9001:2015 for Software Organizations - Capability Maturity Model Integration (CMMI): Levels and Key Process Areas - Six Sigma and DMAIC in Software Quality -Total Quality Management (TQM) Principles - Benchmarking and Process Improvements - Quality Audits and Compliance Tracking - Case Study: Implementing ISO and CMMI in Real Projects.

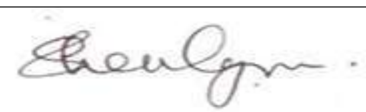
TOOLS, CERTIFICATIONS, AND EMERGING TRENDS **9 Hours**
Tools for Quality Assurance and Control: JIRA, Selenium, QTP - Metrics and Dashboards in Quality Monitoring - Overview of Software Certification Programs - Software Process Improvement Models (SPICE, ISO/IEC 15504) - Agile and DevOps Quality Practices - AI and Automation in Quality Assurance - Future Directions in Software Quality Engineering.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES:

1. Shravan Pargaonkar, A Guide to Software Quality Engineering, Taylor & Francis, 2023.
2. Abu Sayed Mahfuz, Software Quality Assurance: Integrating Testing, Security, and Audit, Routledge, 2021.
3. Galin, Daniel, Software Quality Assurance: From Theory to Implementation, Pearson Education, 2017.
4. Anirban Basu, Software Quality Assurance, Testing and Metrics, PHI Learning, 2021.
5. Dr. M. Kameswari et al., Software Quality Assurance: Principles and Practice, SKRGC Publications, 2023.
6. Stephan Goericke (Ed.), The Future of Software Quality Assurance, Springer, 2020.

ONLINE COURSES:
1. nptel.ac.in/courses/106105087
2. ISO 25010
3. nptel.ac.in/courses/106105218
4. CMMI Institute - CMMI
5. nptel.ac.in/courses/110101010
6. The Selenium Browser Automation Project | Selenium
7. What is JIRA Testing Tool? Tutorial for Beginners
8. DevOps Culture and Mindset | Coursera



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U18ITE0537 **DEVOPS MASTERY**

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of DevOps, Linux, and networking concepts required for automation.
- To apply Git and CI/CD practices for automating build and integration using Jenkins.
- To develop and deploy containerized applications using Docker and Kubernetes.
- To implement Infrastructure-as-Code for automated configuration and provisioning using Ansible and Terraform.
- To integrate end-to-end DevOps pipelines combining CI/CD, Docker, Kubernetes, and IaC for efficient deployment and monitoring.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Explain the fundamentals of DevOps, Linux, and networking concepts relevant to software automation. [K2]

CO2: Apply Git and CI/CD practices to automate build and integration workflows using Jenkins. [K3]

CO3: Develop and deploy containerized applications using Docker and Kubernetes orchestration. [K3]

CO4: Implement Infrastructure-as-Code using Ansible and Terraform to automate configuration and provisioning. [K3]

CO5: Apply end-to-end DevOps tools to automate deployment and monitoring processes. [K3]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes(POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	S											
CO2	S				S							
CO3	S		S					M				
CO4	S							M				
CO5	S				S				S			

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COURSE ASSESSMENT METHODS:

DIRECT
1. Project 2. Project presentation/Report 3. Lab Assignments, 4. Demo presentations, 5. Quiz/peer review(optional)
INDIRECT
1. Course-end survey

PRACTICAL COMPONENTS:

DEVOPS FOUNDATIONS & LINUX FUNDAMENTALS LAB **18 Hours**

- Linux file system navigation
- User, group, and permission management
- Shell scripting for automation
- Networking essentials: IP, ports, protocols

Lab tasks:

- Execute Linux command sets, write shell scripts
- Configure networking utilities and environment setup

VERSION CONTROL & CI/CD AUTOMATION LAB **18 Hours**

- Git fundamentals, branching, merging, conflict resolution
- GitHub workflows
- Jenkins setup, job configuration, CI pipeline scripting

Lab tasks:

- Create Git repositories and branching workflows
  Build a Jenkins CI pipeline with automated triggers

CONTAINERIZATION & KUBERNETES ORCHESTRATION LAB **18 Hours**

- Docker architecture, Dockerfile, images, containers
- Docker Compose services
- Kubernetes architecture, pods, deployments, services
- Scaling, load balancing

Lab tasks:

- Containerize an application and deploy using Kubernetes locally.

INFRASTRUCTURE-AS-CODE & AUTOMATION LAB **18 Hours**

- Ansible playbooks, roles, inventory
- Terraform providers, resources, and state
- Automated provisioning and configuration

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Lab tasks:

- Configure multi-node environments using Ansible
- Provision infrastructure using Terraform scripts

DEVOPS INTEGRATION & MONITORING LAB **18 Hours**

- Integrating CI/CD with Docker, Kubernetes, Ansible, Terraform
- Deployment strategies: blue-green, rolling
- Monitoring: Prometheus, Grafana
- Logging, security practices

Lab tasks:

- Build an integrated CI/CD → Docker → K8s → IaC pipeline
- Configure monitoring dashboards.

Theory: 0	Tutorial: 0	Practical: 90	Project: 0	Total: 90 Hours

REFERENCES:

1. Gene Kim, Jez Humble, Patrick Debois, John Willis, The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, Second Ediiton,2021
2. Rafal Leszko, Continuous Delivery with Docker and Jenkins, Third Edition,2023
3. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
4. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.

ONLINE COURSES:

1. https://www.coursera.org/specializations/devops-mastery
2. https://www.coursera.org/professional-certificates/devops-and-software-engineering
3. https://www.coursera.org/learn/intro-to-devops?specialization=devops-and-softwareengineering
4. https://www.jenkins.io/doc/book

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OTHER PROFESSIONAL ELECTIVE COURSES

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U18ITE0001 ARTIFICIAL INTELLIGENCE

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To introduce artificial intelligence (AI) principles and approaches.
- Develop a basic understanding of the building blocks of AI

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1	Demonstrate the awareness of intelligent agents and problem solving using different search algorithms
CO2	Interpret the use of different knowledge representation methods.
CO3	Make use of uncertain knowledge for planning and reasoning in AI applications
CO4	Explain the basics of decision making.
CO5	Apply the knowledge of machine learning methods in AI applications

Pre-requisite: U18MAT3102 - DISCRETE MATHEMATICS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	M	M										M		
CO2	M	M											M		
CO3	S	M	M							M			M		
CO4	M												M		
CO5	M	M										M	M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

INTRODUCTION AND PROBLEM SOLVING **10 Hours**

Intelligent Agents. forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms

KNOWLEDGE REPRESENTATION AND REASONING **8 Hours**

Ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge

PLANNINGAND REASONING WITH UNCERTAIN KNOWLEDGE **10 Hours**

Planning as search, partial order planning, construction and use of planning graphs, probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference

DECISION-MAKING **8 Hours**

Basics of utility theory, decision theory, sequential decision problems, elementary game theory

MACHINE LEARNING AND KNOWLEDGE ACQUISITION **9 Hours**

Learning from memorization, examples, explanation, and exploration. learning nearest neighbour, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.

Theory: 45 Tutorial: 0 Practical:0 Project: 0 Total: 45 Hours

REFERENCES:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 3rd Edition, Pearson Education / Prentice Hall of India, 2015.
2. Judith Hurwitz, Marcia Kaufman, “Cognitive Computing and Big Data Analytics”, Wiley Publication, April 2015
3. Elaine Rich, Kevin Knight, ShivashankarB.Nair, “Artificial Intelligence”, Tata McGraw Hill Publishing Company Limited. Third Edition , 2009
4. Nils J. Nilsson, “Artificial Intelligence: A new Synthesis”, Harcourt Asia Pvt. Ltd.,2000.
5. George F. Luger, “Artificial Intelligence-Structures and Strategies For Complex Problem Solving”, Pearson Education / PHI, 2002
6. David L. Poole, Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.

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U18ITE0002 **DEEP LEARNING**

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge on the basics of neural networks.
- To implement neural networks using computational tools for variety of problems.
- To explore various deep learning algorithms

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Explain the fundamental principles, theory and approaches for learning with deep neural networks

CO2: Explain the main variants of deep learning and their typical applications

CO3: Analyze the key concepts, issues and practices when training and modeling with deep architectures

CO4: Analyze the learning tasks

CO5: Apply deep learning in the context of other ML approaches

Pre-requisite: U18ITI7203 - MACHINE LEARNING

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	M	M										M		
CO2	M	M											M		
CO3	S	M	M							M			M		
CO4	M												M		
CO5	M	M										M	M		

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

<u>THEORY COMPONENT CONTENTS</u>

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Introduction to Deep learning **9 Hours**
Linear Regression -Nonlinear Regression- Logistic Regression Activation
Convolutional Neural Networks (CNN) **9 Hours**
CNN History- Understanding CNNs- CNN Application

Recurrent Neural Networks (RNN) **9 Hours**
Intro to RNN Model Long Short-Term memory (LSTM) Recursive Neural Tensor Network Theory Recurrent Neural Network Model

Unsupervised Learning **9 Hours**
Applications of Unsupervised Learning-Restricted Boltzmann Machine-Collaborative Filtering with RBM

Autoencoders **9 Hours**
Introduction to Autoencoders and Applications- Autoencoders- Deep Belief Network

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, The MIT Press
2. Rajiv Chopra, Deep Learning: A Practical Approach, Khanna Publication
3. Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly Media,August 2017
4. MOOC, Deep Learning By Google, https://in.udacity.com/course/deep-learning--ud730
5. MOOC, Deep Learning https://www.coursera.org/specializations/deep-learning

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U18ITE0003	**DATA VISUALIZATION**	

L	T	P	J	C
3	**0**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis. Ranking analysis, deviation analysis
- To understand visualization for distribution, correlation and multivariate analysis
- To understand issues and best practices in information dashboard design.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1	Explain principles of visual perception
CO2	Apply core skills for visual analysis
CO3	Explain visualization for time-series analysis and ranking analysis.
CO4	Outline visualization for deviation ,distribution , correlation and multivariate analysis
CO5	Demonstrate the skills in information dashboard design

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	M	M										M		
CO2	M	M											M		
CO3	S	M	M							M			M		
CO4	M												M		
CO5	M				M					M		M	M		M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

CORE SKILLS FOR VISUAL ANALYSIS 9 Hours

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 9 Hours

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

DISTRIBUTION, CORRELATION ANALYSIS 9 Hours

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices

MULTIVARIATE ANALYSIS 9 Hours

Multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

INFORMATION DASHBOARD DESIGN 9 Hours

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

REFERENCES:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and JesperThorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
6. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
7. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.

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8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

Theory: 45 Tutorial: 0 Practical:0 Project: 0 Total: 45 Hours

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U18ITE0004 INFORMATION CODING TECHNIQUES

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To understand Information properties and source coding techniques
- To acquire knowledge about error coding techniques for efficient transmission
- To understand various compression algorithms for data, Image and video

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Apply the suitable coding schemes for information.

CO2 Make use of coding schemes for text compression .

CO3 Illustrate the compression schemes for video and image.

CO4 Utilize the various types of error control codes.

CO5 Construct the code tree and state diagram for error control codes

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M										M	M		
CO2	M	M										M	M		
CO3	M	M										M	M		
CO4	M	M										M	M		
CO5	M	M										M	M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

INFORMATION THEORY **9 Hours**

Information–Entropy-Informationrate-classificationofcodes-KraftMcMillaninequality-Source coding theorem–Shannon – Fano coding – Huffman coding–Extended Huffman coding – Joint and conditional entropies – Mutual information-Discrete memory less channels–BSC- BEC – Channel capacity-Shannon limit.

SOURCE CODING:TEXT, AUDIO AND SPEECH **9 Hours**

Text:Adaptive Huffman Coding – Arithmetic Coding – LZW algorithm–Audio:Perceptual coding-Masking techniques – Psycho acoustic model-MEG Audio layersI,II,III,DolbyAC3-Speech: Channel Vocoder-Linear Predictive Coding.

SOURCE CODING : IMAGE AND VIDEO **9 Hours**

Image and Video Formats–GIF–TIFF– SIF–CIF – QCIF–Image compression : READ- JPEG – Video Compression: Principles-I, B, P frames - Motion estimation - Motion compensation - H.261 -MPEG standard.

ERROR CONTROL CODING : BLOCK CODES **9 Hours**

Definitions and Principles: Hamming weight-Hamming distance-Minimum distance decoding –Single parity codes – Hamming codes – Repetition codes – Linear block codes – Cyclic codes –Syndrome calculation-Encoder and decoder– Cyclic Redundancy check codes.

ERROR CONTROL CODING : CONVOLUTIONAL CODES **9 Hours**

Convolutional codes – code tree – trellis-state diagram-Encoding–Decoding : Sequential search and Viterbi algorithm– Principle of Turbo coding.

REFERENCES:

1. Simon Haykin, Communication Systems,fourth edition,JohnWiley&Sons,2014.
2. Bose.R,–Information Theory, Coding And Cryptography, TMH 2011
3. Fred Halsall,Multimedia Communications: Applications, Networks, Protocols And Standards, Pearson Education Asia, 2011
4. Sayood.K, Introduction To Data Compression, Fourth edition, Elsevier, 2014.
5. Gravano. S, –Introduction To Error Control Codes, Oxford University Press, 2010.

Theory: 45 **Tutorial: 0** **Practical:0** **Project: 0** **Total: 45 Hours**

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U18ITE0005 **WEB APPLICATION SECURITY**

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- Understand foundations of Web application paradigm
- Introduce the idea of penetration testing strategies
- Understand in detail about the vulnerabilities and defence mechanism

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Explain the architecture web application architecture
CO2 Demonstrate Core Defence Mechanisms
CO3 Explain the authenticated attacking mechanism
CO4 Explain various process of attacking user
CO5 Design attacking mechanism for Native Software Vulnerabilities

Pre-requisite: U18ITT5001 - CRYPTOGRAPHY AND NETWORK SECURITY,
U18ITI6203 - WEB TECHNOLOGY

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M										M	M		
CO2	M	M										M	M		M
CO3	M	M						S				M	M		M
CO4	M	M						S				M	M		M
CO5	M	M										M	M		M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

<u>THEORY COMPONENT CONTENTS</u>

WEB APPLICATION ARCHITECTURE **9 Hours**

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Web Application Insecurity, Core Defense Mechanisms, Web Application Technologies, Mapping and Analyzing the Application

DEFENSE MECHANISMS **9 Hours**

Bypassing Client Side Controls, Attacking Authentication, Attacking Session Management, Attacking Access Controls

ATTACKING MECHANISMS **9 Hours**

Attacking Data Stores, Attacking Back-End Components, Attacking Application Logic

ATTACKING USERS **9 Hours**

Attacking Users: Cross Site Scripting, Other Techniques, Automating Customized Attacks, Exploiting Information Disclosures

NATIVE SOFTWARE VULNERABILITIES **9 Hours**

Attacking Native Compiled Applications, Attacking Application Architecture, Attacking the Application Server, Finding Vulnerabilities in the Source Code-Approaches and Signatures of Common Vulnerabilities

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. DafyddStuttard and Marcus Pinto, “ The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws” , 2nd edition, Wiley, 2011
2. Michael Cross , “Developer's Guide to Web Application Security” 1st Editiosyngress,2007
3. OWASP Top 10 Vulnerabilities at https://www.owasp.org/images/7/72/OWASP_Top_10-2017_%28en%29.pdf.pdf
4. https://www.udemy.com/topic/web-security

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U18ITE0006 **BIOMETRIC SYSTEMS**

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Biometrics and its functionalities
- To expose the concept of IRIS and sensors
- To expose the context of Biometric Applications
- To learn to develop applications with biometric security

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Identify the various Biometric technologies.
CO2 Explain the role of biometric in the organization
CO3 Design of an IRIS recognition system
CO4 Develop simple applications based on behavioral biometrics
CO5 Summarize the need for biometric system in the society

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M										M	M		
CO2	S	M										M	M		
CO3	M	M	M									M	M		
CO4	S	M						M				M			M
CO5	M	M						S				M			M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course Exit Survey

THEORY COMPONENT CONTENTS

INTRODUCTION **9 Hours**

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Person Recognition – Biometric systems –Biometric functionalities: verification, identification –Biometric systems errors - The design cycle of biometric systems – Applications of Biometric systems– Security and privacy issues

FINGER PRINT AND FACIAL RECOGNITION 9 Hours

FINGERPRINT: Introduction – Friction ridge pattern- finger print acquisition:sensing techniques, image quality –Feature Extraction –matching –indexing. FACE RECOGNITION: Introduction –Image acquisition: 2D sensors,3D sensors- Face detection- Feature extraction -matching.

