Sri Sivasubramaniya Nadar College of Engineering

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Rajiv Gandhi Salai (OMR), Kalavakkam – 603110

Curriculum and Syllabus

B.E

Computer Science and Engineering

Regulations 2021

Choice Based Credit System (CBCS)

B.E. COMPUTER SCIENCE AND ENGINEERING

VISION OF THE DEPARTMENT

To emerge as a world-class technology department through education, innovation, and collaborative research.

MISSION OF THE DEPARTMENT

- To impart quality education to students.
- To create and disseminate knowledge for the betterment of mankind.
- To establish a centre of excellence in collaboration with industries, research laboratories and other agencies to meet the changing needs of society.
- To provide individual attention and enable character building.
- To encourage entrepreneurship skills among students.

B.E. COMPUTER SCIENCE AND ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To enable graduates to pursue higher education and research or have a successful career in industries associated with Computer Science and Engineering, or as entrepreneurs.

2. To ensure that graduates will have the ability and attitude to acquire new skills and adapt to emerging technological changes.

3. To ensure that graduates will be professional and ethical in their work, contributing to the advancement of society.

PROGRAM OUTCOMES (POs)

On successful completion of the program, our graduates will be able to

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. 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 cultural, societal, and environmental considerations.

4. 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.

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

6. 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.

7. 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.

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

9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. 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.

11. 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.

12. 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)

On successful completion of the program, our graduates will be able to

1. Investigate challenging problems across various domains with appropriate computational techniques, construct solutions systematically and evaluate their effectiveness.

2. Apply software engineering principles and practices for building high quality innovative software systems by adopting contemporary and emerging information processing technologies.

MAPPING OF PROGRAM OUTCOMES/PROGRAM-SPECIFIC OUTCOMES TO PROGRAM EDUCATIONAL OBJECTIVES

1: Reasonable, 2: Significant, 3: Strong

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	**3**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**3**	**3**	**2**
PEO2	**1**	**2**	**3**	**2**	**3**	**3**	**3**	**1**	**2**	**1**	**2**	**3**	**2**	**3**
PEO3	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**1**	**3**

MAPPING OF COURSES TO PROGRAM OUTCOMES / PROGRAM SPECIFIC OUTCOMES

Sem		PO												PSO	
	COURSES	1	2	3	4	5	6	7	8	9	10	11	12	1	2
I	Technical English									2	3		2		
	Matrices and Calculus	3	2											1	
	Engineering Physics	3	2	1											
	Engineering Chemistry	3	2		1	1		1			2				
	Problem Solving and Programming in Python	3	2											3	
	Engineering Graphics	3	2	2			2				3				
	Programming in Python Lab	3	2											2	
	Physics and Chemistry Lab	3			2	1									
II	Complex Functions and Laplace Transforms	3	2											1	
	Basic Electrical and Electronics Engineering	3	2	1		1	1								
	Fundamentals and Practice of Software Development	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Environmental Science						2		2	2	2		2		
	Foundations of Data Science	3	2		2	1								2	
	Design Thinking and Engineering Practices Lab	3	3		2					3	1		1		
III	Discrete Mathematics	3	2											1	
	Universal Human Values:						2		3	3	2		3		

	Understanding Harmony														
	Digital Principles and System Design	3	2	3							3			2	
	Data Structures	3	3	3	3						3		3	2	3
	Object Oriented Programming	3	3	3										2	2
	Digital Design Lab	3	2	2	3					3	3			2	
	Data Structures Lab	3	3	3	3							3		2	2
	Object Oriented Programming Lab	3	3	3	3					3	3	3		2	2
IV	Probability and Statistical Methods	3	2		1									1	
	Computer Organization and Architecture	3	2	3				3			3			2	
	Operating Systems	3	3	3										3	
	Design and Analysis of Algorithms	3	2	2							3		3	3	
	Database Management Systems	3	3	3						3	3			2	
	Operating Systems Lab	3	2		3									3	
	Database Lab	3	3	3	3	2				3	2	3		2	
V	Computer Networks	3	2	3									2	2	
	Microprocessors Microcontrollers and Interfacing	3	2	2							3			2	3
	Foundations of Artificial Intelligence	3	3	3	3					3	3		3	3	
	Software Engineering	3	3	3		3	2	3	3	3	3	3	1	3	3
	Networks Lab	3	3		3	2								2	
	Microprocessors Microcontrollers and Interfacing Lab	3	2	2	3						3			2	3
VI	Internet Programming	3	2	3							3			2	
	Software System Security	3	2											2	
	Principles of Machine Learning	3	2	3					3				2	2	

	Theory of Computation	3	2								2			3	
	Professional Readiness for Innovation, Employability And Entrepreneurship						2	2	3	3	2	3	3		
	Internet Programming Lab	3	3	3	3	3	3	3		3	3	3	3	2	
	Machine Learning Lab	3	3	3	3	3	3	3	3	3	3	3		3	2
VII	Distributed Systems	3	3	3									2	3	
	Software Architecture	3	3												2
	Compiler Design	3	3	3	3	3					2			3	3
	Project Work Phase I	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Industrial Training/Internship	3	3	3	3	3	3	3	3	3	3	3	3	3	3
VIII	Project Work Phase II	3	3	3	3	3	3	3	3	3	3	3	3	3	3

PROFESSIONAL ELECTIVES (PE)

	Course Title	Programme Outcome (PO)												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
PE1	Mathematics for Machine Learning	3	2											2	
	Image Processing and Analysis	3	2		3						3		2	2	
	Logic Programming	3	2								3		2	3	
	Probabilistic Graphical Models	3	2		3									2	
	Big Data Technologies	3	2	3	3									2	2
	Software Testing	3	3	2	3	1				3		3		3	
	UNIX Internals	3	2											3	
	IoT Technologies	3	2	2									2	3	
	Advanced Database Management Systems	3	2		3									2	
PE2	Bayesian Data Analysis	3	2	3	3					3	3			3	
	Soft Computing	3	2	3		2				3	3		3	3	
	Deep Learning	3	3		3	3				3				3	2
	Object Oriented Analysis and Design	3	3	3							2			2	
	Software Configuration Management	3	3	2						3	3	3		2	
	Multicore Architectures and Programming	3	2								3			2	
	Network and Server Security	3	2											2	
PE3	Health Care Data Analytics	3	2		3								2	3	
	Social Network Analysis and Applications	3	3	3	3	3				3	3			3	2
	Principles of Reinforcement Learning	3	2								3		3	2	
	User Experience Design	3	2	3							2				2
	Big Data Modeling and Management	3	2		3					3				2	2
	Blockchain Technologies	3	2			1								2	2
	Embedded Systems Design	3	2								3		3	3	3
	Wireless Adhoc and Sensor Networks	3	3			3					3			3	

	Course Title	Programme Outcome (PO)												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
PE4	Time Series Analysis and Forecasting	3	3		3									3	
	Computer Vision	3	2		3						3		2	2	
	Speech Processing and Synthesis	3	2	3		3								2	
	Natural Language Processing and Applications	3	3		3									3	
	Business Intelligence	3	2		3	1								2	2
	Agile Methodologies	3	3	3										2	3
	Mobile Computing	3	2		3						3			3	2
	Mobile and Wireless Security	3	3	1										2	
	Graphics and Multimedia	3	2			2							2	3	
PE5	Bioinformatics Technologies	3	2		2									3	
	Information Retrieval Techniques	3	2		3								2	2	
	Introduction to Robotics	3	2								3		3	2	3
	Service Oriented Architecture	3	3												3
	Software Defined Networking	3	2			3							2	2	
	Cloud Computing	3	3			3								3	
	Cyber Forensics	3	3			1							2	3	2

MANAGEMENT ELECTIVES

S. No	Course Title	Programme Outcome (PO)												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	Principles of Management					3	3	2	3	2	2	2	1		
2	Total Quality Management					2	3	1	2	1		1	1		
3	Work Ethics Corporate Social Responsibility and Governance						3	2	3	1	1	2	2		

HUMANITIES ELECTIVES

S. No	Course Title	Programme Outcome (PO)												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	Languages and Communication									2	3		2		
2	Fundamentals of Linguistics									2	3		2		
3	Film Appreciation									2	3		2		
4	Human Relations at Work									2	3		2		
5	Application of Psychology in Everyday Life									2	3		2		
6	Understanding Society and Culture through Literature									2	3		2		

SUSTAINABLE DEVELOPMENT GOALS

SDG	Short Form	Full Form
1	No Poverty	End poverty in all its forms everywhere
2	Zero Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3	Good health and well being	Ensure healthy lives and promote well-being for all at all ages
4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5	Gender Equality	Achieve gender equality and empower all women and girls
6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable, and modern energy for all
8	Decent work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9	Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
10	Reducing Inequality	Reduce income inequality within and among countries
11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient, and sustainable
12	Responsible consumption and production	Ensure sustainable consumption and production patterns
13	Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
14	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16	Peace, justice and string Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17	Partnerships for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development

MAPPING OF COURSES TO SUSTAINABLE DEVELOPMENT GOALS

Courses	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Technical English				1													
Matrices and Calculus				1													
Engineering Physics				1													
Engineering Chemistry				1													
Problem Solving and Programming in Python				1													
Engineering Graphics				1													
Physics and Chemistry Lab				1													
Programming in Python Lab				1													
Complex Functions and Laplace Transforms				1													
Basic Electrical and Electronics Engineering				1													
Fundamentals and Practice of Software Development (TCP)				1				1	1								
Environmental Science			1	1		1	1						1	1	1		
Humanities Elective I																	
Foundations of Data Science				1													
Design Thinking and Engineering Practices Lab				1													
Discrete Mathematics				1													
Universal Human Values: Understanding Harmony			1	1													
Digital Principles and System Design				1							1						
Data Structures				1													
Object Oriented Programming				1													
Digital Design Lab				1													
Data Structures Lab				1				1									
Object Oriented Programming Lab				1				1									
Probability and Statistics				1													
Indian Constitution				1													
Computer Organization and Architecture				1													
Operating Systems				1													
Design and Analysis of Algorithms (TCP)				1													
Database Management Systems				1													
Operating Systems Lab				1				1									
Database Lab				1				1									
Computer Networks				1													
Microprocessors, Microcontrollers and Interfacing				1													

Foundations of Artificial Intelligence (TCP)				1													
Software Engineering				1													
Professional Readiness for Innovation, Employability And Entrepreneurship				1				1	1								
Management Elective																	
Networks Lab				1							1						
Microprocessors Lab				1							1						
Internet Programming				1													
Software System Security				1													
Principles of Machine Learning				1													
Theory of Computation				1													
Professional Elective I																	
Open Elective I																	
Internet Programming Lab			1	1				1			1						
Machine Learning Lab			1	1				1			1						
Distributed Systems				1												1	
Software Architecture				1												1	
Compiler Design (TCP)				1													
Professional Elective II																	
Professional Elective III																	
Professional Elective IV																	
Project Work Phase I			1	1				1	1								
Industrial Training / Internship				1				1	1								1
Professional Elective V																	
Open Elective II																	
Project Work Phase II				1				1	1								1
Languages and Communication				1				1									
Fundamentals of Linguistics				1				1									
Film Appreciation																	
Human Relations at Work				1	1			1			1						
Application of Psychology in Everyday Life				1							1						
Understanding Society and Culture through Literature				1							1						
Principles of Management			1	1	1												
Total Quality Management			1	1	1				1								
Work Ethics Corporate Social Responsibility and Governance	1	1	1	1	1			1		1							
Mathematics for Machine Learning				1													
Big Data Technologies				1					1								
Software Testing				1					1			1					
Image Processing and Analysis			1	1										1	1		
Logic Programming				1													

UNIX Internals				1													
Advanced Database Management Systems			1	1					1								
Cloud Computing				1												1	
Big Data Modelling and Management				1					1								
Software Configuration Management				1					1								
Probabilistic Graphical Models				1													
Natural Language Processing and Applications			1	1													
Cyber Forensics				1							1						
IoT Technologies			1	1							1						
Bayesian Data Analysis				1													
Wireless Adhoc and Sensor Networks				1							1						
Object Oriented Analysis and Design				1					1								
Soft Computing				1					1								
Deep Learning				1					1		1						
Multicore Architectures and Programming				1													
Network and Server Security				1							1						
Health Care Data Analytics			1	1					1								
User Experience Design				1					1								
Social Network Analysis and Applications				1					1								
Principles of Reinforcement Learning				1													
Blockchain Technologies				1					1								
Embedded Systems Design			1	1							1						
Graphics and Multimedia				1													
Business Intelligence				1				1									
Agile Methodologies				1				1	1								
Time Series Analysis and Forecasting				1													
Computer Vision			1	1										1	1		
Speech Processing and Synthesis				1					1								
Mobile Computing				1					1								
Mobile and Wireless Security				1					1		1						
Bioinformatics Technologies			1	1													
Service Oriented Architecture				1													
Information Retrieval Techniques				1													
Introduction to Robotics				1													
Software Defined Networking				1													

SSN COLLEGE OF ENGINEERING, KALAVAKKAM - 603110

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REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