IRIS AND OTHER TRAITS 9 Hours

Design of an IRIS recognition system-IRIS segmentation- normalization – encoding and matching IRIS quality –performance evaluation –other traits- ear detection –ear recognition –gait feature extraction and matching –challenges- hand geometry –soft biometrics.

BEHAVIORAL BIOMETRICS 9 Hours

Introduction –Features- classification of behavioral biometrics –properties of behavioral biometrics –signature –keystroke dynamics –voice- merits –demerits –applications- error sources-types –open issues –future trends.

APPLICATIONS AND TRENDS 9 Hours

Application areas: surveillance applications- personal applications –design and deployment – user system interaction-operational processes – architecture –application development –design validation disaster recovery plan-maintenance-privacy concerns.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. James wayman,Anilk.Jain,ArunA.Ross,KarthikNandakumar, ―Introduction to BiometricsSpringer, 2011
2. John Vacca "Biometrics Technologies and Verification Systems" Elsevier 2007
3. James Wayman,AnilJain,DavidMAltoni,DasioMaio(Eds) "Biometrics SystemsTechnology", Design and Performance Evalution.Springer 2005
4. Khalid saeed with MarcinAdamski, TapalinaBhattasali, Mohammed K. Nammous, Piotrpanasiuk, mariusz Rybnik and soharabH.Sgaikh, ―New Directions in Behavioral Biometrics,CRC Press 2017
5. Paul Reid "Biometrics For Network Security "Person Education 2004
6. Shimon K.Modi , Biometrics in Identity Management :concepts to applications, Artech House 2011

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U18ITE0007 BLOCKCHAIN TECHNOLOGY

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES

- To acquire the basic knowledge and understandings of Bitcoin
- To understand the mechanisms of Bitcoin, Ethereum, Hyperledger
  To understand the current trends of Blockchain

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Discover the secure and efficient transactions with Bitcoin.
CO2 Identify and analyze the applications of Bitcoin script
CO3 Experiment with Bitcoin mining
CO4 Develop private Blockchain environment and develop a smart contract on Ethereum
CO5 Build the Hyperledger architecture and the consensus mechanism applied in the Hyperledger

Pre-requisite: U18ITT5002 - CRYPTOGRAPHY AND NETWORK SECURITY

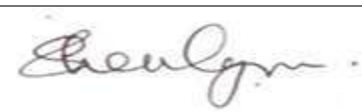
CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
Cos	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	S	M	M	M								M	M		
CO2	S	M	M										M		
CO3	S	M	M												M
CO4	S	S	M	M								M			M
CO5	S	M	M									M			M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group presentation 3. End Semester Exam
Indirect
1.Course Exit Survey

<u>THEORY COMPONENT CONTENTS</u>

CRYPTOCURRENCY AND BLOCKCHAIN- INTRODUCTION 9 Hours



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Cryptography and Cryptocurrency- Anonymity and Pseudonymity in Crypto currencies Digital Signatures-Cryptocurrency Hash Codes. Distributed networks-Blockchain- An Introduction Distinction between databases and Blockchain- Distributed ledger Blockchain ecosystem-Blockchain structure- Blockchain technology- Working - Permission and permission-less Blockchain

BITCOIN AND BLOCKCHAIN 9 hours

Bitcoin – history- Bitcoin- usage, storage, selling, transactions, working- Invalid Transactions- Parameters that invalidate the transactions- Scripting language in Bitcoin Applications of Bitcoin script- Nodes and network of Bitcoin- Bitcoin ecosystem

BITCOIN MINING 9 hours

Purpose of mining- Algorithm used in mining- Mining hardware- Bitcoin mining pools cloud mining of Bitcoin -Mining Incentives-Security and centralizations

ETHEREUM 9 hours

The Ethereum ecosystem, DApps and DAOs - Ethereum working- Solidity- Contract classes, functions, and conditionals- Inheritance & abstract contracts- Libraries- Types & optimization of Ether- Global variables- Debugging- Future of Ethereum- Smart Contracts on Ethereum- different stages of a contract deployment- Viewing Information about blocks in Blockchain- Developing smart contract on private Blockchain- Deploying contract from web and console

HYPERLEDGER 9 hours

Hyperledger Architecture- Consensus- Consensus & its interaction with architectural layers- Application programming interface- Application model -Hyperledger frameworks- Hyperledger Fabric -Various ways to create Hyperledger Fabric Blockchain network- Creating and Deploying a business network on Hyperledger Composer Playground- Testing the business network definition- Transferring the commodity between the participants

Theory: 45 Tutorial : 0 Practical : 0 Project : 0 Total hours:45

REFERENCES:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas M Antonopoulos 2018
2. Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations-2016.

OTHER ONLINE COURSES:

1. https://www.coursera.org/learn/ibm-blockchain-essentials-for-developers
2. https://www.coursera.org/learn/blockchain-basics

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L	T	P	J	C
3	0	0	0	3

U18ITE0008 ADHOC AND SENSOR NETWORKS

COURSE OBJECTIVES

- Understand the design issues and challenges in ad hoc and sensor networks.
- Learn the differenttypes of MAC and routing protocols of ad hoc networks.
- Learn the architecture and protocols of wireless sensor network

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1	Explain the concept of ad hoc and sensor networks, their applications and typical node and network architectures.
CO2	Explain the working of different types of adhoc routing protocols.
CO3	Compare wireless routing protocol's function and their implications on network performance
CO4	Explain the sensor network characteristics, sensor databases and query processing.
CO5	Explain various security threats to ad hoc networks and describe proposed solutions

Pre-requisite: U18ITI4204- COMPUTER NETWORKS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
Cos	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M												M		
CO2	M			W									M		
CO3	M		M										M		
CO4	M										W	M	M		
CO5	M	W		M		W	M						M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group presentation 3. End Semester Exam
Indirect

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1.Course Exit Survey

THEORY COMPONENT CONTENTS

INTRODUCTION **9 Hours**

Characteristics of wireless channel - Wireless local loop - IEEE 802.16 standard – HIPERACCESS -Ad hoc wireless networks: Introduction and issues - MAC protocols: Design issues - Goals and classification - MACAW: A media access protocol for wireless LANs- Distributed packet reservation multiple access protocol-Distributed priority scheduling and Medium access in Ad hoc networks- MAC protocol using directional antennas.

ROUTING PROTOCOLS **9 Hours**

Design issues – Classification – Wireless routing protocol - Location aided routing- Zone routing protocol - Hierarchical state routing protocol - Power aware routing protocol – Operation of multicast routing protocols - Classification of multicast routing protocols – Application-Dependent multicast routing

SECURITY IN AD HOC NETWORKS **9 Hours**

Security in ad hoc wireless networks – Network security requirements - Issues and challenges in security provisioning – Network security attacks – key management – secure routing in Ad hoc networks

WIRELESS SENSOR NETWORKS **9 Hours**

Architecture - Data dissemination - Date gathering - MAC protocols - Location discovery - Quality of sensor networks - Case study

SENSOR NETWORK DATABASE **9 Hours**

Sensor database challenges – Querying the physical environment – Query interfaces - High level database organization – In-Network aggregation – Temporal data – Emerging Applications.

Theory: 45 **Tutorial : 0** **Practical : 0** **Project : 0** **Total hours:45**

REFERENCES:

1. Siva Ram Murthy. C and Manoj B.S, "Ad hoc Wireless Networks: Architectures And Protocols ", Prentice Hall PTR, 2004
2. Toh C.K., "Ad hoc Mobile Wireless Networks: Protocols And Systems", Prentice Hall PTR, First edition 2002
3. Mohammad Ilyas, "The Handbook Of Ad hoc Wireless Networks", CRC press, 2002
4. Charles E. Perkins, "Ad hoc Networking", Addison –Wesley,2000
5. Stefano Basagni , et al " Mobile Ad hoc Networking", Wiley –IEEE press,2004
6. Zhao, Guibas "Wireless Sensor Networks" ,Morgan Kaufmann Publications,2004

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U18ITE0009	NEXT GENERATION NETWORKS	L	T	P	J	C
		3	0	0	0	3

COURSE OBJECTIVES

- To learn the technical, economic and service advantages of next generation networks.
- To learn the evolution of technologies of 4G and beyond.
- To learn Software defined Mobile Network issues and integrating challenges with LTE.
- To explore the NGN framework catering the services of end user with QoS provisioning.
- To learn about the NGM management and standards.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1	Describe the issues and challenges of wireless domain in future generation network design
CO2	Explain the evolution of technologies of 4G and beyond
CO3	Explore the LTE concepts and technologies
CO4	Outline the process of integrating SDN with LTE
CO5	Explain the NGN architectures, management and standardizations

Pre-requisite: U18ITI4204- COMPUTER NETWORKS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													PSO		
Cos	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M												M		
CO2	M												M		
CO3	M			M									M		
CO4	M	M		M								W	M		M
CO5	M					W		W				M	M	M	

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group presentation 3. End Semester Exam
Indirect
1. Course Exit Survey

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THEORY COMPONENT CONTENTS

INTRODUCTION **9 Hours**

Evolution of public mobile services -motivations for IP based services, Wireless IP network architecture –3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.

4G AND BEYOND **9 Hours**

Introduction to LTE-A –Requirements and Challenges, network architectures –EPC, E-UTRAN architecture-mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

SDMN-LTE INTEGRATION **9 Hours**

SDN paradigm and applications, SDN for wireless-challenges, Leveraging SDN for 5G network subiquitous connectivity-mobile cloud-cooperative cellular network-restructuring mobile networks to SDN-SDN/LTE integration benefits.

NGN ARCHITECTURE **9 Hours**

Evolution towards NGN-Technology requirements, NGN functional architecture- Transport stratum, service stratum, service/ content layer and customer terminal equipment function. NGN entities, Network and Service evolution -fixed, mobile, cable and internet evolution towards NGN.

NGN MANAGEMENT AND STANDARDIZATION **9 Hours**

NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management. Service and control management- End-to-End QoS and security. ITU and GSI-NGN releases, ETSI-NGN concept and releases, NGMN alliance and NGMN.

Theory: 45 Tutorial : 0 Practical : 0 Project : 0 Total hours:45

REFERENCES:

1. Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials" Wiley, January 2008.
2. MadhusangaLiyanage, Andrei Gurtov, Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", Wiley, June 2015.
3. Martin Sauter,"3G,4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition-2013.
4. Savo G Glisic," Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition- 2016.
5. Thomas Plavyk, ―Next generation Telecommunication Networks, Services and Management‖, Wiley & IEEE Press Publications, 2010.

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U18ITE0010 SOFTWARE DEFINED NETWORKS

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of software defined networks.
- To understand the separation of the data plane and the control plane.
- To study about the SDN Programming and applications.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Describe the integration of SDN with LTE

CO2 Explain the evolution and components of software defined networks

CO3 Explain the use of SDN in the current networking scenario

CO4 Design and develop various applications of SDN

CO5 Make use of Tools and Languages for programming SDN.

Pre-requisite: U18ITI4204- COMPUTER NETWORKS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
Cos	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M									M			M		
CO2	M									M			M		
CO3	M			W						M			M		
CO4	M	M	M							M			M	M	
CO5	M	M	M		M					M		M	M	M	M

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group presentation 3. End Semester Exam
Indirect
1. course Exit Survey

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THEORY COMPONENT CONTENTS

INTRODUCTION **9 Hours**

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes.

OPEN FLOW & SDN CONTROLLERS **9 Hours**

Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts

DATA CENTERS **9 Hours**

Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

SDN PROGRAMMING **9 Hours**

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications

SDN **9 Hours**

Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total hours:45

REFERENCES

1. Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, ―SDN: Software Defined Networks, O'Reilly Media, 2013.
3. SiamakAzodolmolky, ―Software Defined Networking with Open Flow, Packet Publishing, 2013.
4. Vivek Tiwari, ―SDN and Open Flow for Beginners‖, Amazon Digital Services, Inc., 2013.
5. Fei Hu, Editor, ―Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.

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U18ITE0011 **DISTRIBUTED SYSTEMS**

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- Understand the foundations of Distributed Systems.
- Introduce the idea of peer to peer services and file system.
- Understand in detail the system level and support required for distributed system.
- Understand the issues involved in process and resource management.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1 Explain the architecture of distributed systems
CO2 Demonstrate remote method invocation and objects.
CO3 Explain the distributed file system tools
CO4 Explain various process synchronization methods & ways to achieve its consistency
CO5 Design process and resource management systems

Pre-requisite: U18ITT4001 - OPERATING SYSTEMS

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	M										M	M		
CO2	M	M										M	M		
CO3	M	M										M	M		
CO4	M	M										M	M		
CO5	M	M							M			M	M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course Exit Survey

<u>THEORY COMPONENT CONTENTS</u>

INTRODUCTION **9 Hours**

Examples of Distributed Systems–Trends in Distributed Systems – Focus on resource sharing – Challenges. Case study: World Wide Web.

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COMMUNICATION IN DISTRIBUTED SYSTEM **9 Hours**

System Model – Inter process Communication - the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation and Objects: Remote Invocation – Introduction - Request-reply protocols - Remote procedure call - Remote method invocation. Case study: Java RMI - Group communication - Publish-subscribe systems - Message queues - Shared memory approaches -Distributed objects - Case study: Enterprise Java Beans from objects to components.

PEER TO PEER SERVICES AND FILE SYSTEM **9 Hours**

Peer-to-peer Systems – Introduction - Napster and its legacy - Peer-to-peer – Middleware - Routing overlays. Overlay case studies: Pastry, Tapestry- Distributed File Systems –Introduction - File service architecture – Andrew File system. File System: Features-File model -File accessing models - File sharing semantics Naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.

SYNCHRONIZATION AND REPLICATION **9 Hours**

Introduction - Clocks, events and process states - Synchronizing physical clocks- Logical time and logical clocks - Global states – Coordination and Agreement – Introduction - Distributed mutual exclusion – Elections – Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control - Timestamp ordering – Atomic Commit protocols -Distributed deadlocks – Replication – Case study – Coda.

PROCESS & RESOURCE MANAGEMENT **9 Hours**

Process Management: Process Migration: Features, Mechanism - Threads: Models, Issues, Implementation. Resource Management: Introduction- Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. George Coulouris, Jean Dollimore, Tim Kindberg, , "Distributed Systems: Concepts and Design", 5th Edition, Pearson Education, 2011.
2. A.tS. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006.
3. MukeshSinghal and N. G. Shivaratri, ―Advanced Concepts in Operating Systems‖, 1st Edition, McGraw-Hill, 2011.
4. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
5. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.

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U18ITE0012 PRINCIPLES OF COMPILER DESIGN

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To introduce the major concept areas of language translation and compiler design.
- To enrich the knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table.
- To extend the knowledge of parser by parsing LL parser and LR parsers.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1	Explain the various phases of a compiler
CO2	Construct DFA from a given regular expression
CO3	Outline the top-down and bottom-up parsing techniques
CO4	Develop the intermediate codes
CO5	Identify various types of optimizations on intermediate code and generate assembly code

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	Programme Outcomes(POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO1	M	W											M		
CO2	S	M											M		
CO3	M	M										W	M		
CO4	M	M											M		
CO5	M	M								M			M		

COURSE ASSESSMENT METHODS:

Direct
1. Continuous Assessment Test I, II 2. Assignment, Group Presentation 3. End Semester Examination
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

INTRODUCTION AND LEXICAL ANALYSIS **9 Hours**

Language Processors – The Structure of Compiler – Applications of Compiler Technology – Programming Language Basics. Lexical Analysis – The Role of the Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – The Lexical-Analyzer Generator - LEX– Finite Automata – From Regular Expression to Automata – Design of a Lexical-Analyzer Generator – Optimization of DFA-based Pattern Matchers.

SYNTAX ANALYSIS **9 Hours**

Introduction – Context-Free Grammars – Writing a Grammar – Top-Down Parsing – Recursive-Descent Parsing and Predictive Parsers - Bottom-up Parsing – Shift-Reduce Parsing and Operator Precedence Parsing - Introduction to LR Parsing: Simple LR – More Powerful LR Parsers – Canonical LR and LALR Parsers.

INTERMEDIATE CODE GENERATION **9 Hours**

Variants of Syntax Trees – Three-Address Code – Types and Declarations – Translation of Expressions – Type Checking – Control Flow – Back patching – Switch-Statements – Intermediate Code for Procedures.

CODE GENERATION **9 Hours**

Issues in the Design of a Code Generator – The Target Language – Addresses in the Target Code – Basic Blocks and Flow Graphs – Optimization of Basic Blocks – A Simple Code Generator – Peephole Optimization.

CODE OPTIMIZATION AND RUN-TIME ENVIRONMENT **9 Hours**

The Principal Sources of Optimization – Introduction of Data-Flow Analysis – Loops in Flow Graphs Run-Time Environments – Storage Organization – Stack Allocation of Space – Heap Management.

Theory: 45 Tutorial: 0 Practical:0 Project: 0 Total: 45 Hours

REFERENCES:

1. Alfred V. Aho et al "Compilers Principles, Techniques and Tools", Second edition, Pearson Education,2011.
2. Allen I. Holub, "Compiler Design in C", Prentice Hall of India, 2003.
3. Fischer C.N. and LeBlanc R.J. "Crafting a Compiler with C", Benjamin Cummings, 2003.
4. Bennet J.P. "Introduction to Compiler Techniques", Second edition, Tata McGraw-Hill, 2003.
5. Kenneth C. Louden, "Compiler Construction: Principles and Practice", Thompson Learning, 2003.

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L	**T**	**P**	**J**	**C**
3	**0**	**0**	**0**	**3**

U18ITE0013 GRAPHICS AND MULTIMEDIA

COURSE OBJECTIVES:

- To know the basics of computer graphics output primitives.
- To appreciate illumination and color models
- To gain knowledge about graphics hardware devices and software used
- To understand the 2D and 3D concepts with modeling.
- To know the basics of multimedia, compression, file handling and hypermedia.

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Explain graphics output primitives and color models.
CO2: Apply 2D and 3D geometric transformations on objects.
CO3: Summarize the graphics modeling process.
CO4: Describe the basics of multimedia, compression, file handling and hypermedia.
CO5: Model a simple application with animation.

Pre-requisites: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M													
CO2	S	M			M								M		
CO3	M	M													
CO4	M	M													
CO5	S	S			S	S			S	S	S	S	M		M

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Assignment 3. Mini Project 4. End Semester Examination
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

ILLUMINATION AND COLOR MODELS **11 Hours**

Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive color concepts - RGB color model - YIQ color model - CMY color model - HSV color model - HLS color model; Color selection. Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.

TWO-DIMENSIONAL GRAPHICS **7 Hours**

Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.

THREE-DIMENSIONAL GRAPHICS **9 Hours**

Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations - Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces.

TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods. CASE STUDY: OPENGL Programming

MULTIMEDIA SYSTEM DESIGN & MULTIMEDIA FILE HANDLING **9 Hours**

Multimedia basics − Multimedia applications − Multimedia system architecture − Evolving technologies for multimedia − Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases. Compression and decompression − Data and file format standards − Multimedia I/O technologies − Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies.

HYPERMEDIA **9 Hours**

Multimedia authoring and user interface – Hypermedia messaging – Mobile messaging – Hypermedia message component – Creating hypermedia message – Integrated multimedia message standards – Integrated document management – Distributed multimedia systems. CASE STUDY: BLENDER GRAPHICS - Blender Fundamentals–Drawing Basic Shapes–Modelling–Shading & Textures-Wrapping

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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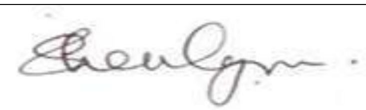
REFERENCES

1. Donald Hearn, M. Pauline Baker, “Computer Graphics”, Second edition, Prentice Hall, 2014.
2. PrabhatK.Andleigh, Kiran Thakrar, “Multimedia Systems Design”, Prentice Hall India, 2013.
3. Foley, Vandam, Feiner and Hughes, “Computer Graphics: Principles and Practice”, 3rdEdition, Addison Wesley Professional, 2013.
4. Jeffrey McConnell, “Computer Graphics: Theory into Practice”, Jones and BartlettPublishers,2006.
5. Hill F S Jr., "Computer Graphics using OpenGL", 2nd edition, Maxwell Macmillan, 2001.
6. Ze-Nian Li and Mark S. Drew, “Fundamentals of Multimedia”, First Edition, Pearson Education, 2004.
7. https://blender.org/support/tutorials/



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U18ITE0014 BUSINESS INTELLIGENCE

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To provide insight to businesses and professionals, helping them make better decisions, gain competitive advantage and enhance return on investment.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Explain the Business Intelligent Environment
CO2: Describe the Business Intelligence Architecture
CO3: Outline the usage of ETL in Business Intelligence
CO4: Explore the Emerging trends in Business Intelligence

Pre-requisite : NIL

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak															
COs	Programme Outcomes(POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M												M		
CO2	M												M		
CO3	M													M	
CO4	M	M	M		M			M		S	M				M

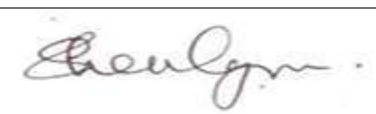
COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

<u>THEORY COMPONENT CONTENTS</u>

INRODUCTION 9 Hours

BI and Information Exploitation - BI Definitions & Concepts - Business Applications of BI- Organizational preparedness for BI and Analytics - Types of BI Users – Planning



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BUSINESS INTELLIGENCE ENVIRONMENT **9 Hours**

BI Framework - Services and system Evolution - Business Processes and Information flow - Data Requirements Analysis

BUSINESS INTELLIGENCE ARCHITECTURE **9 Hours**

Data Modelling and Analytics - Analytical Platforms - Types of Metadata - Semantic Metadata Processes for Business Analytics - Data profiling - Business Rules

DATA QUALITY **9 Hours**

Types of Data Flaws - Dimensions of Data Quality – Assessment – Rules - Data Cleansing - Data Integration – ETL - Data latency and Synchrony

BUSINESS INTELLIGENCE TRENDS **9 Hours**

Knowledge Discovery and Data Mining for Predictive Analytics - Repurposing publicly available Data - Knowledge Delivery - Emerging BI Trends - Case study.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES:

1. David Loshin, “Business Intelligence”, Second Edition, Morgan Kaufmann Series, 2013
2. Mike Bierre, “Business Intelligence for the Enterprise”, IBM Press, 2003
3. Larissa T. Moss, ShakuAtre, “Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications”, Addison-Wesley, 2003
4. CindiHowson, “Successful Business Intelligence: Secrets to Making BI a Killer App”, McGraw-Hill, 2008
5. Brain, Larson, “Delivering business intelligence with Microsoft SQL server 2008”, McGraw-Hill, 2009

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U18ITE0015 NATURAL LANGUAGE PROCESSING

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of natural language processing
- To learn the language models in NLP
- To understand the role of semantics of sentences and pragmatics
- To identify the NLP techniques in IR applications

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Explain the language models
CO2: Analyze the natural language text
CO3: Generate the natural language
CO4: Do machine translation
CO5: Apply information retrieval techniques

Pre-requisite : NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M												M		
CO2	M		M	M	M					M			M		
CO3	M		M		M					M			M		
CO4	M		M		M					M			M		
CO5	M		M		M					M			M		

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

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THEORY COMPONENT CONTENTS

OVERVIEW AND LANGUAGE MODELING 9 Hours

Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages - NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model

WORD LEVEL AND SYNTACTIC ANALYSIS 9 Hours

Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

SEMANTIC ANALYSIS AND DISCOURSE PROCESSING 9 Hours

Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure

NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION 9 Hours

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation-Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages

INFORMATION RETRIEVAL AND LEXICAL RESOURCES 9 Hours

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2 nd Edition, Prentice Hall, 2008.
3. James Allen, "Natural Language Understanding", 2nd edition, Benjamin /Cummings publishing company, 1995.
4. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", First Edition, OReilly Media, 2009.
5. Charniack, Eugene, "Statistical Language Learning", MIT Press, 1993.
6. Manning, Christopher and Heinrich, Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
7. Radford, Andrew et. al., "Linguistics, An Introduction", Cambridge University Press, 1999.

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U18ITE0016 INFORMATION RETRIEVAL TECHNIQUES

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
- To understand the concepts of digital libraries

COURSE OUTCOMES:
After successful completion of this course, the students should be able to

CO1: Build an Information Retrieval system using the available tools
CO2: Identify and design the various components of an Information Retrieval system
CO3: Apply machine-learning techniques to text classification which is used for efficient Information Retrieval
CO4: Apply machine-learning techniques to text clustering
CO5: Design an efficient search engine and analyze the Web content structure

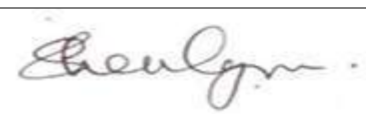
Pre-requisite : NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M												M		
CO2	M	M	M										M		
CO3	M		M		M								M		
CO4	M		M		M								M		
CO5	M		M	M	M					M		M	M		

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey



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INTRODUCTION: MOTIVATION **9 Hours**

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR ―IR Versus Web Search–Components of a Search engine

MODELING **9 Hours**

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

INDEXING **9 Hours**

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

CLASSIFICATION AND CLUSTERING **9 Hours**

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning

UNIT V – SEARCHING THE WEB **9 Hours**

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES:

1. Christopher D. Manning, PrabhakarRaghavan, HinrichSchutze, ―Introduction to Information Retrieval‖, Cambridge University Press, First South Asian Edition, 2008.
2. Implementing and Evaluating Search Engines‖, The MIT Press, Cambridge, Massachusetts London, England, 2010
3. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, ―Modern Information Retrieval: The concepts and Technology behind Search‖ (ACM Press Books), Second Edition, 2011.
4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, ―Information Retrieval

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U18ITE0017 SECURITY OF INTERNET OF THINGS

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- Understand thesecurity and privacy challenges of IoT
- Understand system, application, and network security and privacy threats and vulnerabilities on IoT systems.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to:

CO1: Explain the security and privacy requirements of IoT

CO2: Explain IoT security attacks.

CO3: Explain security issues in the front-end of IoT system

CO4: Explain security issues in the networking of IoT devices.

CO5: Explain security issues in the back-end of IoT system

Pre-requisite: U18ITT6002-Internet of Things – Architecture and Protocols

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													PSO		
COs	Programme Outcomes (POs)														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	3
CO 1	M	M											M		
CO 2	M	M											M		
CO 3	M	M											M		
CO 4	M	M			M								M		
CO 5	M	M			M								M		

COURSE ASSESSMENT METHODS:

DIRECT
1. Continuous Assessment Test I, II **2.** Assignment, Group presentation **3.** End Semester Exam
INDIRECT
4. Course-end survey

THEORY COMPONENT CONTENTS

IoT Security Requirements **9 Hours**

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Fundamentals, Architecture of IoTs, IoT Security Requirements, IoT Privacy Preservation Issues.

Attack Models **9 Hours**

Attack Models – Attacks to Sensors in IoTs, Attacks to RFIDs in IoTs, Attacks to Network Functions in IoTs, Attacks to Back-end Systems,

Security in Front-end **9 Hours**

Security in Front-end Sensors and Equipment, Prevent Unauthorized Access to Sensor Data, M2M Security, RFID Security, Cyber-Physical Object Security, Hardware Security, Front-end System, Privacy Protection,

Networking Function Security **9 Hours**

Networking Function Security- IoT Networking Protocols, Secure IoT Lower Layers, Secure IoT Higher Layers, Secure Communication Links in IoTs,

Security in Back-end **9 Hours**

Back-end Security -Secure Resource Management, Secure IoT Databases, Security Products-Existing Testbed on Security and Privacy of IoTs, Commercialized Products

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total hours:45**

REFERENCES:

1. Fei HU, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", CRC Press,2016
2. Russell, Brian and Drew Van Duren, "Practical Internet of Things Security", Packt Publishing, 2016.
3. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014

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U18CSE0013 PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

L	T	P	J	C
0	0	6	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1:	Upskill in emerging technologies and apply to real industry-level use cases.
CO2:	Understand agile development process.
CO3:	Develop career readiness competencies, Team Skills / Leadership qualities
CO4:	Develop Time management, Project management skills and Communication Skills.
CO5:	Use Critical Thinking for Innovative Problem Solving
CO6:	Develop entrepreneurship skills to independently work on products.

Pre-requisites :Nil

CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**CO/PSO Mapping**		
COs	**PROGRAMME OUTCOMES (POs)**												**PSOs**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	S	S	S				M			M	S		
CO2	S		M										M		
CO3									S			M			
CO4									M	S	S	S			
CO5	M	M	S	S									S		
CO6			M			S	M	M	S				M		

COURSE SESSMENT METHODS

DIRECT
Continuous Project Based Assessment
INDIRECT
Course-end survey

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TABLE 1: ACTIVITIES

Activity Name	Activity Description	Time (weeks)
Choosing a Project	Selecting a project from the list of projects categorized various technologies & business domains	2
Team Formation	Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves.	1
Hands on Training	Students will be provided with hands-on training on selected technology in which they are going to develop the project.	2
Project Development	Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform	6
Code submission,Project Doc and Demo	Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded to cloud-based repository such as GitHub.	3
Mentor Review and Approval	Mentor will be reviewing the project deliverables as per the milestone schedule and the feedback will be provided to the team.	1
Evaluation and scoring	Evaluators will be assigned to the team to evaluate the project deliverables, and the scoring will be provided based on the evaluation metrics	1
TOTAL		**16 WEEKS**

Theory: 0 **Tutorial: 0** **Practical: 100** **Project: 0** **Total: 100 Hours**

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U18ITE0536 FOUNDATIONS OF RESEARCH AND SCIENTIFIC WRITING IN COMPUTING

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES

- To expose students to international collaborative research practices in Computer Science.
- To identify and formulate research problems in alignment with global technology trends.
- To apply computational and analytical methods to solve research problems.
- To enhance skills in academic writing, referencing, and publication ethics.
- To produce a high-quality research paper suitable for submission to an indexed journal or conference.

COURSE OUTCOMES

After Successful completion of this course, the students will be able to:

CO1	Identify a contemporary research problem in Computer Science through collaboration with a foreign mentor. (K4)
CO2	Conduct a structured literature review using recognized digital libraries. (K3)
CO3	Design appropriate algorithms, models, or experiments. (K3)
CO4	Analyze experimental results using statistical or AI-based tools. (K4)
CO5	Prepare a research manuscript as per IEEE/ACM standards for submission. (K4)

Pre-requisites: Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S		M	M			S				
CO2	S				S			S				
CO3				S	S			M		S		
CO4		S			S			M		S		
CO5				S	S				S	S		S

COURSE ASSESSMENT METHODS

FORMATIVE
1. Research proposal 2. Progress reviews 3. Mentor feedback 4. Literature review report 5. Implementation and analysis
SUMMATIVE

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1. Final research paper
2. Final presentation
3. Submission evidence

LITERATURE REVIEW AND PROBLEM DEFINITION **15 Hours**

Conducting a structured literature review using IEEE Xplore, Scopus, and SpringerLink to understand current research developments. Identifying research gaps through comparative analysis of existing studies and formulating clear problem objectives based on identified gaps.
Project Component: Literature review summary (3–5 pages) with citation tools.
Tools: Mendeley, Zotero, Overleaf.

RESEARCH DESIGN AND METHODOLOGY **15 Hours**

Selecting suitable algorithms, datasets, or simulation models relevant to the chosen research problem. Defining the methodology, expected outcomes, and evaluation metrics. Preparing an execution roadmap with timelines and dependencies.
Project Component: Submission of a methodology report and an associated Gantt chart.
Tools: GitHub, Google Sheets, Trello.