B.E. COMPUTER SCIENCE AND ENGINEERING

CURRICULUM

SEMESTER I

No	Code	Course Title	Category	Periods	L	T	P	E	C
		Theory							
1	UEN2176	Technical English	HS	4	2	0	2	0	3
2	UMA2176	Matrices and Calculus	BS	4	3	1	0	0	4
3	UPH2176	Engineering Physics	BS	3	3	0	0	0	3
4	UCY2176	Engineering Chemistry	BS	3	3	0	0	0	3
5	UGE2176	Problem Solving and Programming in Python	ES	3	3	0	0	0	3
6	UGE2177	Engineering Graphics	ES	5	1	0	4	0	3
		Practical							
7	UGS2197	Physics and Chemistry Lab	BS	3	0	0	3	0	1.5
8	UGE2197	Programming in Python Lab	ES	3	0	0	3	0	1.5
		Total		**28**	**15**	**1**	**12**	**0**	**22**

SEMESTER II

No	Code	Course Title	Category	Periods	L	T	P	E	C
		Theory							
1	UMA2276	Complex Functions and Laplace Transforms	BS	4	3	1	0	0	4
2	UEE2276	Basic Electrical and Electronics Engineering	ES	3	3	0	0	0	3
3	UCS2201	Fundamentals and Practice of Software Development (TCP)	ES	6	1	0	5	3	4.5
4	UCY2276	Environmental Science	BS	3	3	0	0	0	0
5		Humanities Elective	HS	3	2	0	2	0	3
6	UCS2202	Foundations of Data Science	ES	3	3	0	0	0	3
		Practical							
7	UGE2297	Design Thinking and Engineering Practices Lab	ES	3	0	0	3	0	1.5
		Total		**25**	**16**	**1**	**8**	**3**	**19**

SEMESTER III

No	Code	Course Title	Category	Periods	L	T	P	E	C
		Theory							
1	UMA2377	Discrete Mathematics	BS	4	3	1	0	0	4
2	UHS2376	Universal Human Values 2: Understanding Harmony	HS	4	2	0	2	0	3
3	UCS2301	Digital Principles and System Design	ES	3	3	0	0	0	3
4	UCS2302	Data Structures	PC	3	3	0	0	0	3
5	UCS2303	Object Oriented Programming	PC	3	3	0	0	0	3
		Practical							
6	UCS2311	Digital Design Lab	ES	3	0	0	3	0	1.5
7	UCS2312	Data Structures Lab	PC	4	0	0	4	0	2
8	UCS2313	Object-Oriented Programming Lab	PC	3	0	0	3	0	1.5
		Total		**27**	**14**	**1**	**12**	**0**	**21**

SEMESTER IV

No	Code	Course Title	Category	Periods	L	T	P	E	C
		Theory							
1	UMA2476	Probability and Statistics	BS	4	3	1	0	0	4
2	AHS2476	Indian Constitution	HS	3	3	0	0	0	0
3	UCS2401	Computer Organization and Architecture	PC	3	3	0	0	0	3
4	UCS2402	Operating Systems	PC	3	3	0	0	0	3
5	UCS2403	Design and Analysis of Algorithms (TCP)	PC	5	3	0	2	0	4
6	UCS2404	Database Management Systems	PC	3	3	0	0	0	3
		Practical							
7	UCS2412	Operating Systems Lab	PC	3	0	0	3	0	1.5
8	UCS2411	Database Lab	PC	3	0	0	3	0	1.5
		Total		27	18	1	8	0	20

SEMESTER V

No	Code	Course Title	Category	Periods	L	T	P	E	C
		Theory							
1	UCS2501	Computer Networks	PC	3	3	0	0	0	3
2	UCS2502	Microprocessors, Microcontrollers, and Interfacing	PC	3	3	0	0	0	3
3	UCS2504	Foundations of Artificial Intelligence (TCP)	PC	5	3	0	2	0	4
4	UCS2503	Software Engineering	PC	3	3	0	0	0	3
5		Professional Elective I	PE	3	3	0	0	0	3
6		Management Elective	HS	3	3	0	0	0	3
		Practical							
7	UCS2511	Networks Lab	PC	3	0	0	3	0	1.5
8	UCS2512	Microprocessors Lab	PC	3	0	0	3	0	1.5
		Total		**26**	**18**	**0**	**8**	**0**	**22**

SEMESTER VI

No	Code	Course Title	Category	Periods	L	T	P	E	C
		Theory							
1	UCS2601	Internet Programming	PC	3	3	0	0	0	3
2	UCS2602	Software System Security	PC	3	3	0	0	0	3
3	UCS2604	Principles of Machine Learning	PC	3	3	0	0	0	3
4	UCS2603	Theory of Computation	PC	3	3	0	0	0	3
5		Professional Readiness for Innovation, Employability And Entrepreneurship	EEC	6	0	0	6	0	3
6		Open Elective I	OE	3	3	0	0	0	3
		Practical							
7	UCS2611	Internet Programming Lab	PC	3	0	0	3	0	1.5
8	UCS2612	Machine Learning Lab	PC	3	0	0	3	0	1.5
		Total		**27**	**15**	**0**	**12**	**0**	**21**

SEMESTER VII

No	Code	Course Title	Category	Periods	L	T	P	E	C
		Theory							
1	UCS2701	Distributed Systems	PC	3	3	0	0	0	3
2	UCS2703	Software Architecture	PC	3	3	0	0	0	3
3	UCS2702	Compiler Design (TCP)	PC	5	3	0	2	0	4
4		Professional Elective II	PE	3	3	0	0	0	3
5		Professional Elective III	PE	3	3	0	0	0	3
6		Professional Elective IV	PE	3	3	0	0	0	3
		Practical							
7	UCS2718	Project Work Phase I	EEC	6	0	0	6	0	3
8	UCS2716	Industrial Training / Internship	EEC	0	0	0	0	6	2
		Total		**26**	**18**	**0**	**8**	**6**	**24**

SEMESTER VIII

No	Code	Course Title	Category	Periods	L	T	P	E	C
		Theory							
1		Professional Elective V	PE	3	3	0	0	0	3
2		Open Elective II	OE	3	3	0	0	0	3
		Practical							
3	UCS2818	Project Work Phase II	EEC	16	0	0	16	0	8
		Total		**22**	**6**	**0**	**16**	**0**	**14**

Total number of credits: 163

L Lecture periods per week
T Tutorial periods per week
P Practical periods per week
E Experiential learning periods per week
C Credits
TCP Theory-cum Practical

HUMANITIES ELECTIVES

No	Code	Course Title	Category	Periods	L	T	P	E	C
1	UEN2241	Language and Communication	HS	3	0	0	0	0	3
2	UEN2242	Fundamentals of Linguistics	HS	3	0	0	0	0	3
3	UHS2243	Film Appreciation	HS	3	0	0	0	0	3
4	UHS2241	Human relations at Work	HS	3	0	0	0	0	3
5	UHS2242	Application of Psychology in Everyday Life	HS	3	0	0	0	0	3
6	UEN2243	Understanding Society and Culture through Literature	HS	3	0	0	0	0	3

MANAGEMENT ELECTIVES

No	Code	Course Title	Category	Periods	L	T	P	E	C
1	UBA2541	Principles of Management	HS	3	3	0	0	0	3
2	UBA2542	Total Quality Management	HS	3	3	0	0	0	3
3	UBA2543	Work Ethics, Corporate Social Responsibility and Governance	HS	3	3	0	0	0	3

PROFESSIONAL ELECTIVES

Professional Elective I

No	Code	Course Title	Category	Periods	L	T	P	E	C
1	UCS2523	Image Processing and Analysis	PE	3	3	0	0	0	3
2	UCS2524	Logic Programming	PE	3	3	0	0	0	3
3	UCS2623	Probabilistic Graphical Models	PE	3	3	0	0	0	3
4	UCS2521	Big Data Technologies	PE	3	3	0	0	0	3
5	UCS2522	Software Testing	PE	3	3	0	0	0	3
6	UCS2525	UNIX Internals	PE	3	3	0	0	0	3
7	UCS2625	IoT Technologies	PE	3	3	0	0	0	3
8	UCS2526	Advanced Database Management Systems	PE	3	3	0	0	0	3

Professional Elective II

No	Code	Course Title	Category	Periods	L	T	P	E	C
1	UCS2721	Bayesian Data Analysis	PE	3	3	0	0	0	3
2	UCS2724	Soft Computing	PE	3	3	0	0	0	3
3	UCS2725	Deep Learning	PE	3	3	0	0	0	3
4	UCS2723	Object Oriented Analysis and Design	PE	3	3	0	0	0	3
5	UCS2622	Software Configuration Management	PE	3	3	0	0	0	3
6	UCS2726	Multicore Architectures and Programming	PE	3	3	0	0	0	3
7	UCS2727	Network and Server Security	PE	3	3	0	0	0	3

Professional Elective III

No	Code	Course Title	Category	Periods	L	T	P	E	C
1	UCS2739	Healthcare Data Analytics	PE	3	3	0	0	0	3
2	UCS2741	Social Network Analysis and Applications	PE	3	3	0	0	0	3
3	UCS2735	Principles of Reinforcement Learning	PE	3	3	0	0	0	3
4	UCS2728	User Experience Design	PE	3	3	0	0	0	3
5	UCS2626	Big Data Modeling and Management	PE	3	3	0	0	0	3
6	UCS2729	Blockchain Technologies	PE	3	3	0	0	0	3
7	UCS2736	Embedded Systems Design	PE	3	3	0	0	0	3
8	UCS2722	Wireless and Adhoc Networks	PE	3	3	0	0	0	3

Professional Elective IV

No	Code	Course Title	Category	Periods	L	T	P	E	C
1	UCS2732	Time Series Analysis and Fore-casting	PE	3	3	0	0	0	3
2	UCS2737	Computer Vision	PE	3	3	0	0	0	3
3	UCS2738	Speech Processing and Synthesis	PE	3	3	0	0	0	3
4	UCS2627	Natural Language Processing and Applications	PE	3	3	0	0	0	3

5	UCS2743	Business Intelligence	PE	3	3	0	0	0	3
6	UCS2731	Agile Methodologies	PE	3	3	0	0	0	3
7	UCS2733	Mobile Computing	PE	3	3	0	0	0	3
8	UCS2734	Mobile and Wireless Security	PE	3	3	0	0	0	3
9	UCS2742	Graphics and Multimedia	PE	3	3	0	0	0	3

Professional Elective V

No	Code	Course Title	Category	Periods	L	T	P	E	C
1	UCS2821	Bioinformatics	PE	3	3	0	0	0	3
2	UCS2824	Information Retrieval Techniques	PE	3	3	0	0	0	3
3	UCS2825	Introduction to Robotics	PE	3	3	0	0	0	3
4	UCS2823	Service Oriented Architecture	PE	3	3	0	0	0	3
5	UCS2827	Software Defined Networking	PE	3	3	0	0	0	3
6	UCS2621	Cloud Computing	PE	3	3	0	0	0	3
7	UCS2624	Cyber Forensics	PE	3	3	0	0	0	3

SPECIALIZATION

PE	AI and Machine Learning	Software Engineering	Systems and Security
I	Image Processing and Analysis, Logic Programming, Probabilistic Graphical Models	Big Data Technologies, Software Testing	UNIX Internals, IoT Technologies
II	Bayesian Data Analysis, Soft Computing, Deep Learning	Object Oriented Analysis and Design, Software Configuration Management	Multicore Architecture and GPU Computing, Network and Server Security
III	Healthcare Data Analytics, Social Network Analysis and Applications, Principles of Reinforcement Learning	User Experience Design, Big Data Modelling and Management	Blockchain Technologies, Embedded Systems Design
IV	Time Series Analysis and Forecasting, Computer Vision, Speech Processing and Synthesis, Natural Language Processing, Business Intelligence	Agile Methodologies	Mobile Computing, Mobile and Wireless Security
V	Bioinformatics Technologies, Information Retrieval Techniques, Introduction to Robotics	Service Oriented Architecture	Software Defined Networking, Cloud Computing, Cyber Forensics

HONOURS SPECIALIZATION

Six additional courses for Honours degree (in AI and Machine Learning) should be elected from

- Mathematics for Machine Learning (offered in semester IV)
- Image Processing and Analysis
- Logic Programming
- Big Data Technologies
- Probabilistic Graphical Models
- Natural Language Processing and Applications
- Big Data Modeling and Management
- Bayesian Data Analysis
- Soft Computing
- Deep Learning
- Healthcare Data Analytics
- Social Network Analysis and Applications
- Principles of Reinforcement Learning
- Business Intelligence
- Time Series Analysis and Forecasting
- Computer Vision
- Speech Processing and Synthesis
- Bioinformatics Technologies
- Information Retrieval Techniques
- Introduction to Robotics

DISTRIBUTION OF COURSES

Sem	HS	BS	ES	PC	PE	OE	EEC	MC	Total
I	3	11.5	7.5	0	0	0	0	0	22
II	3	4	12	0	0	0	0	0	19
III	3	4	4.5	9.5	0	0	0	0	21
IV	0	4	0	16	0	0	0	0	20
V	3	0	0	16	3	0	0	0	22
VI	0	0	0	15	0	3	3	0	21
VII	0	0	0	10	9	0	5	0	24
VIII	0	0	0	0	3	3	8	0	14
	12	**23.5**	**24**	**66.5**	**15**	**6**	**16**	**0**	**163**

HUMANITIES AND SOCIAL SCIENCES (HS)

No	Code	Course	Periods	L	T	P	E	C
1	UEN2176	Technical English	4	2	0	2	0	3
2		Humanities Elective	3	3	0	0	0	3
3	UHS2376	Universal Human Values 2: Understanding Harmony	3	3	0	0	0	3
4	AHS2476	Indian Constitution	3	3	0	0	0	0
5		Management Elective	3	3	0	0	0	3
			16	**14**	**0**	**2**	**0**	**12**

BASIC SCIENCES (BS)

No	Code	Course	Periods	L	T	P	E	C
1	UMA2176	Matrices and Calculus	4	3	1	0	0	4
2	UPH2176	Engineering Physics	3	3	0	0	0	3
3	UCY2176	Engineering Chemistry	3	3	0	0	0	3
4	UGS2197	Physics and Chemistry Lab	3	0	0	3	0	1.5
5	UMA2276	Complex Functions and Laplace Transform	4	3	1	0	0	4
6	UCY2276	Environmental Science	3	3	0	0	0	0
7	UMA2377	Discrete Mathematics	4	3	1	0	0	4
8	UMA2476	Probability and Statistics	4	3	1	0	0	4
			28	**21**	**4**	**3**	**0**	**23.5**

ENGINEERING SCIENCES (ES)

No	Code	Course	Periods	L	T	P	E	C
1	UGE2176	Problem Solving and Programming in Python	3	3	0	0	0	3
2	UGE2177	Engineering Graphics	5	1	0	4	0	3
3	UGE2197	Programming in Python Lab	3	0	0	3	0	1.5
4	UEE2276	Basic Electrical and Electronics Engineering	3	3	0	0	0	3
5	UCS2201	Fundamentals and Practice of Software Development (TCP)	8	2	0	3	3	4.5
6	UCS2202	Foundations of Data Science	3	3	0	0	0	3
7	UGE2297	Design Thinking and Engineering Practices Lab	3	0	0	3	0	1.5
8	UCS2301	Digital Principles and System Design	3	3	0	0	0	3
9	UCS2311	Digital Design Lab	3	0	0	3	0	1.5
			34	**15**	**0**	**16**	**3**	**24**

PROFESSIONAL CORE (PC)

No	Code	Course	Periods	L	T	P	E	C
1	UCS2302	Data Structures	3	3	0	0	0	3
2	UCS2303	Object Oriented Programming	3	3	0	0	0	3
3	UCS2312	Data Structures Lab	4	0	0	4	0	2
4	UCS2313	Object Oriented Programming Lab	3	0	0	3	0	1.5
5	UCS2401	Computer Organization and Architecture	3	3	0	0	0	3
6	UCS2402	Operating Systems	3	3	0	0	0	3
7	UCS2403	Design and Analysis of Algorithms (TCP)	5	3	0	2	0	4
8	UCS2404	Database Management Systems	3	3	0	0	0	3
9	UCS2412	Operating Systems Lab	3	0	0	3	0	1.5
10	UCS2411	Database Lab	3	0	0	3	0	1.5
11	UCS2501	Computer Networks	3	3	0	0	0	3
12	UCS2502	Microprocessors, microcontrollers, and Interfacing	3	3	0	0	0	3
13	UCS2504	Foundations of Artificial Intelligence (TCP)	5	3	0	2	0	4
14	UCS2503	Software Engineering	3	3	0	0	0	3
15	UCS2511	Networks Lab	3	0	0	3	0	1.5
16	UCS2512	Microprocessors Lab	3	0	0	3	0	1.5
17	UCS2601	Internet Programming	3	3	0	0	0	3
18	UCS2602	Software System Security	3	3	0	0	0	3
19	UCS2604	Principles of Machine Learning	3	3	0	0	0	3
20	UCS2603	Theory of Computation	3	3	0	0	0	3

21	UCS2611	Internet Programming Lab	3	0	0	3	0	1.5
22	UCS2612	Machine Learning Lab	3	0	0	3	0	1.5
23	UCS2701	Distributed Systems	3	3	0	0	0	3
24	UCS2703	Software Architecture	3	3	0	0	0	3
25	UCS2702	Compiler Design (TCP)	5	3	0	2	0	4
			82	**51**	**0**	**31**	**0**	**66.5**

PROFESSIONAL ELECTIVES (PE)

No	Code	Course	Periods	L	T	P	E	C
1		Professional Elective I	3	3	0	0		3
2		Professional Elective II	3	3	0	0		3
3		Professional Elective III	3	3	0	0		3
4		Professional Elective IV	3	3	0	0		3
5		Professional Elective V	3	3	0	0		3
			15	**15**	**0**	**0**	**0**	**15**

OPEN ELECTIVES (OE)

No	Code	Course	Periods	L	T	P	E	C
1		Open Elective I	3	3	0	0		3
2		Open Elective II	3	3	0	0		3
			6	**6**	**0**	**0**	**0**	**6**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

No	Code	Course	Periods	L	T	P	E	C
		Professional Readiness for Innovation, Employability And Entrepreneurship	6	0	0	6	0	3
1	UCS2718	Project Work Phase I	6	0	0	6	0	3
2	UCS2716	Industrial Training / Internship	0	0	0	0	0	2
3	UCS2818	Project Work Phase II	16	0	0	16	0	8
			28	**0**	**0**	**28**	**0**	**16**

MANDATORY COURSES (MC)

No	Code	Course	Periods	L	T	P	E	C
1	UCY2276	Environmental Science	BS	3	3	0	0	0
2	AHS2476	Indian Constitution	HS	3	3	0	0	0

COURSE CODE	COURSE TITLE	L	T	P	E	C
UEN2176	TECHNICAL ENGLISH	2	0	2	0	3

OBJECTIVES

- To enhance competence in reading comprehension for Science and Technology.
- To improve the writing proficiency specific to proposals, reports, and letters.
- To develop speaking skills for technical presentations, GDs and public speaking.
- To strengthen the listening skills of the students to enable them to listen and comprehend lectures and talks.
- To strengthen the grammatical competency

UNIT I BASICS OF COMMUNICATION 9

Language development: Subject-Verb Agreement, Tenses (simple), Conjunctions, Numerical adjective; Vocabulary development: Root words – Prefixes and Suffixes, Standard abbreviations; Reading: Comprehension of short technical texts – skimming and scanning; Writing: Describing an object, the process of an event/experiment and others, Paragraph Writing; Listening: Listening for taking notes and seeking clarifications (classroom lectures/ ted talks etc); Speaking: Self-introduction and introducing others/short conversations in formal and informal contexts

UNIT II MAKING PRESENTATIONS 9

Language development: The pronouns-antecedent agreement, Tenses-continuous, If conditionals, Adverbs; Vocabulary development: Collocations and fixed expressions, Avoidance of Jargons; Reading: Comprehension of longer texts – (Interpretative and Critical levels of mean-meaning); Writing: Writing definitions (single sentence and extended), Expository and Persuasive Essays; Listening: Listening Comprehension Tasks; Speaking: Making technical presentations.

UNIT III LISTENING TO SPEAK 9

Language development: Prepositions, Tenses-perfect, Articles, Embedded sentences; Vocabulary development: Compound words, Formal and informal vocabulary, Reading: Reading reviews, advertisements, SOPs for higher studies; Writing: Writing instruction and recommendations, formal and informal letters/ emails, Writing SOPs; Listening: Listening to longer technical talks and discussion; Speaking: Demonstrating working mechanisms.

UNIT IV READING FOR SPEAKING 9

Language development: Reported speech, Active and Passive voices, Framing ‘Wh’ and ‘Yes’ or ‘No’ questions; Vocabulary development: Technical vocabulary, Verbal analogies; Read- ing: Reading industrial case studies, interpreting technical text and making notes; Writing: Interpreting charts and graphs, writing blogs and vlogs; Listening: Listening to telephonic conversations and online interviews; Speaking: Participating in group discussions.

UNIT V PROFESSIONAL NEEDS 9

Language development: Phrasal verbs, clauses, compound and complex sentences; Vocabulary development: Single-word substitutes, Vocabulary retention strategies; Reading: Reading for IELTS,

GER, TOEFL; Writing: Writing proposals and reports, writing minutes of the meeting; Listening: Listening Skills for Proficiency Tests like IELTS; Speaking: Job Interviews (face to face and online) – basics.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Read and comprehend texts (technical) effectively
2. Write proposals, reports, emails, letters, SOPs meeting professional expectations
3. Improve vocabulary (use of right collocations, idioms and phrases etc)
4. Enhance grammatical competency for writing and speaking
5. Improve ability to listen and comprehend at deeper levels.

TEXTBOOKS

1. Praveen Sam D, Shoba N A, "Course in Technical English", Cambridge University Press, New Delhi, 2020.

REFERENCES

1. Sudharshana N P, Saveetha C, "English for Technical Communication", Cambridge University Press, New Delhi, 2016.
2. Raman, Meenakshi, Sharma, Sangeetha, "Technical Communication Principles and Practice", Oxford University Press, New Delhi, 2014.
3. Kumar, Suresh E, "Engineering English", Orient Blackswan, Hyderabad, 2015.
4. Booth L Diana, "Project Work", Oxford University Press, 2014.
5. Grussendorf, Marion, "English for Presentations", Oxford University Press, 2007.
6. Means, L Thomas, Elaine Langlois, "English and Communication for Colleges", Cengage Learning, USA, 2007.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3		2		
CO2									2	3		2		
CO3									2	3		2		
CO4									2	3		2		
CO5									2	3		2		
Course									2	3		2		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UMA2176	MATRICES AND CALCULUS	3	1	0	0	4

OBJECTIVES

- To reduce quadratic form to canonical form of a matrix and identify its nature
- To analyse the convergence of infinite series
- To study the concept of evolute and envelope
- To find the extreme values for a function of two variables
- To compute area of closed surface and volume of solids using multiple integrals

UNIT I MATRICES 12

Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigen- values and eigenvectors, Cayley-Hamilton Theorem – statement and applications, Diagonalization of matrices – Similarity transformation – Quadratic form – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II SEQUENCES AND SERIES 12

Sequences – Definition and examples, Series – Types of Convergence, Series of positive terms, Tests of convergence – Comparison test, Integral test and D'Alembert's ratio test, Alternating series – Leibnitz's test, Series of positive and negative terms, Absolute and conditional convergence.

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 12

Curvature, radius of curvature – Cartesian and parametric co-ordinates – Centre of curvature – Circle of curvature in Cartesian form, Evolutes, Envelopes (including two parameter family), Evolute as envelope of normal.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and its properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS 12

Double integrals in Cartesian and polar coordinates – Change of order of integration, Area enclosed by plane curves – Change of variables in double integrals, Triple integrals.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

1. reduce quadratic form to canonical form by orthogonal transformation and identify the nature of the quadratic form
2. analyse the convergence of a given infinite series
3. find evolute of a given curve and envelope of family of curves

4. find the extrema of function of two variables
5. evaluate the double and triple integrals
6. application of extreme points of functions and multiple integrals in engineering prob- lems

TEXTBOOKS

1. Grewal B S, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2018.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Edition, 2016.

REFERENCE BOOKS

1. Bali N P, Manish Goyal, “A Textbook of Engineering Mathematics”, Ninth Edition, Laxmi Publications Pvt Ltd, 2016.
2. James Stewart, “Calculus: Early Transcendental”, Cengage Learning, New Delhi, 7th Edition, 2013.
3. Dass H K, Rajnish Verma, “Higher Engineering Mathematics”, S Chand Private Ltd, 2011.
4. Srimanta Pal, Subodh C Bhunia, “Engineering Mathematics”, Oxford University Press, 2015.

CO to PO Mapping

PO/PSO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2											1	
CO2	3	2											1	
CO3	3	2											1	
CO4	3	2											1	
CO5	3	2											1	
CO6	3	2											1	
Course	3	2											1	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UPH2176	ENGINEERING PHYSICS	3	0	0	0	3

OBJECTIVES

- To comprehend and identify different crystal structures and their imperfections.
- To explain the elastic and thermal properties of materials and understand their significance.
- To develop an understanding of quantum mechanical phenomena and their applications.
- To provide an overview of the characteristics of sound, architectural acoustics and the production, detection and applications of ultrasound.
- To explain the origin of laser action, production of laser, fibre optics and their applications.

UNIT I CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials– single crystals - Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) – Crystal Imperfections – Point, line (Edge and Screw dislocations – Burger vectors) Surface (stacking faults) and Volume defects.

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Properties of matter: Elasticity – Hooke's law – Relationship between three moduli of elasticity – stress -strain diagram– Poisson's ratio – Factors affecting elasticity – Torsional stress & deformations – Twisting couple – Torsion pendulum - theory and experiment – bending of beams-bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – I-shaped girders. Thermal Physics: Modes of heat transfer – thermal conduction, convection and radiation – Newton's law of cooling – thermal conductivity – Lee's disc method for bad conductor – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel)
– Formation of ice on ponds.

UNIT III ACOUSTICS AND ULTRASONICS 9

Acoustics: Classification and characteristics of Sound – decibel – Weber-Fechner law – Sabine's formula - derivation using growth and decay method – factors affecting acoustics of buildings and their remedies – Methods of determination of Absorption Coefficient. Ultrasonics: Pro- duction of ultrasonics by Magnetostriction and piezoelectric methods – acoustic grating - Non-Destructive Testing – pulse echo system through transmission and reflection modes – A, B and C – scan displays.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh-Jeans' Law from Planck's theory – Compton Effect. Theory and experimental verification – Properties of Matter waves – wave particle duality – Schrodinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one-dimensional box and extension to three dimensional box – Degeneracy of electron energy states - Scanning electron microscope – Transmission electron microscope.