IMPLEMENTATION AND EXPERIMENTATION **20 Hours**

Implementation of the proposed system, model, or algorithm in accordance with the designed methodology. Carrying out experimentation in iterative cycles with periodic mentor review. Maintaining all versions of the code and documentation through version control platforms.
Project Component: Working prototype or model implementation with version-controlled experiment logs.
Tools: Python, R, MATLAB, TensorFlow, GitHub.

DATA ANALYSIS AND VALIDATION **15 Hours**

Performing detailed statistical or computational analysis on the experimental outcomes. Validating the model using appropriate comparison benchmarks and generating visual representations of performance metrics. Interpreting results for accuracy, efficiency, and relevance.
Project Component: Data analysis report accompanied by visual charts and comparison graphs.
Tools: Matplotlib, Seaborn, Tableau, Power BI.

PAPER WRITING AND FORMATTING **15 Hours**

Structuring the research paper according to IEEE/ACM format, including drafting the Abstract, Introduction, Methodology, Results, and Conclusion sections. Reviewing citation style, grammar, coherence, and technical accuracy. Ensuring originality through plagiarism checking with accepted threshold (<10%).
Project Component: Complete draft research manuscript and plagiarism compliance report.
Tools: Overleaf, Grammarly, Turnitin, Urkund.

PEER REVIEW AND SUBMISSION **10 Hours**

Undergoing an internal peer review and incorporating feedback for strengthening the manuscript. Coordinating with the research mentor for final revisions and preparing the paper for official

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submission. Uploading the manuscript to an indexed journal or conference portal and preparing a brief presentation on the submitted work.
Project Component: Submission proof (screenshot/acknowledgment) and final presentation.
Tools: IEEE Manuscript Submission Portal, EasyChair, journal/conference submission systems.

Theory: 0	Tutorial: 0	Practical: 0	Project: 90	Total: 90 Hours

REFERENCES

1. Wayne C. Booth et al., The Craft of Research, University of Chicago Press.
2. Robert A. Day & Barbara Gastel, How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Justin Zobel, Writing for Computer Science, Springer.
4. IEEE Author Digital Tools Kit – IEEE Publishing Guidelines.
5. Elsevier Research Academy – Publication Ethics and Integrity Modules.

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U18CSE0235 TECHNICAL ENTREPRENURSHIP FOR COMPUTER ENGINEERS

L	T	P	J	C
1	0	4	0	3

COURSE OBJECTIVES:

- To introduce students to technology-driven entrepreneurship
- To develop skills in problem identification, ideation, and startup thinking
- To understand business models, product development, and legal aspects

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Apply the concepts of technology entrepreneurship and entrepreneurial mindset to identify real-world problems and recognize startup opportunities influenced by emerging technology trends. [K3]

CO2: Analyze design thinking principles and ideation techniques to generate feasible user-centric solutions using structured creativity tools. [K4]

CO3: Evaluate Minimum Viable Product development approaches and prototyping methods to assess the technical and market feasibility of proposed software product ideas. [K5]

CO4: Analyze technical business model components and revenue strategies to interpret market positioning and competitive advantage for tech-based startups.[K4]

CO5: Apply finance concepts to evaluate startup funding options and select an appropriate company registration model in compliance with cyber laws. [K3]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes(POs)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S										
CO2		S	S									
CO3		M	S		S							
CO4			M		M					S	S	
CO5					M					S	S	

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COURSE ASSESSMENT METHODS:

DIRECT
1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test, Assignment 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT:

INTRODUCTION TO TECHNOLOGY ENTREPRENEURSHIP 3+12 Hours

Entrepreneurial mindset for engineers - Types of entrepreneurs and startups (tech startups, platform startups, AI startups) - Case studies: Google, Flipkart, Zoho, Paytm - Problem identification & opportunity recognition - Technology trends influencing entrepreneurship (AI, IoT, AR/VR, Cybersecurity).

IDEATION AND DESIGN THINKING 3+12 Hours

Design Thinking principles - Empathy maps, user persona creation - Problem statements & customer journey - Brainstorming & idea selection techniques - Value proposition canvas.

MINIMUM VIABLE PRODUCT AND SOFTWARE PRODUCT DEVELOPMENT 3+12 Hours

Concept of Minimum Viable Product (MVP) - Rapid prototyping tools - Web/mobile app basics for MVP - Feasibility analysis (technical + market) - Basics of Agile methodology.

TECHNICAL BUSINESS MODELS 3+12 Hours

Business Model Canvas - Revenue models in technology (SaaS, subscription, freemium, marketplace) - Market segmentation - Go-to-market strategy - Competitor analysis.

STARTUP FINANCE, LEGAL & IP 3+12 Hours

Sources of finance (angel, VC, incubation) - Term sheet basics - Costing & pricing - IP for engineering students: patents, copyrights - Company registration basics (LLP, Pvt Ltd) - Cyber laws affecting startups.

Theory: 15	**Tutorial: 0**	**Practical: 60**	**Project: 0**	**Total: 75 Hours**

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REFERENCES:

1. Angela Duckworth, “Grit: The Power of Passion and Perseverance”, Scribner, 2016.
2. Carol S. Dweck, “Mindset: The New Psychology of Success”, Ballantine Books, 2006.
3. Rod Judkins, “The Art of Creative Thinking”, Sceptre, 2015.
4. Edward de Bono, “Lateral Thinking”, Penguin, 2017.

ONLINE COURSES:

1. Startup Entrepreneurship | Coursera
2. Essentials of Entrepreneurship: Thinking & Action | Coursera
3. Innovation: From Creativity to Entrepreneurship | Coursera

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U18CSE0736 ENTREPRENEURSHIP PRACTICUM

L	T	P	J	C
0	0	0	6	3

COURSE OBJECTIVES:

- To enable students to build a real, functioning technology prototype.
- To apply startup concepts in a real-world project.
- To prepare pitch presentations and technical documentation.
- To evaluate the feasibility of launching a student startup.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Analyze real-world problems and user requirements to validate problem statements through structured customer interactions and evidence-based reasoning. [[K4].

CO2: Create a functional MVP using appropriate technologies to produce a working prototype supported by iterative reviews and technical documentation. [K6].

CO3: Analyze business model components and market factors to interpret feasibility, revenue potential, and strategic positioning for the proposed startup idea. [K4]

CO4: Evaluate technical, financial, and market insights to justify the viability and scalability of the developed product and business plan. [K5]

CO5: Create a professional pitch and demonstration framework to develop and present a convincing startup proposal supported by MVP evidence and business strategy. [K6]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes(POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	S											
CO2	M	S										
CO3	S	M			S						S	
CO4		M			M					S	S	
CO5					M					S	S	

COURSE ASSESSMENT METHODS:

DIRECT
1. Mid-Sem Review (Prototype) 2. Business Plan Report 3. Final Demo 4. Viva
INDIRECT
1. Course-end survey

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PRACTICAL COMPONENT:

PROBLEM DEFINITION AND VALIDATION **25 Hours**

Choose a real societal/industrial problem - Conduct customer interviews (minimum 25) - Create - Problem statement - User persona - Validation report.

MINIMUM VIABLE PRODUCT DEVELOPMENT **25 Hours**

Build a functional prototype using

- Web app / mobile app
- IoT prototype
- AI/ML model
- AR/VR simulation
- Cybersecurity tool, etc.
- Weekly sprint reviews
- Technical documentation

BUSINESS MODEL AND STRATEGY **25 Hours**

- Business Model Canvas
- Market analysis
- Go-to-market plan
- Revenue model
- Costing estimation
- Basic marketing plan (digital + offline)

FINAL PITCH AND DEMO DAY **15 Hours**

- MVP Demo
- Complete technical report
- Business plan report
- Pitch deck (10–12 slides)
- Viva-voce

Theory: 0	**Tutorial: 0**	**Practical: 0**	**Project: 90**	**Total: 90 Hours**

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U18AIE0529 PRAGMATIC PROGRAMMING

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES:

- Build basic programming skills by using fundamental data types, writing structured logic, and creating small modular programs.
- Understand and apply object-oriented concepts by designing reusable classes, using inheritance, and implementing simple interfaces.
- Learn essential data handling methods including searching, sorting, and working with common data structures.
- Develop algorithmic thinking by solving problems using step-by-step logic, recursion, and basic optimization strategies.
- Create simple applications that combine programming, object-oriented design, data processing, and algorithms to solve real-world tasks.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Apply fundamental programming concepts to process structured data, use basic memory operations, and build modular programs. [K3]

CO2: Develop object-oriented solutions using classes, objects, abstraction, inheritance, and polymorphism for real-world problems. [K3]

CO3: Implement searching, sorting, and traversal techniques on linear and hierarchical data structures and analyze their efficiency. [K3]

CO4: Analyze algorithmic strategies, including recursion and optimization methods, to solve multi-step computational problems. [K4]

CO5: Apply programming, object-oriented design, data handling, and algorithms to develop functional applications that manipulate and analyze data effectively. [K3]

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	**Programme Outcomes (POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	S	M						M		M		
CO2	S	M		S				M		M		
CO3	S		S			M				M		
CO4	S				S					M		
CO5	S	M						M		M		

COURSE ASSESSMENT METHODS:

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DIRECT
1. Lab Assignments, 2. Demo presentations, 3. Quiz/peer review(optional)
INDIRECT
1. Course-end survey

PRACTICAL COMPONENTS:

PROGRAMMING FOUNDATIONS **18 Hours**

- Work with fundamental data representations and perform structured data processing.
- Implement multi-level storage structures and apply basic memory interaction concepts.
- Manipulate character sequences and tabular data for real-world computation tasks.
- Use foundational user-defined data grouping techniques to create simple models.

Lab tasks:

- Build small programs demonstrating structured logic and modular design.
- Implement tabular and text-based data operations.
- Create programs that incorporate grouped data structures for simple applications.

OBJECT-CENTRIC DESIGN BASICS **18 Hours**

- Construct reusable program units with controlled access and lifecycle management.
- Understand and apply abstraction for modular program development.
- Design simple interface-driven components.

Lab tasks:

- Design object-based modules for real-world problems.
- Implement multi-level behavior refinement and interface-driven components.
- Implement basic interface-driven components.

ADVANCED OBJECT-CENTRIC DESIGN & IMPLEMENTATION **18 Hours**

- Implement hierarchical and polymorphic behaviors to build flexible systems.
- Apply interface-driven design for scalable solutions.
- Use dynamic containers and basic generic utilities.

Lab tasks:

- Implement multi-level behavior refinement.
- Develop applications using dynamic containers and generic utilities.

DATA HANDLING, SEARCHING & ORDERING TECHNIQUES **18 Hours**

- Analyze program efficiency using basic performance measurement principles.
- Apply systematic techniques to locate information in datasets.
- Implement standard methods to arrange datasets in meaningful order.
- Perform key operations on linear and hierarchical data representations.

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Lab tasks:

- Build utilities for data lookup, ordering, and transformation.
- Create modules that support dynamic data updates and structural operations.
- Develop traversal and exploration routines for interconnected datasets.

ALGORITHMIC THINKING & OPTIMIZATION STRATEGIES **18 Hours**

- Apply strategic decision-making techniques to select optimal solutions.
- Use encoding and compression-style methods to reduce representation size.
- Implement resource-aware strategies for maximizing efficiency under constraints.
- Develop solutions for multi-step logical, spatial, and recursive problem scenarios.

Lab tasks:

- Solve optimization-based problems using strategic algorithmic constructs.
- Implement recursive and pattern-generation solutions for complex challenges.
- Design structured datasets and perform advanced retrieval and transformation operations.

Theory: 0 **Tutorial: 0** **Practical: 90** **Project: 0** **Total: 90 Hours**

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest & Clifford Stein, Introduction to Algorithms, 4th Edition, MIT Press, 2022.
2. Mark Allen Weiss, Data Structures & Algorithm Analysis in C++, 4th Edition, Pearson, 2014.

ONLINE COURSES:

1. https://www.coursera.org/specializations/codio-cpp-dsa
2. https://www.udemy.com/course/data-structures-algorithms-using-c-zero-to-mastery/?couponCode=MT251110G2
3. https://www.codecademy.com/learn/learn-c-plus-plus

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U18AIE0031 QUANTUM COMPUTING FOUNDATIONS

L	T	P	J	C
3	0	0	0	3

COURSE OBJECTIVES:

- Understand the basic ideas of quantum computing and how it differs from classical computing.
- Learn how qubits, quantum gates, and simple quantum circuits work.
- Explore basic quantum algorithms and key concepts like entanglement and teleportation.
- Practice building and running quantum circuits using Qiskit and simulators.
- Identify important applications and future trends of quantum computing in various fields.

COURSE OUTCOMES:

After Successful completion of this course, the students will be able to:

CO1: Identify the fundamental concepts of quantum computing and the distinctions between classical and quantum models. [K2]

CO2: Understand qubit representation, superposition, and the operation of different quantum gates using simple circuit examples. [K2]

CO3: Apply the principles of entanglement, Bell states, and basic quantum algorithm structures to interpret their underlying logic. [K3]

CO4: Apply conceptual quantum circuit construction steps, measurement processes, and the impact of noise and decoherence in simulators. [K3]

CO5: Analyze the applications, challenges, and emerging trends in quantum technologies, including quantum cryptography, QML, and national/global initiatives. [K4]

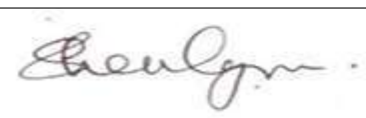
Pre-requisites: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	**Programme Outcomes (POs)**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M					M	M					
CO2	S	M			M						M	
CO3	S	M			M						M	
CO4	M	M		M								
CO5	M					M	M					

COURSE ASSESSMENT METHODS:

DIRECT
1. Continuous Assessment Test I, II (Theory component)



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2. Open Book Test, Cooperative Learning Report, Assignment, Group Presentation.
3. End Semester Examination (Theory components)
INDIRECT
1. Course-end survey

THEORY COMPONENTS

INTRODUCTION TO QUANTUM COMPUTING **9 Hours**

Classical vs Quantum Computing - Need for Quantum Computing - Bits vs Qubits: Basic idea - Key phenomena: Superposition, Entanglement, Measurement - Quantum advantage: Simple examples - Applications overview: AI, Medicine, Cryptography, Finance, Optimization - Introduction to global quantum technologies

QUBITS, SUPERPOSITION & QUANTUM GATES **9 Hours**

Qubit representation - Bloch sphere - Quantum state probability & measurement - Quantum Gates: Pauli gates (X, Y, Z) - Hadamard (H) gate - Phase gates (S, T) - Controlled gates (CNOT) - Building and interpreting quantum circuits - Reversible computing concepts

ENTANGLEMENT & BASIC QUANTUM ALGORITHMS **9 Hours**

Concept of Entanglement - Bell states- No-cloning theorem - Quantum Teleportation - Algorithms - Deutsch–Jozsa - Grover's Search - Shor's Factoring Algorithm - Quantum Fourier Transform (QFT) basics - Introduction to NISQ Algorithms: Variational Quantum Eigensolver - Quantum Approximate Optimization Algorithm.

QUANTUM PROGRAMMING USING QISKIT **9 Hours**

Introduction to Quantum Simulators - Creating and visualizing qubits - Single-qubit circuits - Entanglement circuits using CNOT - Measurements and probability outputs - Running simple circuits on cloud hardware - Basics of noise and decoherence

APPLICATIONS, TRENDS AND FUTURE DIRECTIONS **9 Hours**

Quantum Cryptography - Quantum Machine Learning introduction - Quantum Optimization Use-cases - Quantum chemistry simulations - Quantum-safe cryptography - Limitations of present quantum hardware- India's Quantum Mission (NQM) overview - Global quantum trends and future roadmap

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES:

1. Chris Bernhardt, Quantum Computing for Everyone, MIT Press.
2. Qiskit Textbook (IBM), Free Online Resource.
3. Eleanor Rieffel & Wolfgang Polak, Quantum Computing: A Gentle Introduction.

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4. Michael A. Nielsen & Isaac L. Chuang, Quantum Computation and Quantum Information.
5. Jack D. Hidary, Quantum Computing: An Applied Approach.
6. IBM Quantum Experience online documentation.