UNIT V PHOTONICS AND FIBRE OPTICS 9

Photonics: Spontaneous and stimulated emission – Population inversion – Einstein's A and B coefficients – Conditions for Laser action – Types of lasers – Nd: YAG, & CO2 lasers-Basics of diode lasers – Industrial and Medical Applications. Fibre optics: Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Losses in fibers - attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) – Active and passive fibre sensors – pressure and displacement.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Analyze crystal structures and the influence of imperfections on their properties.
2. Demonstrate and explain the general concepts of elastic and thermal properties of materials.
3. Explain quantum mechanical theories to correlate with experimental results and their applications to material diagnostics.
4. Analyze the applications of acoustics and ultrasonics to engineering and medical disciplines.
5. Elucidate the principle and working of lasers and optical fibers, and their applications in the field of industry, medicine and telecommunication.

TEXTBOOKS

1. Gaur R K, Gupta S L, "Engineering Physics", Dhanpat Rai Publishers, 2012.
2. Serway R A, Jewett J W, "Physics for Scientists and Engineers", Cengage Learning, 2010.

REFERENCE BOOKS

1. Halliday D, Resnick R, Walker J, "Principles of Physics", Wiley, 2015.
2. Tipler P A, Mosca G, "Physics for Scientists and Engineers with Modern Physics", WH Freeman, 2007.
3. Avadhanulu M N, Kshirsagar P G, "A Textbook of Engineering Physics", S Chand & Co Ltd, Ninth Revised Edition, 2012.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2		1	1		1			2				
CO2	3	2		1	1		1			2				
CO3	3	2		1	1		1			2				
CO4	3	2		1	1		1			2				
CO5	3	2		1	1		1			2				
Course	3	2		1	1		1			2				

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCY2176	ENGINEERING CHEMISTRY	3	0	0	0	3

OBJECTIVES

- To impart knowledge to the students on the basic concepts of chemistry and properties of materials for various engineering applications

UNIT I TOMIC AND MOLECULAR NANO CHEMISTRY 9

Atoms – Atomic orbitals, Molecules – Molecular orbitals. Nanoparticles and its uniqueness. Distinction between molecules, nanoparticles and bulk materials. Classification of nanoparticles. Size dependent Properties – Thermal, Optical, Chemical, Electronic and Mechanical. Synthesis of nanomaterials – bottom-up and top-down approaches – Techniques- Colloidal, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation. Objectives of surface modification of nanoparticles. Synthesis and applications – Carbon Nano Tubes (CNT)
– Gold nanoparticle

UNIT II ELECTROCHEMISTRY 9

Conductivity of electrolytes – factors influencing conductivity- Conductometric titration and its applications – estimation of strong acid, estimation of mixture of strong and weak acids and estimation of BaCl2. Electrochemical cell – redox reaction – origin of electrode potential, Types of electrodes, Measurement of electrode potential and emf of the electrochemical cell – reference electrode- saturated calomel electrode and Ag/AgCl electrode – Ion selective electrode – glass electrode measurement of pH – Potentiometric titrations – estimation of ferrous ion and estimation of strong acid. Problems based on all the above concepts.

UNIT III CORROSION AND ITS CONTROL 9

Corrosion – Definition – Classification of corrosion-Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – selection of materials - sacrificial anode and impressed current cathodic methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

UNIT IV PHASE EQUILIBRIA 9

Phase Rule – Definition and explanation of terms involved with suitable examples – Phase – Components – Degrees of Freedom – Applications and limitations of Phase Rule, One com- ponent system – H2O Two component systems – Construction of phase diagram by Thermal Analysis (or) Cooling curves – Condensed Phase Rule – Simple eutectic systems: Pb-Ag system – System with congruent melting point: Zn-Mg – System with incongruent melting point: Ni-Cd

UNIT V SYNTHESIS AND APPLICATIONS OF INDUSTRIAL POLYMERS 9

Polymers and Polymerization: definition, classification – types of polymerization: addition and condensation – mechanism of addition polymerization (cationic, anionic, free radical and coordination polymerization)-Properties: Glass Transition temperature, Average Molecular weight and its determination by viscosity method. Polymer composites (fibre reinforced plas- tics) – preparation, properties and application of engineering plastics Epoxy resin, Polyurethans, Nylon 6:6, Polycarbonate, PS, PVC and PET

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. The unique properties of nanoparticles and their applications
2. The principles of electrochemistry and its application for quantitative analysis
3. The various types of corrosion under normal to severe corrosive environments and their control measures
4. Construction of phase diagram and its application to analyse simple eutectic Systems
5. The synthesis, properties and applications of important industrial polymers

TEXTBOOKS

1. Jain P C, Monika Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company Pvt Ltd, New Delhi, 2015
2. S S Dara, “Engineering Chemistry”, S Chand & Co Ltd, New Delhi, 2011

REFERENCE BOOKS

1. T Pradeep, “NANO: The Essentials: Understanding Nanoscience and Nanotechnology”, 1st edition, McGraw Hill Education, 2017
2. Gurdeep Raj, “Phase Rule”, Goel Publishing House, Meerut, 2011.
3. R Gopalan, K Rangarajan, P S Subramanian, “Elements of Analytical Chemistry” Sultan Chand & Sons,2003.
4. F W Billmayer, “Textbook of Polymer Science”, 3rd Edison, Wiley, 1991.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1											
CO2	3	2	1											
CO3	3	2	1				3							
CO4	3	2	1											
CO5	3	2	1				3							
Course	3	2	1				3							

COURSE CODE	COURSE TITLE	L	T	P	E	C
UGE2176	PROBLEM SOLVING AND PROGRAMMING IN PYTHON	3	0	0	0	3

OBJECTIVES

- To learn algorithmic problem-solving techniques.
- To learn the fundamentals of python programming.
- To compose programs in Python using conditions, iterations and decompose a problem into functions
- To construct programs in Python sequenced data type.
- To develop python programs using advanced constructs like dictionaries and files.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Logical and Algorithmic Thinking: Logical Thinking – Algorithmic Thinking; Problem Solving and Decomposition: Defining the Problem – Devising the Solution – Decomposition; Effective building blocks: Basic Algorithmic Constructs (pseudo code, flow chart, programming language) – Program State.

UNIT II DATA, EXPRESSION, STATEMENT, CONDITIONAL 9

Data and types: int, float, boolean, string, list; variables, expressions, statements, simultaneous assignment, precedence of operators; comments; in-built modules and functions; Conditional: boolean values and operators, conditional (if), alternative (if-else), case analysis (if- elif-else).

UNIT III ITERATION, FUNCTION, STRINGS 9

Iteration: while, for, break, continue, pass; Functions: function definition, function call, flow of execution, parameters and arguments, return values, local and global scope, recursion; Strings: string slices, immutability, string functions and methods, string module.

UNIT IV LISTS, TUPLES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters, nested lists, list comprehension; Tuples: tuple assignment, tuple as return value, tuple operations.

UNIT V MULTIVARIATE ANALYSIS 9

Dictionaries: operations and methods, looping and dictionaries, reverse lookup, dictionaries and lists; Files: Text files, reading and writing files, format operator, file names and paths; command line arguments.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Solve programming problems and express solutions using algorithmic constructs (K3)
2. Develop simple programs using basic constructs and conditional statements (K3)
3. Develop programs using looping constructs, functions and strings (K3)
4. Use lists and tuples to develop programs (K3)

5. Construct programs using dictionaries and perform Input/Output operations using files (K3)

TEXTBOOKS

1. Karl Beecher, “Computational Thinking – A beginner’s Guide to Problem Solving and Programming”, British Computer Society (BCS), 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd edition, Green Tea Press, Shroff/O’Reilly Publishers, 2015

REFERENCE BOOKS

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python", McGraw Hill Education (India) Private Limited, 2018.
2. John V Guttag, “Introduction to Computation and Programming Using Python”, MIT Press, 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”, 2nd Edition, Cengage Learning, 2018.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											3	
CO4	3	2											3	
CO5	3	2											3	
Score	15	10											13	
	3	2											3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UGE2177	ENGINEERING GRAPHICS	1	0	4	0	3

OBJECTIVES

- To develop the graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings

Concepts and Conventions (Not for Examinations):
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING 9

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 9

Orthographic projection principles - Principal planes - First angle projection - Layout of views - Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 9

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 9

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of truncated solids (simple position only) – Prisms, pyramids, cylinders and cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 9

Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Perspective projection of simple solids- Prisms, pyramids and cylinders by visual ray method.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Draw Plane curves and perform Free hand sketching of three - dimensional objects. (BL: L3)
2. Draw the Orthographic projections of points, lines and plane surfaces. (BL: L3)
3. Draw the Projections of solids. (BL: L3)
4. Draw the Projections of sectioned solids and Development of surfaces. (BL: L3)
5. Draw the Isometric and Perspective projections of solids. (BL: L3)

TEXTBOOKS

1. Natarajan K V, “A Textbook of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020 [ISBN: 9788190414089]
2. Venugopal K, Prabhu Raja V, “Engineering Graphics”, New Age International (P) Limited, 15th Edition, 2018 [ISBN: 9789386649249]

REFERENCE BOOKS

1. Bhatt N D, “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2014. [ISBN: 9789380358963]
2. Basant Agarwal, Agarwal C M, “Engineering Drawing”, McGraw Hill, 3rd Edition, 2019. [ISBN: 9789353167448]
3. Gopalakrishna K R, “Engineering Drawing” (Vol I & II Combined), Subhas Publications, 27th Edition, 2017. [ISBN: 9789383214235]
4. Luzzader J Warren, Jon M Duff, “Fundamentals of Engineering Drawing with an intro- duction to Interactive Computer Graphics for Design and Production”, Pearson Education, 11th Edition, 2005. [ISBN :9789332549982]

PUBLICATION OF BUREAU OF INDIAN STANDARDS

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.

2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.

3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.

4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.

5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

SPECIAL POINTS APPLICABLE TO END SEMESTER EXAMINATIONS ON ENGINEERING GRAPHICS

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2			2				3				
CO2	3	2	2			2				3				
CO3	3	2	2			2				3				
CO4	3	2	2			2				3				
CO5	3	2	2			2				3				
Course	3	2	2			2				3				

COURSE CODE	COURSE TITLE	L	T	P	E	C
UGE2197	PROGRAMMING IN PYTHON LAB	0	0	3	0	1.5

OBJECTIVES

- To write, test, and debug simple Python programs.
- To apply conditions and loops to solve problems using python.
- To implement programs using functions
- To write programs using different data types such as strings, lists tuples and dictionaries
- To make use of read and write operations into the files.

SUGGESTIVE EXERCISES

1. Use Linux shell commands, use Python in interactive mode, and an editor
2. Write simple programs (area of a geometric shape, simple interest, solve quadratic equation, net salary).
3. Write programs using conditional statements (leap year, maximum of 2 numbers, maximum of 3 numbers, simple calculator, grade of the total mark).
4. Develop programs using loops and nested loops (gcd, prime number, integer division, sum of digits of an integer, multiplication table, sum of a series, print patterns, square root using Newton's method).
5. Develop programs using functions (sine and cosine series, Pythagorean triplets).
6. Develop programs using recursion (efficient power of a number, factorial, Fibonacci number).
7. Develop programs using strings (palindrome, finding substring) without using in-built functions.
8. Develop programs using lists and tuples (linear search, binary search, selection sort, insertion sort, quicksort).
9. Develop programs using nested lists (matrix manipulations).
10. Develop simple programs using dictionaries (frequency histogram, nested dictionary).
11. Develop programs using Files (read and write files).
12. Develop programs to perform any task by reading arguments from command line.
13. Implement a simple application using appropriate datatypes and files

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Develop Python programs using conditions, loops and functions (K3)
2. Solve problems using strings, lists and tuples (K3)
3. Construct programs using dictionaries and perform Input/Output operations using files (K3)

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3									2	
CO2	3	2		3									2	
CO3	3	2		3									2	
Score	9	6		9									6	
	3	3		3									2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UGS2197	PHYSICS AND CHEMISTRY LAB	0	0	3	0	1.5

PHYSICS LABORATORY

OBJECTIVES

To obtain basic Knowledge about physics concepts applied in optics, thermal physics, and properties of matter.

LIST OF EXPERIMENTS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of the Young's modulus of the material of the given beam by non-uniform bending method.
2. Determination of the rigidity modulus of the material of the given wire using torsion pendulum.
3. Determination of the wavelength of the mercury spectra using Spectrometer and grating.
4. Determination of the dispersive power of a prism using Spectrometer.
5. Determination of the grating element/wavelength, and particle size/ wavelength using a laser.
6. Determination of the Numerical and the acceptance angle of an optical fiber.
7. Determination of the thickness of a thin wire using interference fringes.
8. Determination of the coefficient of viscosity of the given liquid using Poiseuille's method.
9. Determination of the band gap energy of a semiconductor.
10. Determination of the coefficient of thermal conductivity of the given bad conductor using Lee's disc.

COURSE OUTCOMES

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

1. Analyse ions like Fe2+, Fe3+, H+ using different instruments
2. Determine the Molecular weight and Degree of Polymerisation using viscometer

CO-to-PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2	3													
Course	3													

CHEMISTRY LABORATORY

COURSE OBJECTIVES

To impart hands on training for all the possible concepts learned in Engineering Chemistry
Course List of Experiments

LIST OF EXPERIMENTS

(A minimum of 6 experiments to be performed from the given list)
1. Estimation of ferrous ion by potentiometric titration
2. Estimation of strong acid using pH meter.
3. Estimation of strong acid by conductometric titration
4. Estimation of mixture of strong and weak acids using conductometer
5. Estimation of BaCl2 by conductometric titration
6. Determination of degree of polymerization of a water-soluble polymer by Viscosity method
7. Determination of equivalent conductance of a strong electrolyte at infinite dilution
8. Determination of weak acid using weak base by conductometric titration.
9. Determination of rate of corrosion by weight loss method

TEXTBOOKS

1. Manual Prepared by Faculty of Chemistry Department, SSNCE

REFERENCES

1. B Viswanath, P S Raghavan, “Practical Physical Chemistry”, ViVa Books Pvt Ltd, New Delhi, 2012.

COURSE OUTCOMES

1. To study the concepts of classical logic, normal forms and its applications.
2. To solve problems using different counting techniques.
3. To learn the basic concepts in graph theory and prove simple properties.
4. To study the algebraic structures.
5. To study the concept of Boolean algebra.

COURSE CODE	COURSE TITLE	L	T	P	E	C
UMA2276	COMPLEX FUNCTIONS AND LAPLACE TRANSFORMS	3	1	0	0	4

OBJECTIVES

- To apply C-R equations in the construction of Analytic Functions.
- To study the methods of Complex Integration, finding Taylor's and Laurent's Series expansions.
- To find the Laplace Transforms and inverse transforms for standard functions.
- To solve Differential Equations using different techniques.
- To evaluate Line, Surface and Volume integrals.

UNIT I ANALYTIC FUNCTIONS 9

Analytic functions – necessary and sufficient conditions, Cauchy-Riemann equations in Cartesian and polar form (with proof) – Properties – harmonic functions, Construction of analytic function, conformal mapping – some standard transformations w = z + c, cz, 1 , z–, bilinear transformation.

UNIT II COMPLEX INTEGRATION 9

Line integral – 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 – Use of circular contour and semicircular contour (except the poles on the real axis).

UNIT III LAPLACE TRANSFORMS 9

Definition, properties, existence conditions – Transforms of elementary functions – Trans- form of unit step function and unit impulse function, shifting theorems, Transforms of derivatives and integrals, Initial and final value theorems, Periodic functions, Inverse transforms – Convolution theorem.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 9

Solution of second and higher order linear differential equation with constant coefficients (f (x) = emx , sin mx, cos mx, f (x)emx , f (x) sin mx), Method of variation of parameters, Simultaneous linear equations with constant coefficients of first order, Solving linear second order ordinary differential equations with constant coefficients using Laplace transforms.

UNIT V VECTOR CALCULUS 9

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields, Line integral over a plane curve, Surface integral – Area of a curved surface, Volume integral, Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Solve problems in Analytic functions and construction of analytic functions using C-R equations

2. Solve problems using integration techniques, find Taylor's and Laurent's Series expansions
3. Obtain the Laplace Transforms and inverse transforms of standard functions.
4. Solve Differential Equations using different techniques
5. Evaluate Line, Surface and Volume integrals
6. Apply Complex integration, Laplace transforms, Ordinary differential equations, and vector calculus in engineering problems

TEXTBOOKS

1. Grewal B S, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2016.

REFERENCE BOOKS

1. Bali N P, Goyal M, Watkins C, "Advanced Engineering Mathematics", Laxmi Publications Pvt Limited, 2007.
2. Boyce W E, DiPrima R C, "Elementary Differential Equations and Boundary Value Problems", 11th Edition, Global Edition, Wiley, 2017.
3. George B Thomas Jr, Maurice D Weir, Joel R Hass, "Thomas' Calculus: Early Transcendental", 13th Edition, Pearson Education, 2014.
4. O'Neil P V, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning India Pvt Ltd, New Delhi, 2012.
5. Howard Anton, Irl C Bivens, Stephen Davis, "Calculus: Early Transcendentals", 11th Edition, Global Edition, John Wiley & Sons, Inc., 2017.
6. Srimanta Pal, Subodh C Bhunia, "Engineering Mathematics", Oxford University Press, 2015.
7. Srivastava A C, Srivastava P K, "Engineering Mathematics", Volume I and II, PHI learning Pvt Ltd, 2011.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2											1	
CO2	3	2											1	
CO3	3	2											1	
CO4	3	2											1	
CO5	3	2											1	
CO6	3	2											1	
Course	3	2											1	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UEE2276	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	0	3

OBJECTIVES

- To learn the basic concepts of electric circuits.
- To know the operation of various electrical machines.
- To study the concepts of utilization of electrical power.
- To comprehend the working principle of electronic devices and its applications.
- To grasp the working principle of various sensors and transducers.

UNIT I ELECTRICAL CIRCUITS 9

DC Circuits: Ohm's Law- Kirchhoff's laws - Mesh current and Node voltage methods (Analysis with only independent source). Network theorems - Superposition theorem, Thevenins theorem and Norton theorem. AC circuit: Waveforms and RMS value, Phasor diagram, Power, Power factor. Three phase supply – Star connection, Delta connection – Balanced Loads - Power in three-phase systems.

UNIT II ELECTRICAL MACHINES 9

Construction, Principle of Operation, Basic Equations and Applications - DC Generators, DC Motors, Single Phase Transformer, Single phase Induction Motor, Three phase Induction Mo- tor, Three phase Alternator, Stepper and BLDC motors.

UNIT III UTILIZATION OF ELECTRICAL POWER 9

Renewable energy sources- wind and Solar panels. Illumination by lamps- Sodium Vapour, Mercury vapour, Fluorescent tube. Batteries-NiCd, Pb Acid and Li ion Charge and Discharge Characteristics. Protection- Earthing, Fuses. Energy Tariff calculation for domestic loads.

UNIT IV ELECTRONIC DEVICES AND APPLICATIONS 9

Operation of PN junction diodes, VI characteristics, Zener diode, BJT- CB, CE, CC configurations, input and output characteristics, MOSFET. Half wave and full wave rectifier, capacitive filters, zener voltage regulator, Operational amplifiers, Ideal Op-Amp characteristics, Inverting and Non-inverting amplifier.

UNIT V SENSORS AND TRANSDUCERS 9

Sensors: Capacitive and resistive sensors, magnetic sensors, Hall effect sensors, Piezo-resistive sensors, viscosity, optical sensors, Ultrasonic sensors, Nuclear and microsensors. Transducers: Classification of transducers, strain gauges, RTD, thermocouples, Piezo-electric, LVDT and Thermoelectric transducers

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Solve and analyse DC and AC circuits.
2. Explain the operating principle of AC and DC machines.

3. Know the concepts electrical power utilization.
4. Describe the working principle of various electronic devices and its applications
5. Describe the working principle of various sensors and transducers.

TEXTBOOKS

1. Kothari DP, I J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, 2014
2. Alan S Moris, “Principles of Measurements and Instruments”, Prentice Hall of India Pvt Ltd, New Delhi,1999.
3. S Salivahanan, R Rengaraj, G R Venkatakrishnan, “Basic Electrical, Electronics and Measurement Engineering”, McGraw Hill, 2017.

REFERENCE BOOKS

1. S B Lal Seksena, Kaustuv Dasgupta, “Fundaments of Electrical Engineering”, Cambridge, 2016.
2. M S Sukhija, T K Nagsarkar, “Basic Electrical and Electronic Engineering”, Oxford, 2016.
3. S K Sahdev, “Basic of Electrical Engineering”, Pearson, 2015.
4. Edward Hughes, John Hiley, Keith Brown, Ian McKenzie Smith, “Electrical And Electronic Technology”, Pearson Education Ltd, 10th Edition, 2008
5. H Cotton, “Electrical Technology” 7th Edition, CBS, 2005.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2											1	
CO2	3	2											1	
CO3	3	2											1	
CO4	3	2											1	
CO5	3	2											1	
CO6	3	2											1	
Course	3	2											1	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2201	FUNDAMENTALS AND PRACTICE OF SOFTWARE DEVELOPMENT	1	0	5	3	4.5

OBJECTIVES

- To link system building to computing fundamentals.
- To progress from fundamental principles to larger engineering systems
- To motivate independent learning and exploration.

UNIT I PROGRAM DEVELOPMENT BASICS 4

Algorithm – Algorithmic problem solving – modularity, reusability, maintainability – Software engineering fundamentals: project management, feasibility study. Best practices and guidelines for Programming. Basic data types and control constructs in C.

UNIT II FUNCTIONS 3

Function prototype -- function definition and call -- passing parameters -- recursion -- Standard library functions

UNIT III ARRAYS AND STRINGS 4

Arrays: declaration, initialization – multi-dimensional arrays -- passing arrays to functions - Pointers; Strings: reading and writing strings -- string operations -- string library functions.

UNIT IV STRUCTURES 4

User-defined data types -- Structures: structures and functions -- array of structures ---– type definition (typedef) -- enumerated data type -- Files -- Choosing suitable data types and programming constructs.

LECTURE PERIODS: 15

LAB ASSIGNMENTS

1. Algorithm writing, verification, and test case design
2. Programs using looping constructs
3. Programs using functions with different parameter passing techniques: Call by value, call by reference (e.g. changing the elements of an array), Recursion
4. Programs using one-dimensional array
5. Programs using strings and their operations (e.g. concatenation of strings, extracting a substring, checking for the palindrome, search for a given string using binary search)
6. Programs to demonstrate simple structure manipulations and passing structures to a function (e.g. generating a transcript with CGPA and class obtained, operations on complex numbers, difference between times)

LAB PERIODS: 45

STUDIO SESSIONS

Sample Case Study: Timetable Management System for an Academic Institution

- Input: Set of courses in a semester, Type of courses, Classrooms, Labs, Faculty offerings, Student degree, Year and Section

- Output: Timetable for a week satisfying the following constraints
- Constraints:
  – All theory courses for a class are scheduled in the same room.
  – More than one lab course cannot be scheduled in the lab at the same time.
  – A faculty does not handle more than 2 sessions per day for the same course.
  – A faculty cannot handle more than one class in each session.

STUDIO PERIODS: 30
TOTAL PERIODS: 15 + 45 + 30 = 90

COURSE OUTCOMES

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

1. Formulate the problem elaborating the requirements and identifying the scope and boundaries. (K6)
2. Apply engineering fundamentals in computer science to advanced industrial applications or products. (K3)
3. Design and develop solutions adapting novel technologies, tools, and techniques. (K6)
4. Communicate effectively through reflections, reports, and presentations.
5. Work in teams to develop modules and integrate them.
6. Analyze the impact on health, safety, society, environment as well as underlying legal and ethical considerations whichever are applicable.
7. Solve programming problems using basic constructs in C programming language. (K3)

TEXTBOOKS

1. Byron Gottfried, Programming with C (Schaum's Outlines Series), McGraw-Hill Education, 3rd Edition, 2017.
2. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Edu- cation India, 2nd Edition, 2015.

REFERENCE BOOKS

1. Reema Thareja, Programming in C, Oxford University Press, 2nd Edition, 2016.
2. Yashwant Kanetkar, Let Us C, BPB Publications, 14th Edition, 2016.
3. King, K.N., C Programming A Modern Approach, W. W. Norton & Company, II Ed. 2008.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3									3	3
CO2	2												2	
CO3			3	3	3			3					3	3
CO4										3		3		
CO5									3		3			
CO6						2	3							
CO7	2	3	3	3	2								3	3
Score	2	6	8	9	5	2	3	3	3	3	3	3	11	9
Course Mapping	2	3	3	3	3	2	3	3	3	3	3	3	3	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCY2276	ENVIRONMENTAL SCIENCE	3	0	0	0	0

OBJECTIVES

- To better understand human relationships, perceptions and policies towards the environment
- To focus on design and technology for improving environmental quality

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – concept, structure and function of an ecosystem – energy flow- food chains, food webs and ecological pyramids – ecological succession Introduction to biodiversity definition and types– values of biodiversity- India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity-endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II NATURAL RESOURCES 9

Uses, over-exploitation of natural resources: Forest, Water, Mineral, Food, Energy and Land. Case studies on over exploitation of natural resources – Role of an individual in conservation of natural resources- Equitable use of resources for sustainable lifestyles.