ONLINE COURSES:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/professional-certificates/ibm-rag-and-agentic-ai
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/specializations/ai-agents-python

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MANDATORY COURSES

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U18TLR1001- HERITAGE OF TAMILS

L	T	P	J	C
1	0	0	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Enhance the fundamental knowledge of tamil language and literature

CO2: Understand the heritage ,rock art paintings to modern art sculpture

CO3: Acquire essential knowledge in the folk and martial arts

CO4: Understand the importance of role thinai concept of tamils.

CO5: Gain the knowledge of contribution by tamils to indian national movement and indian culture

UNIT I LANGUAGE AND LITERATURE

Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

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UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)

7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

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U18CSR1001 **DISRUPTIVE TECHNOLOGIES**

L	T	P	J	C
2	0	0	0	2

REAMBLE

This course introduces various emerging technologies to enable the students to stay relevant and to thrive towards domain.

OUTCOMES:

CO1- Understand the emergence of cutting-edge technologies and their impact on the businesses.
CO2 – Understand the evolution of techno entrepreneurial ecosystems
CO3- Analyse the ways in which the disruptive technologies play a pivotal role in solving contemporary and futuristic real-world operations.

DATA SCIENCE, ANALYTICS AND VISUALIZATION **3 HRS**

Data as the new oil - Data-Driven Innovation- Big Data Technologies – Data Analysis vs Data Analytics – Data Visualization – Decision making through Data - Ethical and Privacy Challenges - Trends – opportunities – skills.

AUTOMATION & AI **3 HRS**

Information Systems – ERP – CRM – Robotic Process Automation - AI basics - Machine Learning - Neural networks - Deep Learning - Natural Language Processing - Computer Vision - Generative Adversarial Networks (GANs) – Robotics – Ethical AI and Regulatory Considerations - Global Investments – Sustainability - Trends – opportunities – skills.

INTERNET OF THINGS & UNMANNED ARIAL VEHICLES **3 HRS**

Characteristics of IoT – Physical Design of IoT - Logical Design of IoT – Enabling Technologies – IoT Components – IoT Prototyping – IoT Devices – Applications: Home Automation – Industry 4.0 - Smart Cities - Unmanned Aerial Vehicles & types - UAV Technologies: Urban Air Mobility (UAM), Vertically Integrated Drones, Drone Swarms - Counter-Drone Technology- Energy Efficiency and Sustainability - Trends – Opportunities – Skills.

CLOUD & EDGE COMPUTING **3 HRS**

Cloud models – Cloud applications - storage, Collaborative documents, presentations, spreadsheets – SAAS – PAAS – IAAS -Benefits of cloud – Challenges in cloud computing – Edge Computing – Forms of Edge Computing – EDGE VS Cloud - Trends – opportunities – skills.

EXTENDED REALITY **4 HRS**

Basics of XR - XR Landscape - Intro to AR-VR-MR Concepts – Metaverse - MR Strategy & Remote Collaboration – Spatial computing - Challenges and Ethical Considerations – Skills - Trends – opportunities.

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NETWORKING & DISTRIBUTED COMPUTING 3 HRS

Layered Architecture – Networking tools – 5G and Beyond – Software Defined Networks – Network Monitoring and analysis – Distributed Computing – Distributed Sensor Networks – Blockchain fundamentals – DAO - Trends – opportunities – skills.

WEB AND SOFTWARE DEVELOPMENT 3 HRS

Web Technologies - Web 3.0 – Need for Software Engineering – Full stack development – Mobile application development – front end - backend - Meta Developer Circles & forums - Cross-platform application development – UI & UX - Open-Source development – Responsive Web Design - Trends – opportunities – skills.

CYBERSECURITY 4 HRS

Fundamentals - Security goals, mechanisms and Services – Cyber Defence – Offensive Cyber Security - Cyber forensics – Malware Analysis – Threat Intelligence - Threat Hunting - Security technologies - Cyber warfare – Cyber Physical System – Trends – opportunities – skills. User behaviour analysis -

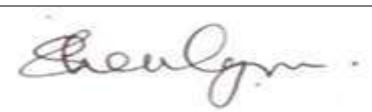
INNOVATION AND TECHNOPRENEURSHIP 4 HRS

Innovation and Creativity - Entrepreneurial Mindset - Identifying Opportunities - Business Planning - Product Development and Innovation - Technology Commercialization -
Marketing and Branding - Entrepreneurial Leadership - Entrepreneurial Ecosystems - Trends – opportunities – skills.

TOTAL 30 HRS

REFERENCES

1. Davy Cielen, Arno D B Meysman, Mohamed Ali, "Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools", 2016.
2. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth edition, 2020.
3. Höller, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D., " From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Springer, 2019. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc
4. B. Lawal, "Cloud Computing Fundamentals: Learn the Latest Cloud Technology and Architecture with Real-World Examples and Applications", A. B. Lawal publication, 2020.
5. Ralf Doerner, Wolfgang Broll, Paul Grimm, Bernhard Jung," Virtual and Augmented Reality (VR/AR),Foundations and Methods of Extended Realities (XR)"Springer Cham



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6. Andrew S Tanenaum, David Wetherall, “Computer Networks”, Pearson Prentice Hall, Fifth edition, 2011.
7. Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, Michael Wuehler, “Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions”, McGraw-Hill, 2018.
8. . Nico Loubser , “Software Engineering for Absolute Beginners: Your Guide to Creating Software Products”, First edition, 2021.
9. William Stallings, “Cryptography and Network Security – Principles and Practices”, Pearson Education; Seventh edition, 2017.
10. Pankaj Goyal, “Before You Start Up : How to Prepare to Make Your Startup Dream a Reality”,Fingerprint Publishing, 2017.

Assessments

- **Continuous Assessment (50 marks)**
  - MCQS (10 questions) on every cohort in Coursera- 9 assessments (one per cohort).
  - This can be aggregated to 50 marks.
- **End Semester Examination (50 marks)**

  Students should register in anyone cohort of their interest and they should do a presentation (individual/2 per team) on what verticals they are interested in for 15 minutes. (poster presentation- one block on their interest, other part can be overall understanding on new technologies)
  - This presentation may be shared in their LinkedIn

Presenting: Clarity of Presentation [20 Marks]	Tightly focused; Content is very clear; Good timing **[20]**	Mostly focused; Content is mostly clear; Keeps almost to time [**15**]	Less focused; Content is less clear; Keeps very almost to time [**10**]	Rambling, unfocussed; Content is unclear; Runs over time or too brief **[5]**
Engages audience: Keeps audience attention / group engaged. [10 Marks]	Audience fully engaged; Invokes useful discussion **[10]**	Audience mostly engaged; Invokes some discussion **[7.5]**	Audience slightly engaged; Invokes some discussion **[5]**	Audience not engaged; Inability to invoke discussion **[2.5]**
Active discussion/ participation of the presenter while others are presenting. [10 Marks]	If the student raises an excellent question with proper understanding of the context **[10]**	If the student raises an good question with proper understanding of the context **[7.5]**	If the student raises a question with little understanding of the context **[5]**	If the student raises a question **[2.5]**
Clarifying Doubts [10 Marks]	Convincing responses to questions **[10]**	Adequate response to questions **[7.5]**	Few responses to questions **[5]**	Inability to answer questions **[2.5]**
Total Marks : 50 Marks				

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The Challenges of ICT-enabled Financial Inclusion, Measurement and Metrics for ICT and theSDGs , Managing Data for the SDGs, ICT Innovation for Statistical Development,Engaging with Data: Communications and Citizen Empowerment, ICT for Monitoring the SDGs .

Module 3: **10 Hrs**

Artificial Intelligence for Development, Implications for Discrimination and Exclusion, The Human Side of AI: Risks and Ethics ,Concerns for our Digital Future, Privacy and the Importance of Trust ,Knowing your Data Rights ,Cybersecurity, Combatting Disinformation , The Way Forward , The New Workforce: Six Points about the Future of Work ,The Open Movement ,Closing Thoughts on ICT for the SDGs

Theory: 15 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

References:

1. Ramanathan, U. (2015). Considering Social Implications of Biometric Registration. IEEE Technology and Society Magazine.
2. Tannam, E. (2018, Jul. 26). How can smart cities make data a public good before time runs out? Silicon Republic.
3. Garvie, C., Beydoya, A., & Frankle, J. (2016, Oct. 18). The Perpetual Line-Up: Unregulated Police Face Recognition in America. perpetuallineup.org. Georgetown Law Center on Privacy & Technology. [Executive Summary and Introduction only.]
4. Hollister, S. (2018, Jul. 27). Congressmen demand answers after Amazon facial recognition matches them to mugshots.
5. Raso, F., Hilligoss, H., Krishnamurthy, V., Bavitz, C., & Kim, L. (2018). Human Rights & Artificial Intelligence: Opportunities & Risks. Berkman Klein Center for Internet & Society at Harvard University.
6.Raso, F., Hilligoss, H., Krishnamurthy, V., Bavitz, C., & Kim, L. (2018). Human Rights & Artificial Intelligence: Opportunities & Risks. Berkman Klein Center for Internet & Society at Harvard University.
7. Zadek, S., & Bayat-Renoux, F. (2018). "Harnessing Digital Finance for Sustainable Development." Financing the UN Development System: Opening Doors. (Pages 130-131only)

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U18CHT4000 **Environmental Science and Engineering (Common to All branches)**

L	T	P	J	C
3	0	0	0	0

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO 1: Analyze the impact of engineering solutions in a global and societal context.

CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.

CO 3: Highlight the importance of ecosystem and biodiversity.

CO 4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.

CO 5: Paraphrase the importance of conservation of resources.

CO 6: Play an important role in transferring a healthy environment for future generations.

PRE -REQUISITE: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1		M					S		M			
CO 2						M				M		
CO 3							M					
CO 4						M	S					
CO 5							S					
CO 6			W				S					M

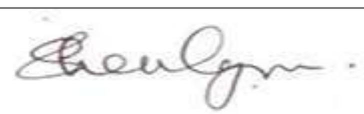
COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End Semester Exam	Course end survey

INTRODUCTION TO ENVIRONMENTAL STUDIES AND ATURAL RESOURCES
14 Hours

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams



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– benefits and problems – Water conservation, rain water harvesting, watershed management.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies.
Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

ECOSYSTEMS AND BIODIVERSITY **9 Hours**

ECOSYSTEM: Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

BIODIVERSITY: Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION **8 Hours**

Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **7 Hours**

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights.

HUMAN POPULATION AND THE ENVIRONMENT **7 Hours**

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Population growth and explosion – Welfare Program – Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

1. G. Tyler Miller and Scott Spoolman, ‘Environmental Science’, Fourteenth Edition, Brooks Cole, 2012.
2. Gilbert M. Masters and Wendell P. Ela, ‘Introduction to Environmental Engineering and Science’, Third Edition, Pearson Education, 2013.
3. BharuchaErach, ‘The Biodiversity of India’, Mapin Publishing Pvt. Ltd., Ahmedabad, 2002.
4. Trivedi R.K and P.K.Goel, ‘Introduction to Air Pollution’, Techno-Science Publications, 2003.
5. Trivedi R.K., ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards’, Vol. I and II, Enviro Media, 1996.
6. Cunningham, W.P.Cooper and T.H.Gorhani, ‘Environmental Encyclopedia’, Jaico Publication House, Mumbai, 2001.
7. Wager K.D., ‘Environmental Management’, W.B. Saunders Co., Philadelphia, USA, 1998.
8. Colin R. Townsend, Michael Begon and John L. Harper, ‘Essentials of Ecology’, Third Edition, Blackwell Publishing, 2008.

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U18INT5000 **CONSTITUTION OF INDIA (Mandatory course)**

L	T	P	J	C
2	0	0	0	0

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO 1: Gain Knowledge about the Constitutional Law of India
CO 2: Understand the Fundamental Rights and Duties of a citizen
CO 3: Apply the concept of Federal structure of Indian Government
CO 4: Analyze the Amendments and Emergency provisions in the Constitution
CO 5: Develop a holistic approach in their life as a Citizen of India

Pre-requisites :NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	ProgrammeOutcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M			W			S
CO2						S		S				M
CO3									M	S		W
CO4								W	M			M
CO5						M		M				S
CO6												

COURSE ASSESSMENT METHODS

Direct
1. Group Activity / Quiz/ Debate / Case studies 2. Class test / Assignment
Indirect
Surveys

THEORY COMPONENT:

Module.1: Introduction to Indian Constitution **4 hours**
Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India

Module.2: Fundamental Rights **8 hours**
Scheme of the fundamental rights - Right to Equality - Fundamental Right under

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Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation

Module.3:Federal Structure **8 hours**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

Module.4:Amendment to Constitution **6 hours**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

Module.5:Emergency Provisions **4 hours**

National Emergency, President Rule, Financial Emergency
Local Self Government – Constitutional Scheme in India

Theory: 30 Tutorial: 0 Practical: 0 Project: 0 Total: 30 hours

REFERENCES

1.Constitution of India - Ministry of Law & Justice – PDF format
awmin.nic.in/coi/coiason29july08.pdf
2. Introduction to the Constitution of India by DurgadasBasu
3. The Constitution of India – Google free material -
www.constitution.org/cons/india/const.html
4. Parliament of India – PDF format
download.nos.org/srsec317newE/317EL11.pdf
5. The Role of the President of India – By Prof.Balkrishna
6. Local Government in India – E Book - Pradeep Sachdeva
https://books.google.com/books/.../Local_Government_in_In...

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FIRST YEAR- EDGE COURSES

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L	T	P	C
1	0	2	2

U18ITR0001 Fundamentals of Digital Design

Faculty Coordinator: Ms .RAJALAKSHMI S/AP/CIVIL

Course Outcomes:

After successful completion of this course students should be able to:

CO1:Create and identify designs that adhere to the basic principles of graphic design.
CO2: Use and create simple visual designs and elements using Adobe software package (Adobe Illustrator or Adobe Photo shop or Adobe In Design)
CO3: Differentiate between good and bad user interfaces and analyse design aspects with positive user experience using Figma.

MODULE	COMPONENTS	HOURS
Fundamentals of Graphic Design	• What is Graphic Design? • Elements of Graphic Design • Types and Formsof Graphic Design • Colour Discord • RGBand CMYK • Raster and Vector differences	**7**
Basics of Adobe Illustrator	• Canvas Settings, Layers • Getting to know Shapes and Tools • Pentool and masking • Illustration process • Logo Designing • Common mistakes to avoid	**7**
Introduction to Photoshop	• Getting to know Effects and Tools • Key differences between Illustrator and Photoshop • Popular design techniques in photo shop • Masking	**7**
Basics of In Design	• Understanding book layout • Where can we use In Design • Key features	2

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Basics of UI/UX	• Difference between UI and UX • Importance of UI • Identification of good and bad UI based on UX • Getting familiar with Figma • Wire framing • Basic UI creation	7

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U18ITR0002 MOBILE APP DEVEPLOMENT USING MIT

L	T	P	C
1	0	2	2

Faculty Name & Designation/Dept: Mr.V.Gunaseela Manikandan/Technical Lead/Innovate Engineering Products, Hosur

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Understand the MIT app inventor emulator environment

CO2: Troubleshoot installation, Repositories and compatibility issues

CO3 Handle advance features of MIT app inventor for interfacing sensors with cloud

CO4: Execute testing and debugging procedure to solve live app development issues

CO5: Apply MIT modern tools technology to implement app for given new project

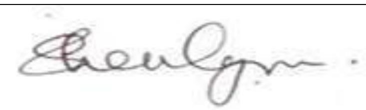
Module	**Hours**
Module 1:Getting Started with App Inventor Setup computer and phone/tablet or emulator for live testing as you build - Preview the IDE - Compatibility Issues with Releases of Android and App Inventor - Built-in Blocks Documentation - Component Documentation - Using App Inventor Templates and Creating App Inventor Template Repositories	**10**
Module 2: App Inventor Features Building Apps with Many Screens - Using the Backpack Cut and Paste System - Live Development, Testing, and Debugging Tools - App Inventor Concepts: Lists, Variables, Databases, Activity Starter, Google Play – Sensors: Using the Location Sensor - Interfacing App Inventor projects to external sensors	**10**
Module 3: MIT MODERN TECHNOLOGY Working with XML and Web services – Appinventor Extensions - Using App Inventor extensions to implement multitouch: Scale Detector - Using App Inventor extensions to implement multitouch: Rotation Detector - Brief introduction to cloud data and the Firebase component (replaced by CloudDB in 2019) - Project merger tool	**10**

Total: 30 Hours

Course Assessment: Continuous Assessment

Reference Books:

1. David Wolber, Hal Abelson, Ellen Spertus, and Liz Looney, App Inventor 2: Create your own Android Apps, O'REILLY, 2014.