UNIT III CURRENT ENVIRONMENTAL ISSUES 9

Environmental issues – causes, effects and control measures of Pollution of (a) Air (Smog, acid rain, climate change and global warming, ozone layer depletion) (b) Water (rainwater harvesting, watershed management and wastewater treatment) (c) Soil (solid waste management, wasteland reclamation) (d)Electronic waste. Population explosion, Resettlement and rehabilitation of people and Disaster management

UNIT IV ENGINEERING INTERVENTIONS TO REDUCE ENVRIONNMENTAL STRESSES 9

Role of information technology in environment – Remote Sensing – satellites and sensors – Geographical Information Systems(GIS) – Applications. Environment data base management system. Green chemistry – Principles – Green buildings – Advantages of green buildings over conventional buildings – Electric and Hybrid Electric Vehicles (HEV)

UNIT V ENVIRONMENTAL REGULATIONS 9

Environmental Ethics for sustainable development – Human rights – Environmental Impact Assessment – Ecomark – role of NGO- Central and state pollution control boards – Air (Prevention and Control of Pollution) act 1981 – Water (Prevention and control of Pollution) act 1974 – Wildlife protection act 1972 – Forest conservation act 1980 – The National Green Tribunal Act 2010

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. The structure and functions of the ecosystems and diversity among life forms within an ecosystem
2. The importance of various natural resources and its sustainable use
3. The various environmental issues such as pollution, population explosion etc and suggest remedial measures.
4. The role of engineering techniques to minimize environmental stress
5. The role of various environmental machineries and to ensure proper environmental regulation

TEXTBOOKS

1. Anubha Kaushik, C P Kaushik, “Environmental Science and Engineering”, New Age In- ternational Publishers, 14thEdition, 2014.
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, 2006.

REFERENCE BOOKS

1. Gilbert M Masters, “Introduction to Environmental Engineering and Science”, 2nd edition, Pearson Education, 2004.
2. G Tyler Miller, Scott E Spoolman, “Environmental Science”, Cengage Learning India PVT Ltd, New Delhi, 2014.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						2		2	2	2		2		
CO2						2		2	2	2		2		
CO3						2		2	2	2		2		
CO4						2		2	2	2		2		
CO5						2		2	2	2		2		
Course						2		2	2	2		2		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2202	FOUNDATIONS OF DATA SCIENCE	3	0	0	0	3

OBJECTIVES

- To learn fundamentals of Data Science using Python.
- To develop python program for analysis of data using Python libraries.
- To understand probability distributions.
- To understand statistical Inferences.
- To be familiar with supervised and unsupervised methods in machine learning.

UNIT I INTRODUCTIN TO DATA SCIENCE 9

Introduction: Need for data science – Benefits and uses – Facets of data – Big data ecosystem – Data science process: Retrieving data – Cleansing, integrating, and transforming data – Data analysis – Build the models – Presenting findings and building applications.

UNIT II DATA PREPROCESSING 9

Data manipulation: Reading and selection – Filtering missing data – Sorting – Grouping – Ranking and plotting; Introduction to Python; Fundamental Python Libraries for Data Scientists: Numpy – Scipy – ScikitLearn – Pandas – Matplotlib; IDE; Data Manipulation with Pandas; Sample programs to pre-process and visualize data.

UNIT III DESCRIPTIVE STATISTICS 9

Introduction – Data Preparation – Exploratory Data Analysis: Data summarization – Data distribution – Outlier Treatment – Measuring asymmetry – Continuous distribution; Estimation: Mean – Variance – Sampling – Covariance – Correlation.

UNIT IV STATSTICAL INFERENCE 9

Introduction – Frequentist Approach – Measuring the Variability in Estimates: Point estimates – Confidence intervals; Hypothesis Testing: Using confidence intervals – Using p-values.

UNIT V MACHINE LEARNING 9

Supervised Learning: Introduction – kNN classifier – Decision Tree – CART; Regression analysis: Linear regression – Logistic regression; Unsupervised Learning: Introduction – Clustering – K-means; Evaluation metrics.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Demonstrate the need for data science and data preparation process (K2)
2. Develop Python programs to perform analysis on data (K3)
3. Apply statistical techniques to explain and analyze data (K3)

4. Interpret various statistical inferences (K2)
5. Apply machine learning algorithms to solve problems (K3)

TEXTBOOKS

1. Davy Cielen, Arno D B Meysman, Mohamed Ali, "Introducing Data Science – Big data, Machine Learning, and more using Python tools", Manning Publications Co, 2016.
2. Laura Igual, Santi Segua, "Introduction to Data Science – A Python Approach to Concepts, Techniques and Applications", Springer Nature, 2017

REFERENCE BOOKS

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly Media, 2016
2. Foster Provost, Tom Fawcett, "Data Science for Business", O'Reilly Media, 2013
3. Rachel Schutt, Cathy O'Neil, "Doing Data Science", O'Reilly Media, 2016

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2		2	1								2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2			1								2	
Score	15	10		2	2								10	
	3	2		2	1								2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UGE2297	DESIGN THINKING AND ENGINEERING PRACTICES LAB	0	0	3	0	1.5

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering
- To train the students to dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model, and to assemble the different engineering components

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL ENGINEERING PRACTICE) I CIVIL ENGINEERING PRACTICE.

Buildings:
Study of plumbing and carpentry components of residential and industrial buildings - Safety aspects.
Plumbing Works:

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2. Preparation of plumbing line sketches for water supply and sewage works.
3. Hands-on-exercise:

• Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
• Plumbing with basic connections for washing basin and sink

Carpentry using Power Tools only:
1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise: Woodwork, joints by sawing, planning and cutting.
   (a) Fabrication of different models of pencil box and pen stand.
   (b) Fabrication of wooden wall shelf
3. Demonstration of wood working machinery

II MECHANICAL ENGINEERING PRACTICE
Basic Machining:
• Drilling Practice (holes of various diameters - steel sheet metal, wood, hylam/plywood sheet)

Sheet Metal Work:
• Forming & Bending
• Different type of joints.
   – Fabrication of mobile phone metal stand
   – Fabrication of electrical control panel box

Design thinking practices: To dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model, and to assemble the following components.

- Pedestal Fan head swing mechanism - Reserve mechanism (Two-wheeler) - Hot Glue gun
- Paper clips - Flush tank container mechanism - Hand pump - washer Mechanism

GROUP B (ELECTRICAL & ELECTRONICS ENGINEERING PRACTICE)

1. Residential house wiring, staircase wiring and tube light wiring with single phase AC two wire system.
2. Energy measurement with RLC Load.
3. Earth resistance measurement.
4. Measurement of AC parameters using CRO and half wave and Full wave rectifier.
5. Study of logic gates AND, OR, EX-OR & NOT.
6. Soldering practice – Components Devices and Circuits – Using PCB.

Design thinking practices:

1. Assemble a single phase 3 wire circuit for connecting household appliances and explain through schematic diagram
2. Measure the energy consumed by the household appliances and verify it theoretically
3. Analyze the fault occurring in electrical appliances
4. Design, assemble and test a cell phone charger
5. Design, assemble and test a relay logic to control electrical appliances.
6. Design, assemble and test a dc power supply using PCB

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Draw pipeline plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household woodwork (K2)
2. Practice machining to make holes on different materials; fabricate sheet metal components (K2)
3. Dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model of various components (K2)
4. Construct domestic electrical circuits and verify their output parameters (K3)
5. Construct electronics circuits and verify their output (K3**)**

REFERENCE BOOKS

1. S Gowri, T Jeyapoovan, “Engineering Practices Lab Manual”, 5th Edition, Vikas Publishing, 2016.
2. V Ramesh Babu, Engineering Practices Laboratory, VRB Publications, 2006.
3. Willis H Wagner, Howard "Bud" Smith, Mark W Huth, “Modern Carpentry”, 12th Edition, 2015
4. P C Sharma, “Production Technology: Manufacturing Process”, S Chand publisher, 2006
5. Robert W Messler, “Reverse Engineering: Mechanisms, Structures, Systems & Materials”, McGraw-Hill Education, 2014
6. David W Rongey, “A Complete Guide to Home Electrical Wiring”, 2013
7. K Jeyachandran, S Natarajan, S Balasubramanian, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						2		2	2	2		2		
CO2						2		2	2	2		2		
CO3						2		2	2	2		2		
CO4						2		2	2	2		2		
CO5						2		2	2	2		2		
Course						2		2	2	2		2		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UMA2377	DISCRETE MATHEMATICS	3	1	0	0	4

OBJECTIVES

- To study the concepts of classical logic, normal forms and its applications.
- To solve problems using different counting techniques.
- To learn the basic concepts in graph theory and prove simple properties.
- To study the algebraic structures.
- To study the concept of Boolean algebra.

UNIT I LOGIC AND PROOFS 13

Propositional Logic – Propositional equivalences – Predicates and quantifiers – Nested quantifiers – Rules of inference – Introduction to proofs – Proof methods and strategy – Normal forms – Applications to switching circuits.

UNIT II COMBINATORICS 11

Mathematical induction – Strong induction – The pigeonhole principle – Recurrence relations – Partition of integers – Solving linear recurrence relations using generating functions – Inclusion and Exclusion Principle and its applications.

UNIT III GRAPHS 10

Graphs – Graph terminology and special types of graphs – Subgraphs – Matrix representation of graphs and graph isomorphism – Connectivity – Eulerian and Hamilton graphs.

UNIT IV ALGEBRAIC STRUCTURES 13

Algebraic systems – Semi groups and monoids – Groups – Subgroups Homomorphisms – Normal subgroup and coset – Lagrange's theorem – Definitions and examples of Rings and Fields.

UNIT V LATTICES AND BOOLEAN ALGEBRA 13

Partial ordering – Posets – Lattices as Posets – Properties of lattices – Lattices as algebraic systems – Sublattices – Direct product and Homomorphism; Boolean algebra – Stone's representation Theorem.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

1. Write simple proofs using Propositional and First Order Logics
2. Solve problems using different counting techniques
3. Prove simple graph properties.
4. Explain basic concepts in group theory such as semigroups, monoids and groups.
5. Solve problems in partial ordering relations, equivalence relations and lattices.
6. Application of Graph theory and Boolean algebra in engineering problems

TEXTBOOKS

1. Kenneth H Rosen, “Discrete Mathematics and its Applications”, 7th Edition, Special Indian edition, Tata McGraw Hill, New Delhi, 2017.
2. Tremblay J P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, 30th Reprint, Tata McGraw Hill, New Delhi, 2011.

REFERENCE BOOKS

1. Ralph P Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, 4th Edition, Pearson Education Asia, 2007.
2. Eric Lehman, F Tom Leighton, Albert R Meyer, “Mathematics for Computer Science”, Samurai Media Limited, 2017.
3. Thomas Koshy, “Discrete Mathematics with Applications”, Elsevier Publications, 2006.
4. Seymour Lipschutz, Mark Lipson,“Discrete Mathematics”, Schaum’s Outlines, 3rd Edition, Tata McGraw Hill, 2010.
5. C L Liu, D P Mohapatra, “Elements of Discrete Mathematics”, 4th Edition, McGraw Higher Education, 2017.
6. John M Harris, Jeffry L Hirst, Michael J Mossinghoff, “Combinatorics and Graph Theory”, Springer Verlag New York, 2008.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	1	11	12	1	2
CO1	3	2		1									1	
CO2	3	2		1									1	
CO3	3	2		1									1	
CO4	3	2		1									1	
CO5	3	2		1									1	
CO6	3	2		1									1	
Course	3	2		1									1	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UHS2376	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	3	0	2	0	3

OBJECTIVES

- To help students distinguish between values and skills, and understand the need, basic guidelines, content, and process of value education.
- To help students initiate a process of dialogue within themselves to know what they want to be in their life and profession
- To help students understand the meaning of happiness and prosperity for a human being.
- To facilitate the students to understand harmony at all the levels of human living and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life Course

UNIT I INTRODUCTION TO VALUE EDUCATION 9

Value Education – Need, Basic Guidelines, Content and Process, Self-Exploration – meaning, importance and process, Continuous Happiness and Prosperity – A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities – The basic requirements, Understanding Happiness and Prosperity – A critical appraisal of the current scenario, Method to fulfil the above human aspirations – UNDERSTANDING and living in harmony at various levels.

UNIT II HARMONY IN THE HUMAN BEING 9

An understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' – Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail, Pro- grams to ensure Sanyam and Swasthya.

UNIT III HARMONY IN THE FAMILY AND SOCIETY 9

Understanding harmony in the family – The basic unit of human interaction, understanding values in a human-to-human relationship; Understanding Trust – The foundational value in relationship, Difference between intention and competence, Understanding Respect – as the right evaluation, Difference between respect and differentiation; the other salient values in a relationship, Understanding the harmony in the society – comprehensive Human Goals, Visualizing a universal harmonious order in society– Undivided Society, Universal Order – From family to world family!

UNIT IV HARMONY IN NATURE AND EXISTENCE 9

Understanding the harmony in Nature, Interconnectedness, self-regulation and mutual fulfilment among the four orders of nature – recyclability, Understanding Existence as Coexistence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 9

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Hu- manistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics – augmenting universal human order, the scope and characteristics of people-friendly and eco-friendly, Holistic Technologies, production systems and management models – Case studies, Strategy for the transition from the present state to Universal Human Order – At the level of individual: as socially and ecologically responsible engineers, technologists and managers, At the level of society: as mutually enriching institutions and organizations.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society.
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.
4. Understand the harmony in nature and existence and work out their mutually fulfilling participation in nature.
5. Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

TEXTBOOKS

1. R R Gaur, R Sangal, G P Bagaria, “A Foundation Course in Human Values and Professional Ethics”, Excel Books, New Delhi, 2nd Revised Edition, 2019.