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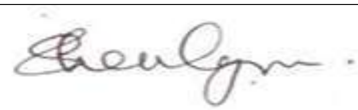
2. Karen Lang and Selim Tezel, Become an App Inventor, MIT Computer Science and Artificial Intelligence Laboratory, 2022.
3. Sarah Guthals, Building a Mobile App: Design and Program Your Own App, Dummies, 2017.



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U18ITR0003 SOFTWARE ENTROPY

L	T	P	C
1	0	2	2

Faculty Name&Designation/Dept:Mr.M.Kalimuthu/Technical Lead/Innovate Engineering Products, Hosur

Course Outcomes:

After successful completion of this course, the students should be able to

CO1: Understand the MS Office working environment

CO2: Perform documentation tasks using MS Office

CO3 Handle Google tools for project presentation mailing communication

CO4: Execute editing steps to manipulate Imaging, Audio and video systems using Active presenter

CO5: Develop poster – Brochure and modern resume using canva

Module	**Hours**
Module 1: EXPERTISE WITH MICROSOFT OFFICE Text Basics: Text Formatting and saving file - Working with Objects - Header & Footers - Working with bullets and numbered lists - Styles and ContentMerging Documents - Sharing and Maintaining Document - Proofing the document - Mail Merge - Formatting excel work book - Perform Calculations with Function - Sort and Filter Data with Excel - Create Effective Charts to Present Data Visually - Analyze Data Using Pivot- Tablesand Pivot Charts - Setting Up PowerPoint Environment: Creating slides and applyingthemes Working with bullets andnumbering - Hyperlinks and Action Buttons - Working with Movies and Sounds	**15**
Module 2: WORKING WITH GOOGLE TOOLS Google Forms – Spreadsheets -G-meet – Emailing: Content writingHyperlinks -Digital Content Execution - Email attachments, Browsing, Search engines	**5**
Module 3: IMAGE-AUDIO-VIDEO EDITING Introduction to Active Presenter : Content Creation - Importing Online Content - Introduction to Canva: Poster and Brochure design - Modern Resume Preparation	**10**

Total: 30 Hours

Course Assessment: Continuous Assessment

Reference Books:

1. Peter Weverka and Timothy L. Warner, Office 365 All-in-One for Dummies, July 2019
2. Torben Lage Frandsen, Microsoft Office Word, bookboon, 2010
3. Book by Curtis Frye and Joan Preppernau, Microsoft Office 2019 Step by Step, 2018
4. by Tammy Worcester, and David Hoerger, Google Tools For Teaching and Learning: 4th Edition Spiral-bound,Google Inc 2010

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5. Patrick Ejeke , Professional Tips and Tricks When You Design with Canva, Kindle Edition, 2022

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OPEN ELECTIVES

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U18MEO0014	SUSTAINABLE INNOVATIONS AND PRACTICES	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3			

Pre-requisite: Nil

Faculty Name:	**Mr. M. Sathish**
Designation:	**Assistant Professor-II**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/sathish-mathiyazhagan-2a63b65b/**

Course Objectives:	**The purpose of taking this course is to:**
1	Gain a deep understanding of sustainability principles.
2	Learn how to design and implement sustainable solutions.
3	Enhance knowledge of sustainable business practices.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understand the fundamental principles of sustainability and sustainable development.	U
CO 2	Analyse the impact of human activities on the environment and society.	An
CO 3	Assess and design sustainable solutions for various sectors.	An
CO 4	Evaluate the role of policy, technology, and global cooperation in achieving sustainability goals.	E

MODULE	**Hours**
INTRODUCTION TO SUSTAINABILITY Introduction- Definition and history of sustainability-The three pillars: environmental, social, and economic sustainability-The Anthropocene: Human impact on the Earth-Sustainable Development Goals (SDGs) overview-Systems Thinking and Global Challenges-Systems thinking in sustainability-Global environmental challenges: Climate change, deforestation, pollution-Introduction to ecological footprints and planetary boundaries.	**9**
ENVIRONMENTAL SUSTAINABILITY Climate Change and Energy-Science of climate change and global warming-Renewable energy: Solar, wind, and other alternatives-Transitioning to a low-carbon economy-Biodiversity and Ecosystems-The importance of biodiversity and ecosystems-Threats to	**8**

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biodiversity: Habitat loss, pollution, and overexploitation-Conservation strategies and sustainable resource management.	
SOCIAL SUSTAINABILITY Poverty, Inequality, and Development-The relationship between poverty, inequality, and sustainability-Sustainable development in low-income countries-Social justice and equity in the context of sustainable development-Sustainable Cities and Communities-Urbanization and its impact on sustainability-Designing sustainable cities: Smart cities, green infrastructure-Case studies of sustainable urban planning.	**8**
ECONOMIC SUSTAINABILITY The Economics of Sustainability-Economic growth and sustainability: The concept of decoupling-The circular economy and sustainable business models-Sustainable finance and green investing-Corporate Responsibility and Policy-The role of businesses in sustainability-Corporate social responsibility (CSR) and ethical practices-Government policies and international agreements-Paris Agreement.	**10**
GLOBAL COOPERATION AND FUTURE DIRECTIONS Global Cooperation for Sustainable Development-The role of international organizations - UN, World Bank in sustainability-Global partnerships and collaborative efforts to achieve the SDGs-Case studies of successful global sustainability initiatives-Innovations and Future Trends-Technological innovations driving sustainability clean tech, AI-Future scenarios and challenges in sustainability. Case Study: Developing a comprehensive sustainability plan for a real-world challenge.	**10**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources
Reference books/ Web Links
1. Tom Theis and Jonathan Tomkin, *Sustainability: A Comprehensive Foundation*, OpenStax CNX (2018). 2. Ken Webster, The Circular Economy: A Wealth of Flows, 2nd Edition Ellen MacArthur Foundation Publishing, Cowes, UK, (2017). 3. Jeffrey D. Sachs, The Age of Sustainable Development, Columbia University Press (2015). 4. Mark Maslin, Climate Change: A Very Short Introduction, Oxford University Press (2014).
Online Resources
1. “Introduction to Sustainability " https://www.coursera.org/learn/sustainability 2. “The Age of Sustainable Development" https://www.coursera.org/learn/sustainable-development

Grading Policy

Academic	Assignment	Case Study/Mini Project					TOTAL
	40	60					100

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U18MEO0015	Electric and Autonomous Mobility	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3			

Pre-requisite: Nil

	**Faculty Name:**	**Mr. V. Senthilkumar**
	Designation:	**Assistant Professor-II**
	Concern/industry/Institution:	**KCT**
	LinkedIn profile	**https://www.linkedin.com/in/senthil-kumar-v-5498aa60/**

Course Objectives:	**The purpose of taking this course is to:**
1	Understand the design and evolution of electric vehicles and their market trends.
2	Analyse electric mobility ecosystems and emerging business models.
3	Apply deep learning techniques to enhance computer vision and sensor fusion in autonomous vehicles.
4	Implement object detection and tracking methods using advanced computer vision and sensor fusion techniques.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO1	Understand the design and evolution of electric vehicles and their market trends.	U
CO2	Evaluate EV components, charging technologies, and infrastructure challenges.	U
CO3	Analyse electric mobility ecosystems and emerging business models.	An
CO4	Apply deep learning techniques to enhance computer vision and sensor fusion in autonomous vehicles.	Ap
CO5	Implement object detection and tracking methods using advanced computer vision and sensor fusion techniques.	E

Module	**Hours**
INTRODUCTION TO ELECTRIC VEHICLES (EVS) Overview of Electric Vehicles: Historical development and evolution of EVs, Components and Architecture of EVs: Key components of EVs: Electric motors, batteries, power electronics, and control systems. EV Market and Trends: Current global and regional market trends, Government policies, incentives, and regulations supporting EV adoption.	**6**
EV CHARGING INFRASTRUCTURE AND TECHNOLOGY EV Charging Basics: Types of EV charging (AC, DC, wireless), levels of charging (Level 1, Level 2, Level 3) and their differences. Charging Infrastructure Deployment: Planning and implementation	**9**

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of public and private charging stations., Role of smart grids and Vehicle-to-Grid (V2G) technology. Challenges and Solutions in Charging Infrastructure: Addressing range anxiety and charging time issues, Infrastructure challenges in urban and rural areas.	
ELECTRIC MOBILITY ECOSYSTEM AND BUSINESS MODELS Electric Mobility and Urban Planning: Impact of EVs on urban transportation systems, Role of EVs in reducing urban pollution and congestion, Integration of EVs with public transportation and shared mobility services. Business Models for Electric Mobility: Emerging business models: Mobility-as-a-Service (MaaS), Car-as-a-Service (CaaS),EV fleet management for businesses and public transportation, Economic and environmental benefits of electric mobility.Case Studies in Electric Mobility: Successful case studies of electric mobility implementations in different regions.	**10**
ADVANCED DEEP LEARNING TECHNIQUES FOR AUTONOMOUS VEHICLES Advanced Computer Vision Techniques: Convolutional Neural Networks (CNNs): Used for detecting and classifying objects. Semantic Segmentation, Instance Segmentation: Identifies and distinguishes objects in complex environments. Deep Learning for Sensor Fusion: Sensor Integration, Ulti-Modal Learning, Data Handling, Reinforcement Learning for Autonomous Driving: Basics of Reinforcement Learning, Application in Driving, Simulations Safety and Reliability in Deep Learning Systems: Ensuring Safety, Testing and Validation.	**10**
ADVANCED COMPUTER VISION TECHNIQUES FOR AUTONOMOUS VEHICLES Object Detection and Tracking: YOLO (You Only Look Once),SSD (Single Shot MultiBox Detector),Kalman Filters, Semantic and Instance Segmentation: Semantic Segmentation, Instance Segmentation Sensor Fusion for Enhanced Perception: Integration of Camera and LiDAR Data, Multi-Modal Fusion Techniques, Noise Reduction and Data Synchronization.	**10**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources
Reference books/ Web Links
1. Tom Denton, Electric and Hybrid Vehicles, Routledge, (2020). 2. Shai Shalev-Shwartz and Shaked Shammah, Deep Learning for Autonomous Vehicles, Springer, (2021). 3. James Larminie and John Lowry, Electric Vehicle Technology Explained, Wiley, (2012).
Online Resources
1. https://www.coursera.org/learn/electric-vehicles-mobility 2. https://www.coursera.org/learn/introduction-deep-learning-computer-vision?specialization=deep-learning-computer-vision 3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/advanced-deep-learning-techniques-computer-vision?specialization=deep-learning-computer-vision

Grading Policy

Academic	Assignment	Case Study/Mini Project					TOTAL
	40	60					100

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<table>
<tr><td>P18CAO0001</td><td rowspan="2">Modern Financial Strategies and Innovations</td><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr>
<tr><td rowspan="2">OE</td><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td></td><td>SDG</td><td colspan="4">4, 9</td></tr>
</table>

Pre-requisite: Nil

Faculty Name:	**Mayuri P T**
Designation:	**Assistant Professor 1**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/mayuri-palanisamy**

Course Objectives:	**The purpose of taking this course is to:**
1	This course covers essential financial principles and concepts useful for both personal and corporate finance.
2	This course provides an in-depth introduction to the ideas, methods, and institutions that help manage risks and foster enterprise in financial markets.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understanding the financial principles and concept of Finance	U
CO 2	Equip learners with the financial decision-making skills.	Ap
CO 3	Evaluate company performance using profitability, efficiency, leverage, and other ratios.	E
CO 4	Assess the working capital needs of the business.	An
CO 5	Manage risks and foster enterprise in financial markets.	Ap

MODULE	**Hours**
FINANCIAL STATEMENTS AND CASHFLOWS Introduction to Finance- Balance sheet - Assets, Liabilities, and Stockholders & Equity-Income Statement- Profit & loss- Cash flows -Sources and use of cashflows- Liquidity Leverage Ratios-Turnover Ratios- Profitability Ratios-Financial Ratios: Market Value Ratios- Financial Forecasting.	**9**
TIME VALUE OF MONEY Introduction to Time Value of Money-Present Value (PV) and Future Value (FV)- difference between the quoted interest rate and effective annual rate- Annual Percentage Rate (APR) - Effective Annual Interest Rate (EAR)-Annuity and perpetuity- Applications of time value of money.	**9**
VALUATION AND CAPITAL BUDGETING Basic terms of bonds-Interest Rates-Zero Coupon bonds- Types of Bonds- Bond Ratings- structure	**9**

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of bond market- Basic Concepts of Stock- Parameter Estimation- Growth Opportunities- P/E ratio- Stock Markets- Tax salvage value - Opportunity Costs- Sunk Costs- Side Effects- Capital Budgeting with Example.	
RISK AND RETURN Historical record of return and risk- Trade-off between risk and return-Calculate return and risk- Systematic risk and unsystematic risk- Beta Coefficient- Valuation & Risk Estimation- The Capital Asset Pricing Model.	**9**
FINANCIAL MARKETS Financial Markets Introduction- Distribution and Outliers- Insurance Fundamentals-Forecasting-- Introduction to Behavioural Finance- Prospect Theory- Leverage- Shares and Dividends- Investment Banks Introduction- Importance of Financial Theory.	**9**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources

Reference books/ Web Links

1. Introduction to Finance by Lawrence J. Gitman, Jeff Madura
2. The Financial Times Guide to Investing: The definitive companion to investment and the financial markets by Glen Arnold

Online Resources

1. https://www.coursera.org/learn/introduction-to-finance-the-basics
2. https://www.coursera.org/learn/financial-markets-global
3. https://www.coursera.org/learn/introduction-to-finance-the-role-of-financial-markets

Grading Policy

Academic	Assignment	Case Study/Mini Project					TOTAL
	40	60					100

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P18CAO0002	Sports Analytics and Emerging Technologies	L	T	P	J	C
		3	0	0	0	3
OE		SDG	4, 8			

Pre-requisite: Nil

	**Faculty Name:**	**Asmitha Shree R**
	Designation:	**Assistant Professor 1**
	Concern/industry/Institution:	**KCT**
	LinkedIn profile	**https://www.linkedin.com/in/asmitha-shree**

Course Objectives:	**The purpose of taking this course is to:**
1	To provide a foundational understanding on the relation between sports and society.
2	To enable students to apply core marketing principles in the context of sports.
3	To develop analytical skills for comparing sports marketing with other sectors.
4	To foster an understanding of the influence of data-driven decision-making in sports.
5	To develop critical thinking and problem-solving skills in sports management.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understand the social dynamics, cultural identity, and globalization's impacts on the sports world.	U
CO 2	Understand the Evolution and Commercialization of Sports.	U
CO 3	Apply Marketing Principles to Sports.	Ap
CO 4	Analyse and differentiate between sports marketing and other marketing industries.	An
CO 5	Understanding Machine Learning Workflow in sports analytics.	U
CO 6	Apply regression analysis and machine learning models to predict sports outcomes.	Ap

Module	**Hours**
THE SOCIAL DYNAMICS OF SPORTS Exploring the concepts of games, play, and sports - Analyzing the impact of globalization, nationalism, and politics in sports - Understanding race, cultural identity, and their influence on the sports world.	**8**
THE EVOLUTION AND COMMERCIALIZATION OF SPORTS Examining the rise of women's sports, gender, and sexuality - Investigating why sports captivate global audiences - Understanding the mega business of sports- outdoor sports-extreme sports, and the search for adventure.	**8**
INTRODUCTION TO THE SPORTS MARKETING Introduction to the Sports Marketing- Sports Marketing Challenges- Marketing Basics Applied to Sports	**9**

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Marketing- The Traditional 4 P's: A Meaningful Update for Sports- Fan Marketing- Influence Marketing: Sports- Service vs. Product Marketing in Sports- Sports Marketing versus other Marketing Industries- Event Marketing & Management.	
ENTERTAINMENT MARKETING Entertainment Marketing -Business Marketing- Creating Creative Content-Virtual Reality and Over the Top TV, Entertainment Branding (Placement) -Digital Viral Marketing- Dangers of Viral Marketing- Personal Entertainment Experience- Virtual Reality.	**10**
PREDICTION MODELS WITH SPORTS Machine Learning-The Machine Learning Workflow- Model: NHL Game Outcomes-Introduction to Regression Analysis -Building the Logistic Regression Model-Interpreting Regression Results -Considerations in Deploying The Model-Case Study: Regression Analysis - Batsman's performance and salary , Regression Analysis - Batsman's performance and salary ,Regression Analysis with Cricket Data.	**10**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources
Textbooks
1. Grant Jarvie., Sport, Culture and Society: An Introduction., Taylor & Francis, (4th Edition, 2021). 2. Matthew D. Shank and Mark R. Lyberger., Sports Marketing: A Strategic Perspective., Routledge, (6th Edition, 2021). 3. Thomas W. Miller Machine Learning and Data Mining for Sports Analytics, Pearson Education, Inc, (2017).
Reference books/ Web Links
1. Richard Giulianotti, The Globalization of Sport: The Politics, Economics, and Culture of Sports", (2005) 2. Manfred Bruhn, Peter Rohlmann , "Sports Marketing: Fundamentals - Strategies – ‚Springer, Instruments", (2022).
Online Resources
1. https://www.coursera.org/learn/international-entertainment-sports-marketing 2. https://www.coursera.org/learn/sports-marketing 3. https://www.coursera.org/learn/prediction-models-sports-data#modules 4. https://www.coursera.org/learn/machine-learning-sports-analytics 5. https://www.coursera.org/learn/foundations-sports-analytics#modules

Grading Policy

Academic	Assignment	Case Study/Mini Project					TOTAL
	40	60					100

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P18CAO0003	Healthcare Innovation and Technology	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3			

Pre-requisite: Nil

	**Faculty Name:**	**G. Shobana**
	Designation:	**Assistant Professor-II**
	Concern/industry/Institution:	**KCT**
	LinkedIn profile	**www.linkedin.com/in/shobana-g-0425b348/**

Course Objectives:	**The purpose of taking this course is to:**	
1	Understand Healthcare Systems and their Challenges.	
2	Explore Ethical and AI-driven Approaches in Healthcare.	
3	Investigation of Healthcare Marketplace Dynamics.	
Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Understand the structure and functions of healthcare systems, along with the associated ethical and technological frameworks.	U
CO 2	Understand the implementation and challenges of electronic health records (EHR) and eHealth models.	U
CO 3	Analyse Healthcare Market Dynamics over time.	An
CO 4	Examine Insurance and Medical Technology Markets and the impact of technological advancements on healthcare delivery and policy.	An
CO 5	Understand the global medical innovations, their impact, and the trends shaping the healthcare industry.	U

Module	**Hours**
INTRODUCTION TO HEALTHCARE SYSTEMS Overview of healthcare systems-Issue in healthcare – patients-Intermediaries -providers-challenges in healthcare access and delivery- Characteristics of Physician Practices -healthcare organizations and functions- Procedure Codes and Diagnosis Codes- Payment Systems- EMRs, EHRs, and PHRs- Stereotypical Plan Design- Public and Private Plans- Ethical frameworks - AI in health care delivery and payment structure.	**6**
EHR MANAGEMENT SYSTEM eHealth -model -challenges- Future scope- Collecting the data- Clinical use of personal health data- Mobile apps -social media apps -design of eHealth solutions-Evaluating health apps- Data and digital health records- Anatomy-Predictive and precision medicine- Privacy and security- performance- Interacting with healthcare professional – Advantages -Telehealth- personalize healthcare-EHR applications- patient journey -Features- Login, Authentication, Credentialing- Clinical Decision Support-types- CDS Committees-Introduction to Databases-Components of a SQL Server-EHR Interfaces- Training- Communications- Change Management.	**12**

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HEALTHCARE MARKETPLACE Marketplace Overview, Healthcare Spending Drivers, Quality Trends, Market Evolution-Health Cost Growth- Issues -Effects of Health Behaviours. **Physician and hospital Service Market: Provider** Market Overview-Price Discrimination-Physician Market Evolution-Physician Sites of Care- Physician-Hospital Market Evolution: Hospital Features-Scale and Scope, Hospital Issues, Quality and Safety- Hospital Future Trends, Policy Impact on Hospitals.	**10**
INSURANCE AND MEDICAL TECHNOLOGY MARKET Risky Business, Utility of Wealth- working of Insurance model- Moral Hazard and Adverse Selection-Early Public Health Insurance- Healthcare Laws and Regulations (HIPAA, FDA, etc.) Quality and Safety Standards in Healthcare-Role of Policy -Future Health Reform. **Medical Technology Market**: Device- Drug-Medical Device Evolution-Medical Devices -Vision -New Technology Make Money-Measuring Medical Technology Value -FDA Approval for Pharmaceuticals- FDA Approval for Medical Devices- Drive Towards Cost-Effectiveness-preparing a Global Health Technology -Pharma & Device Convergence-Medical Technology Market.	**10**
GLOBAL MEDICAL INNOVATION Globalization of the Medical Industry, Medical Tourism Evolution & Growth, Medical Tourism in India, Key Issues, Health Bads and Their Consequences-Goals of Health Information Technology-Value of Health Information Technology- Insurer Information Technology- Provider Information Technology-Integrated Health Care Delivery-Key Questions for an Innovation Valuation-Technology- Secure- Return Investment on Technology.	**7**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**0**	**Project Hours:**	**0**	**Total Hours:**	**45**

Learning Resources
Reference books/ Web Links
1. Robert E. Hoyt, Ann K. Yoshihashi, Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, Lulu.com (2019). 2. Peter M. Ginter, Linda E. Swayne, and Robert J. Duncan, Healthcare Systems: An Introduction, Health Administration Press (2018). 3. Sharon B. Buchbinder, Nancy H. Shanks, Introduction to Healthcare Management, Jones & Bartlett Learning (2017). 4. Richard Gartee, Electronic Health Records: Understanding and Using Computerized Medical Records, Pearson (2014). 5. Peter R. Kongstvedt, Healthcare Economics and Policy, Jones & Bartlett Learning (2013).
Online Resources
1. https://www.coursera.org/learn/intro-to-healthcare 2. https://www.coursera.org/learn/health-it-fundamentals 3. https://www.coursera.org/learn/ehealth 4. https://www.coursera.org/specializations/healthcare-marketplace

Grading Policy

Academic	Assignment	Case Study/Mini Project					TOTAL
	40	60					100

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P18CAO0004	Corporate Strategy and Innovation	L	T	P	J	C
		3	0	0	0	3
OE		SDG	4, 9			

Pre-requisite : Nil

	**Faculty Name:**	**Ms. P. T Mayuri**
	Designation:	**Assistant Professor 1**
	Concern/industry/Institution:	**KCT**
	LinkedIn profile	**https://www.linkedin.com/in/mayuri-palanisamy**

Course Objectives:	**The purpose of taking this course is to:**
1	This course is designed to help learners develop structured approaches to making sound strategic decisions in multi-business firms.
2	This focuses on modern practices in product management, especially for digital products.
3	It covers essential skills for product managers, emphasizing the need to understand customer needs, use actionable analytics, and apply agile methodologies.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Develop structured, decision-based frameworks for making key corporate strategy decisions.	Ap
CO 2	Understand how to make informed decisions about business diversification and entering new markets or industries.	U
CO 3	Learn how to design corporate headquarters that add value across business units.	Ap
CO 4	Develop the ability to leverage actionable analytics and user data to drive product decisions.	E
CO 5	Understand how to iterate and enhance digital products continuously, using feedback and analytics.	An

Module	**Hours**
CORPORATE ADVANTAGE Introduction to Corporate strategy- Understanding Differences: Number of Businesses, Corporate Advantage, Competition- Sum-of-the-parts Analysis- Corporate Strategy Decisions- value multi-	**9**

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business firms.	
DIVERSIFICATION AND DIVESTITURE Understanding the Basic Modes of Diversification- Diversification Test -Five-step Approach- Understanding the Basic Modes of Divestiture- Divestiture Test- Three-step Approach to the Divestiture Decision.	**9**
CORPORATE HEADQUARTERS Example of Corporate Headquarters- Controls of Corporate Headquarters- HQ Influence Models- Financial Perspective- Uncertainty Perspective- Synergy Perspective- Social Perspective- Synergistic Portfolio Framework.	**9**
FOCUS AND PRODUCT INNOVATING METHODS Introduction to Product Management Journey- Creating, Testing and Facilitating- Product Owner-Team Collaboration- Qualitative Analytics- Quantitative Analytics- Managing Habits- Customer Collaboration- Funnel Focus- Managing Product.	**9**
EXPLORING AND AMPLIFYING PRODUCTS Introduction to Exploring a new Product Idea- Building for learning- Horizons of growth-Corporate Innovation Pipeline- Business Model Design- Introduction to Amplifying an existing products- Business model types- Actionable analytics- Data science- Chanel - Modality- Roadmap.	**9**

Theory Hours: 45	**Tutorial Hours: 0**	**Practical Hours: 0**	**Project Hours: 0**	**Total Hours: 45**

Learning Resources
Reference books/ Web Links
1. Competitive Strategy: Techniques for Analyzing Industries and Competitors, Michael E. Porter 2. User Experience Is Brand Experience: The Psychology Behind Successful Digital Products and Services by Felix Van De Sand, Anna-Katharina Frison, Pamela Zotz 3. Corporate Strategy and Product Innovation by Robert R. Rothberg
Online Resources
1. https://www.coursera.org/learn/corporatestrategy 2. https://www.coursera.org/learn/uva-darden-digital-product-management

Grading Policy

Academic	Assignment	Case Study/Mini Project					TOTAL
	40	60					100

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P18CAO0005	Gamification and Gaming	L	T	P	J	C
		3	0	0	0	3
OE		SDG	3, 4, 9			

Pre-requisite: Nil

		
	Faculty Name:	**Dr. K. Saranya**
	Designation:	**Assistant Professor-II**
	Concern/industry/Institution:	**Kumaraguru college of Technology**
	LinkedIn profile	**https://www.linkedin.com/in/dr-saranya-k-b3a93313a/**

Course Objectives:	**The purpose of taking this course is to:**
1	Understand the core differences between Gamification and Games.
2	Explore how gamification drives innovation in business.
3	Analyse the effectiveness of gamification in Advocacy, Media, Politics, and Education.
4	Identify the risks and future trends in gamification.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Acquire in-depth knowledge of gamification principles and identify specific applications across various contexts.	U
CO 2	Develop a comprehensive conceptual framework for gamification tailored to different sectors.	C
CO 3	Critically analyse and evaluate the benefits and risks associated with gamification.	E
CO 4	Analyse the role of motivation in gamification and how it drives innovation in the game market.	An

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Module	Hours
GAMIFICATION Core concepts, distinctions between gamification and games, Motivation in Gamification, Gamification drive Innovation, Game Market.	**9**
GAMIFICATION IN BUSINESS Business sector adopts gamification techniques -Case studies, features of gamification in business, marketing strategies.	**8**
GAMIFICATION FOR ADVOCACY AND MEDIA Applications in civil society, differences from business gamification, effectiveness in raising awareness, media outlets adopt gamification techniques, features of gamification in media, journalism and communication benefiting from gamification.	**10**
GAMIFICATION IN POLITICS AND EDUCATION Political gamification, effectiveness for political campaigns, differences from other sectors, gamification effective for policymaking. Educational applications, effectiveness in teaching and learning.	**10**
RISKS AND FUTURE IN GAMIFICATION Gamification desirability, Social and mental sickness, features of gamification in social networks, need of gamers-Future with games.	**8**

Theory Hours:	45	Tutorial Hours:	0	Practical Hours:	0	Project Hours:	0	Total Hours:	45

Learning Resources
Reference books/ Web Links
1. Yu-Kai Chou," Actionable Gamification: Beyond Points, Badges, and Leaderboards", Fremont (CA), 2014. 2. B. Burke, "Gamify: How Gamification Motivates People to Do Extraordinary Things", Bibliomotion, 2014. 3. J. Lerner, "Making Democracy Fun: How Game Design Can Empower Citizens and Transform Politics", Boston (MA), 2014.
Online Resources
1. https://www.coursera.org/specializations/esports 2. https://www.coursera.org/learn/gamification

Grading Policy

Academic	Assignment	Case Study/Mini Project					TOTAL
	40	60					100

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<table>
<tr><td rowspan="2">P18CAO0006</td><td rowspan="3">Environmental Innovations and Management</td><td>L</td><td>T</td><td>P</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>OE</td><td>SDG</td><td colspan="4">6, 15</td></tr>
</table>

Pre-requisite: Nil

Faculty Name:	**Dr. N. Rajathi**
Designation:	**Professor**
Concern/industry/Institution:	**KCT**
LinkedIn profile	**https://www.linkedin.com/in/dr-rajathi-natarajan-7748758b/**

Course Objectives:	**The purpose of taking this course is to:**
1	Explore urbanization, climate change, sustainability, and circular economy principles in managing environmental challenges.
2	Understand integrated water resource management and pollution control in relation to environmental hazards and public health.
3	Investigate population dynamics, agriculture's impact on the environment, and ethical approaches to solving complex environmental issues.

Course Outcomes:	**After successful completion of this course, the students shall be able to**	**Revised Bloom's Taxonomy Level (RBT)**
CO 1	Analyse and address the environmental challenges associated with global trends.	An
CO 2	Evaluate and apply integrated water resource management principles to address complex water-related challenges,	Ap
CO 3	Explain the impact of environmental hazards.	U
CO 4	Explain the relationship between global population dynamics, agriculture, and soil resources.	U
CO 5	Identify and apply environmental ethics and management principles to complex issues.	Ap

Module	**Hours**
GLOBAL TRENDS AND ENVIRONMENT MANAGEMENT Sustainability and the SDGs-Demographic Trends-Global urbanization-Environment Management -Cities and the rising sea level-Climate Change and Water-Circular Thinking in Waste Management-Plastic as Part of the Circular Economy-Stakeholder and Social Sustainability Analysis-–Utility Management -Environmental Management in Rural Areas-Phases in Solid Waste Management -Regulation -Outdoor and Indoor air pollution –Technologies for the environment built .	**9**
WATER RESOURCE MANAGEMENT AND POLICY The rules of resource, uses and their circumvention- Integrated water resource management to	**9**

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water-food-energy –Integrated Water shed management –water as source of conflict and cooperation.	
ENVIRONMENTAL HAZARDS AND GLOBAL PUBLIC HEALTH Air and water pollution –key concepts – controlling air pollution –key concepts in water pollution-controlling water pollution –physical hazards and soil waste - Solid Waste Disposal Methods- Hazardous Waste Disposal Methods-Population pressure –Build environment.	**9**
POPULATION, FOOD, AND SOIL Population the world- population changes-Global population – Global population dynamics - Agriculture and Environment – Agriculture and Human Nutrition- Modern Agriculture Effects and Alternatives -Soil and Environment –Soil resource and Profile.	**9**
ENVIRONMENTAL MANAGEMENT & ETHICS Introduction – Environmental Ethics- Environmental management of tame and wicked problems- Decision support tools-Environmental regulation and principles.	**9**
Theory Hours: 45 **Tutorial Hours: 0** **Practical Hours: 0** **Project Hours: 0** **Total Hours: 45**	

Learning Resources
Reference books/ Web Links

1. **Circular Economy for the Management of Operations. United States, CRC Press, (2020).**
2. **Pangare, Vasudha. Global Perspectives on Integrated Water Resources Management. India, Academic Foundation, (2006).**
3. **Hutchinson, Emma, and Kovats, Sari. Environment, Health and Sustainable Development. United Kingdom, McGraw-Hill Education, (2017).**
4. **Wild, Alan. Soils, Land and Food: Managing the Land during the Twenty-First Century. United Kingdom, Cambridge University Press, (2003).**
5. **Krishnamoorthy, Bala. Environmental Management: Text and Cases. India, Prentice Hall India Pvt., Limited, (2017).**
6. Politics and Policies for Water Resources Management in India. United Kingdom, Taylor & Francis,(2020).