REFERENCE BOOKS

1. A Nagaraj, “Jeevan Vidya: Ek Parichaya”, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A N Tripathi, “Human Values”, New Age Intl Publishers, New Delhi, 2004.
3. “The Story of Stuff” (Book).
4. Mohandas Karamchand Gandhi, “The Story of My Experiments with Truth”.
5. E F Schumacher, “Small is Beautiful”
6. Cecile Andrews, “Slow is Beautiful”
7. J C Kumarappa, “The Economy of Permanence”
8. Pandit Sunderlal, “Bharat Mein Angreji Raj”
9. Dharampal, “Rediscovering India”
10. Mohandas K Gandhi, “Hind Swaraj or Indian Home Rule”
11. Maulana Abdul Kalam Azad, “India Wins Freedom”
12. Romain Rolland, “Vivekananda” (English)
13. Romain Rolland, “Gandhi” (English)

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2		3	3	2		3		
CO2						2		3	3	2		3		
CO3						2		3	3	2		3		
CO4						2		3	3	2		3		
CO5						2		3	3	2		3		
Total						10		15	15	10		15		
Score						2		3	3	2		3		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2301	DIGITAL PRINCIPLES AND SYSTEM DESIGN	3	0	0	0	3

OBJECTIVES

- To design digital circuits using simplified Boolean functions
- To analyze and design combinational circuits
- To analyze and design synchronous and asynchronous sequential circuits
- To understand Programmable Logic Devices
- To write HDL code for combinational and sequential circuits.

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES 9

Number Systems – Arithmetic Operations – Binary Codes– Boolean Algebra and Logic Gates – Theorems and Properties of Boolean Algebra – Boolean Functions – Canonical and Standard Forms – Simplification of Boolean Functions using Karnaugh Map – Logic Gates – NAND and NOR Implementations.

UNIT II COMBINATIONAL LOGIC 9

Combinational Circuits – Analysis and Design Procedures – Binary Adder–Subtractor – Decimal Adder – Binary Multiplier – Magnitude Comparator – Decoders – Encoders – Multiplexers – Introduction to HDL – HDL Models of Combinational circuits.

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC 9

Sequential Circuits – Storage Elements: Latches, Flip–Flops; Analysis of Clocked Sequential Circuits – State Reduction and Assignment – Design Procedure – Registers and Counters – HDL Models of Sequential Circuits.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC 9

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards.

UNIT V MEMORY AND PROGRAMMABLE LOGIC 9

RAM – Memory Decoding – Error Detection and Correction – ROM – Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Solve Boolean functions using KMap (K3)
2. Analyze and construct Combinational Circuits (K4)
3. Analyze and construct Synchronous Sequential Circuits (K4)
4. Analyze and construct Asynchronous Sequential Circuits (K4)
5. Build various memories and Boolean functions using Programmable Logic Devices (K3)

TEXTBOOKS

1. Morris R Mano, Michael D Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog”, 6th Edition, Pearson Education, 2017.
2. S Salivahanan, S Arivazhagan, “Digital Circuits and Design”, 5th edition, Oxford University Press, 2018.

REFERENCES

1. G K Kharate, “Digital Electronics”, Oxford University Press, 2010.
2. John F Wakerly, “Digital Design Principles and Practices”, 5th Edition, Pearson Education, 2017.
3. Charles H Roth Jr, Larry L Kinney, “Fundamentals of Logic Design”, 6th Edition, Cengage Learning, 2013.
4. Donald D Givone,“Digital Principles and Design”, Tata Mc Graw Hill, 2003.
5. Thomas L Floyd, “Digital Fundamentals”, 11th edition, Pearson Education, 2017.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2	3							3			2	
CO3	3	2	3							3			2	
CO4	3	2											2	
CO5	3	2	2										2	
Score	15	10	8							6			10	
Course Mapping	3	2	3							3			2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2302	DATA STRUCTURES	3	0	0	0	3

OBJECTIVES

- To comprehend the notion of linear and nonlinear data structures
- To apply the linear and non-linear data structures to various problems
- To learn sorting and hashing techniques
- To design suitable data structures for different problems and implement them in C.

UNIT I LINEAR DATA STRCTURES - LIST 9

Algorithm Analysis: Running time calculations; Abstract Data Types (ADTs); List ADT: Array implementation of lists – Linked lists – Circular linked lists – Doubly linked lists – Applications of Lists: Polynomial manipulation.

UNIT II LINEAR DATA STRUCTURES – STACKS AND QUEUES 9

Stack ADT: Stack model – Implementation of stacks – Applications: Balancing symbols – Infix to postfix conversion – Evaluating postfix expressions – Function calls; Queue ADT: Queue model – Array implementation of queues – Applications of queues.

UNIT III NON-LINEAR DATA STRUCTURES - TREES 9

Preliminaries; Binary trees: Expression trees; Binary search tree ADT; AVL trees; Tree traversals; B-Trees; Priority Queues: Binary heap.

UNIT IV NON LINEAR DATA STRUCTURES - GRAPHS 9

Graph Algorithms: Definitions – Representation of graphs; Graph Traversals: Breadth-first traversal – Depth-first traversal; Topological sort – Shortest-Path Algorithms: Dijkstra's algorithm – All-pairs shortest path.

UNIT V SORTING AND HASING TECHNIQUES 9

Sorting: Insertion sort – Shell sort – Radix Exchange sort; Hashing: Hash function – Separate chaining – Open addressing – Rehashing – Extendible hashing.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Develop programs using arrays, linked lists for various applications and analyse their time complexity (K4)
2. Develop programs using stacks and queues (K3)
3. Apply the operations of unbalanced and balanced trees to develop solutions to various problems (K3)
4. Solve problems using graph data structure (K3)
5. Apply sorting and hashing algorithms to solve various computing problems (K3).

6. Choose appropriate data structure to solve the given problem (K5).

TEXTBOOKS

1. M A Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education, 2002.
2. Richard F Gilberg, Behrouz A Forouzan, “Data Structures: A Pseudocode Approach with C”, 2nd Edition, Cengage India, 2007.

REFERENCES

1. A V Aho, J E Hopcroft, J D Ullman, “Data Structures and Algorithms”, Pearson Education, 1st Edition Reprint, 2003.
2. R F Gilberg, B A Forouzan, “Data Structures”, 2nd Edition, Thomson India Edition, 2005.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, 2nd Edition, University Press, 2008.
4. S Sridhar, “Design and Analysis of Algorithms”, 1st Edition, Oxford University Press, 2014.
5. Byron Gottfried, Jitender Chhabra, “Programming with C” (Schaum’s Outlines Series), 3rd Edition, Mcgraw Hill Higher Education, 2010.

CO to PO Mapping

	PO1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**
CO1	3	2											2	3
CO2	3	2											2	3
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2											2	3
CO6	3	3	3	3						3		3	2	3
Sum	18	13	3	3						3		3	12	12
Course	3	3	3	3						3		3	2	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2303	OBJECT ORIENTED PROGRAMMING	3	0	0	0	3

OBJECTIVES

- To learn the basics of Object Oriented Programming
- To know the principles of inheritance and polymorphism
- To learn the concepts of generic methods and generic collections.

UNIT I INTRODUCTION 9

Principles of OOP: Classes – Objects – Data hiding – Data encapsulation – Inheritance – Poly- morphism; Definition of Classes: Objects – Methods – Access specifiers – Static and final classes and members; Object Construction and Destruction – Fundamental programming structures in Java; Streams: Input– Output, String handling – Examples in Java.

UNIT II INHERITANCE 9

Inheritance: Definition – Types of inheritance: Single – Multilevel – Multiple – Hierarchical; Subclass constructors – Interfaces in Java: Definition – Implementation – Extending interfaces
– Inheritance versus delegation – Inheritance rules – Inner classes – Examples in Java.

UNIT III POLYMORPHISM AND EXCEPTION HANDLING 9

Polymorphism: Method overloading and overriding – Dynamic method dispatch; Exceptions: Hierarchy – Built-in exceptions – Creating own exception; Packages in Java – Examples in Java.

UNIT IV GENERIC TYPES AND METHODS 9

Definition and concepts: Generic classes and generic methods – Generic types – Restrictions and limitations – Inheritance rules for generic types – Reflections – Examples in Java.

UNIT V GENERIC COLLECTIONS FOR ADTS AND ALGORITHMS 9

Introduction to collections – Collection Classes and Interfaces: Array list – Linked list – Queue – Set – Trees; Iterators for collections – Map class – Collection algorithms: Sorting – Searching – User-defined algorithms – Examples in Java.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Use classes and objects for problem solving (K3)
2. Develop programs using inheritance and interfaces (K3)
3. Apply the concepts of polymorphism and exception handling (K3)
4. Build applications using generic programming (K3)
5. Apply the concepts of generic collections (K3).

TEXTBOOKS

1. Danny Poo, Derek Kiong, Swarnalatha Ashok, “Object-Oriented Programming and Java”, 2nd Edition, Springer Publication, 2008.
2. Herbert Schildt, “Java: The Complete Reference”, 8th Edition, McGraw Hill Education, 2011.

REFERENCES

1. Timothy Budd, “Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000.
2. C Thomas Wu, “An introduction to Object-oriented programming with Java”, 4th Edition, Tata McGraw-Hill Publishing company Ltd., 2006.
3. Cay S Horstmann, Gary Cornell, “Core Java Volume – I Fundamentals”, 9th Edition, Prentice Hall, 2013.
4. Paul Deitel, Harvey Deitel, “Java SE 8 for programmers”, 3rd Edition, Pearson, 2015.
5. Steven Holzner, “Java 2 Black book”, Dreamtech press, 2011.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2	3										2	
CO3	3	2	3										2	
CO4	3	2											2	
CO5	3	2											2	
Score	15	10	9										10	
	3	3	3										2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2311	DIGITAL DESIGN LAB	0	0	3	0	1.5

OBJECTIVES

- To understand the various basic logic gates
- To design and implement the various combinational circuits
- To design and implement combinational circuits using MSI devices.
- To design and implement sequential circuits
- To understand and code with HDL programming

SUGGESTIVE EXPERIMENTS

1. Verification of Boolean Theorems using basic gates.
2. Design and implementation of combinational circuits using basic gates for arbitrary functions, code converters.
3. Design and implement half/full adder and subtractor.
4. Design and implement combinational circuits using MSI devices:
• 4-bit binary adder/subtractor
• Parity generator/checker
• Magnitude Comparator
• Application using multiplexers
5. Design and implement shift-registers.
6. Design and implement synchronous counters.
7. Design and implement asynchronous counters.
8. Coding combinational circuits using HDL.
9. Coding sequential circuits using HDL.
10. Design and implementation of a simple digital system (Mini Project).

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Use Boolean simplification techniques to design a combinational circuit using logic gates and MSI devices(K3)
2. Build different functional units in a digital computer system and model using VHDL/ Verilog HDL (K3)
3. Build sequential circuits and model using VHDL/ Verilog HDL (K3)

LABORATORY REQUIREMENT FOR BATCH OF 25 STUDENTS

Hardware:

1. Digital trainer kits - 25

2. Digital ICs required for the experiments in sufficient numbers

Software:

1. HDL simulator.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3					3	3			2	
CO2	3	2	2	3					3	3			2	
CO3 CO3	3	2	2	3					3	3			2	
Score	9	6	4	9					9	9			6	
Course Mapping	3	2	2	3					3	3			2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2312	DATA STRUCTURES LAB	0	0	4	0	2

OBJECTIVES

- Develop program solutions for various problems
- Apply suitable data structures, linear and nonlinear for a given problem statement
- Design the data structure for the given problem and implement them in a high-level programming language.

SUGGESTIVE EXPERIMENTS

1. Represent polynomial expression as linked list and write functions for polynomial manipulation
2. Implement doubly linked list ADT (e.g Insert, delete, search, merge, reverse operations)
3. Implementation of Stack ADT (e.g Balancing parenthesis, infix to postfix conversion, evaluation of postfix expression)
4. Implementation of Queue ADT (e.g Simulating printer jobs)
5. Implement binary search tree and produce its pre-order, in-order, and post-order traversals
6. Implement AVL trees (e.g Implement dictionary)
7. Implement priority queue using binary heaps (e.g Storing employee records based upon salary)
8. Graph representation and implement graph traversal algorithms
9. Implement Dijkstra's algorithm using graph (e.g Find the shortest route to connect one city to another)
10. Implement any two sorting algorithms
11. Implement hashing using separate chaining technique
12. Mini Project

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Solve the applications using linear and nonlinear data structures applying best practices in programming (K3)
2. Apply searching, sorting, and hashing techniques to solve the given problems (K3)
3. Choose suitable data structure and solve the given problem (K5)

LABORATORY REQUIREMENT FOR BATCH OF 25 STUDENTS

Hardware:

1. Standalone Systems - 25 Nos

Software:

1. C / C++ Compiler

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3									2	2
CO2	3	2	2	3									2	2
CO3	3	3	3	3							3		2	2
Sum	9	7	7	9							3		6	6
Score	3	3	3	3							3		2	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2313	OBJECT ORIENTED PROGRAMMING LAB	0	0	3	0	1.5

OBJECTIVES

- To build software development skills using object oriented programming for real world applications
- To develop applications using inheritance and polymorphism
- To understand and implement generic programming.