Online Resources

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://www.coursera.org/learn/global-environmental-management
3. https://www.coursera.org/learn/water-management
4. https://www.coursera.org/learn/environmental-hazards-and-global-public-health
5. https://www.coursera.org/learn/population-food-and-soil
6. https://www.coursera.org/learn/environmental-management-ethics

Grading Policy

Academic	Assignment	Case Study/Mini Project					TOTAL
	40	60					100

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P18CAO0207 **STARTUP REGISTRATION**

L	T	P	J	C
1	0	4	0	3

Course Overview

This course provides a comprehensive understanding of how startups in India can legally establish themselves, register on government portals, comply with regulatory requirements, and operate within the Indian startup ecosystem. Students will learn entity structures, registration workflows, compliance demands, and step-by-step procedures using platforms like MCA, DPIIT Startup India, GST, MSME Udyam, EPFO/ESIC, and local authority registrations. Practical lab sessions ensure hands-on experience with mock startup registration, documentation filing, and compliance tracking.

COURSE OUTCOMES **After successful completion of this course, the students should be able to**	
CO1:	Explain the regulatory framework and registration pathways for startups in India. [K2]
CO2:	Analyse and choose suitable legal entity structures for different start-up scenarios. [K4]
CO3:	Apply step-by-step procedures to register a start-up using relevant government portals. [K3]
CO4:	Evaluate the post-registration compliance and legal responsibilities of a registered entity. [K5]
CO5:	Create a complete start-up registration roadmap for a new venture. [K6]

Pre-requisite: NIL

COs	**CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											**CO/PSO Mapping**		
	PROGRAMME OUTCOMES (POs)											**PSOs of CSE**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2				3		2				2			
CO2	2	3				3		2			2	2			
CO3	3		2								2		2		
CO4		3				3		3			3	3			
CO5	3		3			2		2		3	3	3	2		

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Open book test, Written tests (Theory)

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Indirect
1. Course-end survey

THEORY COMPONENT CONTENTS

INDIAN STARTUP REGULATORY ECOSYSTEM AND POLICY FRAMEWORK 3 Hours

Overview of Startup India Mission; DPIIT Startup recognition: eligibility, benefits, exemption under Section 80-IAC & Angel Tax relief; Central & State policies supporting startups; Regulatory touchpoints: MCA, MSME, GST, Labour codes, FSSAI, Shops & Establishment; Key compliance bodies: MCA, CBDT, DPIIT, ROC, EPFO, ESIC, DIPP, RBI (FEMA), State authorities.

LEGAL ENTITY STRUCTURES AND THEIR IMPLICATIONS **3 Hours**

Proprietorship vs Partnership vs LLP vs Private Limited Company; Choosing the entity type: taxation, liability, funding readiness, compliance load; Incorporation laws: Partnership Act 1932, LLP Act 2008, Companies Act 2013; Comparison for startups: ESOP readiness, investor preference, founder agreements; Case-based evaluation of entity selection

CORE STARTUP REGISTRATIONS AND STEP-BY-STEP PROCESSES 3 Hours

MCA Portal (SPICe+, AGILE-PRO)- Name approval, DIN, PAN, TAN, MOA/AOA, Bank account opening, EPFO/ESIC, Professional tax

LLP Registration- RUN-LLP, FiLLiP, LLP Agreement, Form 3 filing;

DPIIT Startup Registration- Application workflow, submission requirements, obtaining recognition certificate;

MSME (Udyam) Registration; GST Registration - Threshold criteria, required documents, portal filing

Local Registrations- Shops & Establishment, Trade License, Pollution NOC

POST-REGISTRATION COMPLIANCE 3 Hours

MCA compliance: AOC-4, MGT-7A, ADT-1, PAS-3, DIR-3 KYC; LLP compliance; Form 11, Form 8; IP compliance (Trademark filing, renewal steps); Financial compliance: TDS, GST returns, Income Tax filings. Labour law compliance for startups; Maintaining statutory registers, minutes, resolutions.

CREATING A STARTUP REGISTRATION ROADMAP **3 Hours**

Designing an end-to-end registration workflow-Document checklist creation for various entity types; Mapping compliance calendar for 12 months; Simulated incorporation project; Tools & templates: Founder agreement, Co-founder equity split, ESOP basics; Final roadmap presentation & evaluation.

PRACTICAL COMPONENT 60 Hours

Sample Experiment:

1. Create a mock founder profile & venture idea
2. Navigate the MCA portal & simulate the SPICe+ process

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3. Prepare MOA/AOA templates using sample data
4. Fill LLP incorporation forms (FiLLiP, Form 3)
5. Create a DPIIT Startup Recognition application (dummy submission)
6. Register a mock startup on Udyam portal (simulation)
7. Complete GST new registration workflow
8. Create compliance calendar for a Pvt Ltd & LLP
9. Prepare a one-year statutory register & return filing tracker
10. Final project: Startup Registration Roadmap for a new venture

Theory: 15 Tutorial: 0 Practical: 60 Project: 0 Total: 75 Hours

REFERENCES:

1. Companies Act 2013 – Ministry of Corporate Affairs
2. LLP Act 2008 & Rules – MCA
3. Startup India Handbook, DPIIT
4. GST Act & Rules – CBIC
5. Indian Partnership Act 1932
6. FEMA Guidelines for Startups – RBI

ONLINE RESOURCES:

1. https://www.startupindia.gov.in
2. https://www.mca.gov.in
3. https://udyamregistration.gov.in
4. https://www.gst.gov.in
5. https://www.incometax.gov.in
6. https://ipindiaonline.gov.in

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U18ENO0518

PROFESSIONAL SKILLS FOR CAREER GROWTH

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES

1. Equip students with industry-ready professional, communication, and workplace skills essential for corporate hiring processes.
2. Develop aptitude, logical reasoning, and analytical problem-solving competencies needed for placement assessments.
3. Enable students to build effective resumes, LinkedIn profiles, digital portfolios, and personal branding.
4. Train students in group discussions, case analyses, online interviews, and assessment center activities.
5. Build confidence, etiquette, adaptability, and career planning abilities required for entry into IT, Core Engineering, Analytics, and Business roles.

COURSE OUTCOMES

After Successful completion of this course, the students will be able to:		BTL
CO1	Demonstrate effective professional communication required for corporate recruitment processes.	K3
CO2	Apply quantitative aptitude, logical reasoning, and data interpretation techniques to solve company-specific placement assessments.	K3
CO3	Create industry-ready resumes, LinkedIn profiles, and digital portfolios tailored to specific career paths.	K5
CO4	Participate effectively in group discussions and assessment-centre activities using structured analytical and collaborative frameworks.	K4
CO5	Perform confidently in HR, technical, and online interview formats by demonstrating professional etiquette, preparedness, and structured responses.	K3

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
	Programme Outcomes (POs)														
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	
CO1	W	W							M	S	S	M	W		
CO2	W	S	W	M					W	W	W	M	W		
CO3			M		W		W		M	S	S	S	W	W	
CO4	W	W	M			W			S	S	S	S			
CO5		W				M		W	S	S	S	S			

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COURSE ASSESSMENT METHODS

FORMATIVE
1. Weekly communication tasks 2. Aptitude quizzes & adaptive tests 3. Resume/LinkedIn/GitHub drafts 4. GD practice and journal reflections 5. Mock interview practices (HR, technical, AI-based)
SUMMATIVE
1. Final Aptitude Test 2. Career Portfolio Submission 3. Final Group Discussion Assessment 4. Final HR & Technical Interview Simulation (online) 5. Capstone: Online Interview Video Portfolio

PRACTICAL COMPONENT

PROFESSIONAL COMMUNICATION FOR INDUSTRY **15 Hours**

Foundations of corporate communication, Email etiquette, business writing, report standards, Presentation skills: structure, storytelling, data visualization, Non-verbal communication, body language, Cross-cultural communication in global companies.

Practical: Email drafting exercises, Presentation design and delivery, Workplace communication role-plays, Project: Virtual team communication simulation

APTITUDE AND LOGICAL REASONING FOR PLACEMENTS **20 Hours**

Quantitative aptitude: Algebra, numbers, time and work, Permutations and Combinations, Logical Reasoning and Data Interpretation, Pattern-based aptitude for product companies, Solving adaptive tests: TCS NQT, Infosys, Deloitte, Amazon, Zoho, Resume-based case aptitude

Practical: Timed aptitude tests, LRDI challenges, Role-based aptitude: IT, Core, Analytics, Project: Personalized aptitude improvement dashboard

CAREER BRANDING AND PORTFOLIO DEVELOPMENT **15 Hours**

Resume (ATS-compliant), LinkedIn optimization, GitHub / Portfolio / Notion-based profiles, Cover letters, Statement of Purpose, Personal branding across platforms

Practical: Resume writing workshop, LinkedIn/GitHub audit, Portfolio website setup, Project: Complete personal brand kit

GROUP DISCUSSIONS AND ASSESSMENT CENTRE SKILLS **20 Hours**

GD types: factual, abstract, case, managerial, Frameworks: SCQA, MECE, PESO, STAR, Leadership & teamwork simulation, Caselets and mini-case evaluations

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Practical: GD practice sessions, Case-based problem solving, Peer feedback sessions, Project: GD video + reflection journal

INTERVIEW READINESS AND ONLINE INTERVIEW SKILLS 20 Hours

Types of interviews: HR, Technical, Managerial, Online interviews: One-way/asynchronous (HireVue, Shortlist), Live technical coding (HackerRank/CodePair), Panel interviews on MS Teams/Zoom, Camera presence, voice clarity, digital etiquette, troubleshooting internet, lighting, audio, background, explaining academic projects & internships, Salary negotiation, job offer analysis, ethics

Practical: Online HR mock interviews, online technical interview simulation, Asynchronous video interview practice, Environmental readiness assessment, Project: Online interview video portfolio + evaluation

Theory: 0	Tutorial: 0	Practical: 90	Project: 0	Total: 90 Hours

REFERENCES

1. Andrews, Sudha. Communication Skills for Professionals. McGraw-Hill (2020).
2. Sharma, R.C. Business Correspondence and Reporting. McGraw-Hill (2019).
3. Dale Carnegie. The Art of Public Speaking. Simon & Schuster (2018).
4. Stephen Covey. 7 Habits of Highly Effective People. Free Press (2020).

ONLINE RESOURCES

1. https://www.khanacademy.org
2. https://nptel.ac.in
3. https://swayam.gov.in

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U18ENO0519

ADVANCED COMMUNICATION SKILLS FOR INTERNATIONAL HIGHER EDUCATION

L	T	P	J	C
0	0	6	0	3

COURSE OBJECTIVES

1. To develop proficiency in English communication for academic and global contexts.
2. To familiarize students with formats, scoring, and strategies of international exams (IELTS, TOEFL, GRE, PTE, Duolingo).
3. To strengthen vocabulary, critical reading, analytical writing, and oral presentation skills.
4. To enhance confidence and time management through simulated test experiences.
5. To guide students in SOP writing and academic email communication for university applications.

COURSE OUTCOMES

After Successful completion of this course, the students will be able to:		BTL
CO1	Understand the structure, content, and evaluation criteria of global standardized tests (IELTS, TOEFL, GRE, etc.)	K2
CO2	Apply strategies to comprehend academic passages, lectures, and verbal reasoning questions	K3
CO3	Demonstrate analytical and argumentative writing proficiency for academic and test-based tasks	K4
CO4	Demonstrate oral fluency, clarity, and structured responses in academic interviews and speaking assessments.	K5
CO5	Generate complete and coherent test responses by synthesizing all four language skills in full-length simulations.	K6

Pre-requisites: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													**PSO**		
COs	**Programme Outcomes(POs)**														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	1	2	
CO1	M	S				S				M			S	S	
CO2	S	S	M			S							S	S	
CO3		S	S	M		M				S			S	S	
CO4	M			M	S				S	S		S	S	S	
CO5	S	S	M	S	S				S	S		S	S	S	

COURSE ASSESSMENT METHODS

FORMATIVE

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1. Diagnostic Test & Learning Plan 2. Weekly Practice Tasks (Listening, Reading, Writing, Speaking) 3. Vocabulary & Reading Journal 4. Writing Portfolio (Task 1 & Task 2 Drafts) 5. Mid-Semester Partial Mock Test
SUMMATIVE
1. Final Full-Length Mock Examination 2. Final SOP & Application Portfolio 3. Final Oral Viva / Interview Simulation

PRACTICAL COMPONENT

GLOBAL EXAMS & ACADEMIC COMMUNICATION FOUNDATIONS 16 Hours

Overview of IELTS, TOEFL, PTE, Duolingo & GRE formats, Scoring patterns, band descriptors, evaluation criteria, Global admissions pathways, country-wise requirements, Academic listening fundamentals, accents, note-taking, Diagnostic test and personalized study plan

Project Component: Test Comparison Analysis and Report.

Tools: Magoosh Diagnostic Platform, ETS Official Test Prep Portal, IELTS.org & British Council Resource Kits

LISTENING & READING SKILLS FOR GLOBAL EXAMS 20 Hours

IELTS/TOEFL listening: main ideas, inference, summarization, Academic lectures, multi-speaker conversations, Reading skills: skimming, scanning, critical comprehension, GRE Verbal Reasoning, Text Completion, Sentence Equivalence, Reading Comprehension (short & long passages)

Project Component: Listening–Reading Skills Workbook, Vocabulary Journal

Tools: TED Talks, BBC Learning English, NPR Audio,ETS GRE Prep Tools, Cambridge IELTS Reading Resources

ANALYTICAL & ARGUMENTATIVE WRITING 24 Hours

IELTS Writing Task (Charts/Graphs/Processes), TOEFL Writing Independent and Integrated Tasks GRE Analytical Writing:Issue Essay, Argument Essay, Structuring arguments, coherence, logical flow.Academic grammar, sentence variety, transitions

Project Component: 2-essay Writing Portfolio containing:

IELTS/TOEFL Task 1 report (chart/graph/process)

GRE Issue or Argument essay

Writing drafts with peer-reviewed annotations

Tools: ETS GRE Analytical Writing Analyzer, Cambridge IELTS Writing Samples

SPEAKING FOR GLOBAL ACADEMIC CONTEXTS 12 Hours

IELTS Speaking Parts 1–3, TOEFL Speaking prompts, Pronunciation, fluency, stress, intonation,

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Academic discussion, expressing opinions, structured responses, Interview preparation for international programs

Project Component: TOEFL speaking responses, Pronunciation & Fluency Improvement Log(documents)
Tools: ELSA Speak / Speechling (AI Pronunciation Coach), IELTS Speaking Sample Videos.

INTEGRATED PRACTICE, SOP WRITING & FULL SIMULATION **18 Hours**

Combined listening–reading–writing tasks, Time management drills for GRE/IELTS/TOEFL
Application communication: SOP Writing, Email etiquette, Recommendation request drafting, LinkedIn academic profile setup.
Mock Test 1 (Listening + Reading), Mock Test 2 (Writing + Speaking), Final full simulation: hybrid global test

Project Components: Submit a University Application Portfolio
Complete Mock Test Package
Tools: British Council IELTS Mock Test Portal, ETS TOEFL Practice Platform,
Manhattan GRE Practice Book

Theory: 0 **Tutorial: 0** **Practical: 90** **Project: 0** **Total: 90 Hours**

REFERENCES

1. The Official Cambridge Guide to IELTS – Cambridge University Press
2. Barron's TOEFL iBT – Barron's Educational Series
3. ETS GRE Official Guide – ETS
4. Official IELTS Practice Materials – British Council / IDP / Cambridge
5. Manhattan Prep GRE Verbal Strategy Guides
6. Online Portals: IELTS.org, ETS.org, Magoosh, British Council LearnEnglish
7. Listening: TED Talks, BBC Learning English, NPR, Guardian Audio
8. Writing Tools: Grammarly, Hemingway, QuillBot, Overleaf
9. Speaking Practice: ELSA Speak, Speechling, VoiceThread
10. GRE Tools: Magoosh GRE App, Manhattan 5lb Book, Quizlet Flashcards

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