SUGGESTIVE EXPERIMENTS

1. Build an application using classes and objects (Eg: Electricity bill generation)
2. Develop an application using Inheritance (Eg: Payroll application)
3. Write a program to experiment with Polymorphism (E.g. Area of different shapes)
4. Design a Java interface for ADTs. (E.g. Stack, Queue)
5. Programs using Exception handling. (E.g. Bank Account manipulation)
6. Program to implement packages (Eg: Currency converter)
7. Program to implement generic classes, methods (Eg: Generic stack, Sorting)
8. Program to perform operations using Collection classes (Eg: ArrayList, LinkedList)
9. Develop a mini project for any application using the constructs of Java.

TOTAL PERIODS:45

COURSE OUTCOMES

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

1. Develop applications in Java using classes and methods (K3)
2. Develop applications using object-oriented concepts (K3)
3. Select real-world problem in team by applying the appropriate features of object-oriented programming paradigm with best practices and document its methodology (K4).

LABORATORY REQUIREMENT FOR BATCH OF 25 STUDENTS

Hardware:

1. Standalone Systems - 25 Nos

Software:

1. Java

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3										2	2
CO2	3	3	3	3									2	2
CO3	3	3	3	3					3	3	3		2	2
Score	9	9	9	6					3	3	3		6	6
	3	3	3	3					3	3	3		2	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UMA2476	PROBABILITY AND STATISTICS	3	1	0	0	4

OBJECTIVES

- To identify the standard distributions and apply them in solving problems.
- To solve problems in joint probabilities and to find correlation between them.
- To perform hypothesis testing using normal, t, F, chi square distribution
- To evaluate the tests of significance in analysis of variance.
- To calculate the various statistical quality control measurements.

UNIT I RANDOM VARIABLES 9

Random variables – Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, and Normal distributions – Functions of random variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTS OF SIGNIFICANCE 9

Sampling distributions – Small and large sample test – Test based on Normal and t distribution (Single and difference of mean)– $\chi 2$ – Test for goodness of fit, Independence of attributes – F test for variance.

UNIT IV DESIGN OF EXPERIMENTS 9

Completely randomized design – Randomized block design – Latin square design – Factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits – Acceptance sampling.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. identify standard distributions and apply them.
2. solve problems in two dimensional random variables and find the correlation between them.
3. identify and apply the suitable testing of hypothesis under normal, t, F and chi square distribution
4. solve problems in analysis of variance.
5. analyze quality control by applying control chart methods.
6. apply random variables, and design experiments and control charts in engineering problems

TEXTBOOKS

1. Milton J S and Arnold J C, “Introduction to Probability and Statistics”, 4th Edition, 3rd Reprint, Tata McGraw Hill, 2014.
2. Johnson R A and Gupta C B, “Miller and Freund’s Probability and Statistics for Engineers”, 9th Edition, Pearson Education, 2016.

REFERENCES

1. Devore J L, “Probability and Statistics for Engineering and the Sciences”, 8th Edition, Thomson Brooks/Cole, International Student Edition, 2012.
2. Walpole R E, Myers R H, Myers S L, Ye K, “Probability and Statistics for Engineers and Scientists”, 9th Edition, Pearson Education, Asia, 2012.
3. Ross S M, “Introduction to Probability and Statistics for Engineers and Scientists”, 5th Edition, Elsevier, New Delhi, 2014.
4. Spiegel M R, Schiller J, Srinivasan R A, “Schaum’s Outline of Theory and Problems of Probability and Statistics”, 3rd Edition, Tata McGraw Hill, New Delhi, 2004.
5. Gupta S C, Kapoor V K, “Fundamentals of Mathematical Statistics”, 12th Edition, Sultan and Chand Company, New Delhi, 2020.

CO to PO Mapping

PO/PSO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**11**	**12**	**1**	**2**
CO1	3	2		1									1	
CO2	3	2		1									1	
CO3	3	2		1									1	
CO4	3	2		1									1	
CO5	3	2		1									1	
CO6	3	2		1									1	
Course	3	2		1									1	

COURSE CODE	COURSE TITLE	L	T	P	E	C
AHS2476	INDIAN CONSTITUTION	3	0	0	0	3

OBJECTIVES

- To teach the history and philosophy of the Indian constitution.
- To summarize the powers and functions of the Indian government.
- To explain the structure and functions of local administration.
- To demonstrate the organization and working of the Judiciary.
- To discuss financial power and emergency provisions.

UNIT I INTRODUCTION 9

Historical background – Government of India act – Indian councils act – Making of the constitution - Philosophy of the Indian constitution – Preamble.

UNIT II GOVERNEMTN OF THE UNION 9

Powers and Functions of President and Prime Minister - Council of Ministers – President in relation to his council - Legislature structure and functions of Lok Sabha and Rajya Sabha – Speaker.

UNIT III GOVERNMENTS OF THE STATES AND LOCAL GOVERNMENT 9

The state executive: General structure – Governor – Council of ministers – State legislature. Local government - Panchayat – Municipality– Power authority and responsibilities municipalities.

UNIT IV THE JUDICATURE 9

Organization and Composition of Judiciary – Constitution – Appointment – Qualifications – Powers and functions of the supreme court – High courts – Control over subordinate courts.

UNIT V THE FEDERAL SYSTEM 9

Distribution of financial powers: Need, principles-Underlaying distribution of tax revenues- Distribution of legislative power – Interstate relation - Emergency provisions.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Understand the history and philosophy of the Indian constitution.
2. Realize the powers and functions of the Indian government.
3. Acquire awareness of the structure and functions of local administration.
4. Enhance knowledge about the organization and composition of the judiciary.
5. Explore the distribution of financial powers and emergency provisions.

TEXTBOOKS

1. Basu D.D, “Introduction to Indian Constitution”, Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, “Indian Government and Politics”, Vikas Publishing House, New Delhi, 2010.

REFERENCES

1. Pylee M V, “Introduction to the Constitution of India”, Vikas Publishing House, New Delhi, 2011.
2. Kashyap S, “Our Constitution”, National Book Trust, New Delhi, 2010.
3. “The Constitution of India, 1950 (Bare Act”), Government Publication.
4. Jain M P, “Indian Constitution Law”, 7th Edition., Lexis Nexis, 2014.
5. Busi S N, Ambedkar B R ,“Framing of Indian Constitution”, 1stEdition, 2015.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						2		2	2	2		2		
CO2						2		2	2	2		2		
CO3						2		2	2	2		2		
CO4						2		2	2	2		2		
CO5						2		2	2	2		2		
Course						2		2	2	2		2		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2401	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	0	3

OBJECTIVES

- To learn the basic structure and operations of a computer
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit
- To learn the basics of pipelined execution
- To understand the memory hierarchies, cache and virtual memories and communication with I/O devices
- To understand parallelism and multi-core processors.

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9

Functional Units – Basic Operational Concepts – Performance; Instructions: Language of the computer – Operations, Operands – Instruction representation; Logical operations – Decision making; MIPS addressing.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and subtraction; Multiplication; Division; Floating Point Representation: Floating point operations.

UNIT III PROCESSOS AND CONTROL UNIT 9

A Basic MIPS implementation: Building a datapath – Control implementation scheme; Pipelining: Pipelined datapath and control – Handling data hazards & Control hazards – Exceptions
– Issues in predictive branching: Spectre and Meltdown.

UNIT IV MEMORY & I/O SYSTEMS 9

Memory Hierarchy; Memory technologies; Cache Memory: Basics and cache mapping techniques; Measuring and improving cache performance; Virtual Memory: TLBs; Accessing I/O devices – Interrupts; Direct memory access; Bus structure – Bus operation – Arbitration; Interface circuits; USB.

UNIT V PARALLEL PROCESSORS 9

Parallel processing challenges; Flynn's classification: SISD – MIMD – SIMD – SPMD and Vector Architectures; Hardware multithreading; Multi-core processors and other shared memory multiprocessors; Introduction to Graphics Processing Units.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the basics structure of computers, operations and instructions (K2)
2. Design arithmetic and logic unit (K3)

3. Explain pipelined execution and design its control unit (K3)
4. Design various memory systems and understand I/O communication (K3)
5. Explain parallel processing architectures (K2)
6. Design a multi-functional ALU as per the requirement by applying best practices of system design (K4)

TEXTBOOKS

1. David A Patterson, John L Hennessy, "Computer Organization and Design: The Hardware/Software Interface", 5th Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", 6th Edition, Tata McGraw Hill, 2012.

REFERENCES

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", 8th Edition, Pearson Education, 2010.
2. John P Hayes, "Computer Architecture and Organization", 3rd Edition, Tata McGraw Hill, 2012.
3. John L Hennessey, David A Patterson, "Architecture – A Quantitative Approach", 5th edition, Morgan Kaufmann, Elsevier, 2012 (Units I, III).
4. Morris Mano M, "Computer System Architecture", Revised 3rd Edition, Pearson Publication, 2017.
5. Chakraborty P, "Computer Architecture and Organization", JAICO Publishing House, 2010.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	2	2										2	
CO3	3	2	2										2	
CO4	3	2	2										2	
CO5	3	2											-	
CO6			3				3			3				
Score	15	10	9	0	0	0	3	0	0	3	0	0	6	0
Course Mapping	3	2	3	0	0	0	0	0	0	3	0	0	2	0

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2402	OPERATING SYSTEMS	3	0	0	0	3

OBJECTIVES

- To understand the structure and functions of OS
- To learn about Processes, Threads and Scheduling algorithms
- To understand the principles of concurrency and Deadlocks
- To learn various memory management schemes
- To study disk management and File systems.

UNIT I OPERATING SYSTEMS OVERVIEW 9

Computer System Overview: Basic elements – Instruction execution – Interrupts – Memory hierarchy – Cache memory – Direct memory access – Multiprocessor and multicore organization; Operating System Overview: Objectives and functions – Evolution of operating system; Computer system organization; Operating System Structure and Operations: System calls
– System programs – OS generation and system boot.

UNIT II PROCESS MANAGEMENT 9

Processes: Process concept – Process scheduling – Operations on processes – Interprocess communication; Threads: Overview – Multithreading models – Thread issues; CPU Scheduling: FCFS, SJF, Priority, Round robin, Rate Monotonic and EDF scheduling; Process synchronization – Critical section problem – Mutex locks – Semaphores; Deadlocks – Avoidance – Prevention – Detection and Recovery.

UNIT III MEMORY MANAGEMENT 9

Main Memory: Contiguous memory allocation – Segmentation – Paging – 32 and 64 bit architecture Examples; Virtual Memory: Demand paging – Page replacement algorithms – Allocation of Frames – Thrashing.

UNIT IV STORAGE MANAGEMET 9

Mass Storage Structure: Overview – Disk scheduling and management; File System Storage: File concepts – Directory and disk structure – Sharing and protection; File System Implementation: File system structure – Directory structure – Allocation methods – Free space management.

UNIT V CASE STUDY 9

Linux Vs Windows: Design principles – Process management – Scheduling – Memory management – File systems; Mobile OS: iOS and Android – Introduction and architecture.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Outline the basic services and functionalities of operating systems (K2)
2. Analyze various scheduling algorithms, and explain process synchronization, deadlock prevention and avoidance schemes (K4)
3. Apply different memory management schemes (K3)
4. Apply various disk management schemes and illustrate the functionalities of file systems (K3)
5. Compare and contrast Linux, Windows and mobile operating systems (K2).

TEXTBOOKS

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc, 2012.
2. Neil Smyth, "iPhone iOS 4 Development Essentials - Xcode", 4th Edition, Payload media,2011.

REFERENCES

1. Ramez Elmasri, A Gil Carrick, David Levine, "Operating Systems A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. Achyut S Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.
3. Andrew S Tanenbaum, "Modern Operating Systems", 2nd Edition, Pearson Education, 2004.
4. Harvey M Deitel, "Operating Systems", 3rd Edition, Pearson Education, 2004.
5. Daniel P Bovet, Marco Cesati, "Understanding the Linux Kernel", 3rd edition, O'Reilly,2005.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	2										3	
CO2	3	3	3										3	
CO3	3	3	3										3	
CO4	3	2											3	
CO5	3												3	
Score	15	10	8										15	
Course Mapping	3	3	3										3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2403	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	2	0	4

OBJECTIVES

- To learn algorithms analysis techniques.
- To analyze the asymptotic performance of algorithms.
- To apply different algorithm design strategies.
- To prove the limitations of algorithmic power.
- To demonstrate the familiarity with important algorithms and data structures.

UNIT I INTRODUCTION AND ANALYSIS 9

Introduction: 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 for recursive and non-recursive algorithms.

UNIT II DIVIDE-AND-CONQUER, BACKTRACKING 9

Divide and Conquer: Mergesort – Quicksort – Multiplication of large integers – Strassen's matrix multiplication; Backtracking: Subset sum – N-queens problem – Hamiltonian circuit problem.

UNIT III DYNAMIC PROGRAMMING, GREEDY 9

Dynamic Programming: Computing a binomial coefficient – Knapsack problem and memory functions – Ordering of matrix multiplications – Warshall's and Floyd's algorithm; Greedy Technique: Dijkstra's algorithm, Prim's algorithm – Kruskal's algorithm.

UNIT IV ITERATIVE IMPROVEMENT, BRANCH-AND-BOUND 9

Iterative Improvement: Stable matching – Maximum Network Flow – Maximum matching in bipartite graphs; Branch and Bound: Knapsack problem – Traveling salesman problem.

UNIT V LIMITATIONS OF ALGORITH POWER 9

Limitations of algorithm power: Lower-bound arguments – P, NP and NP-complete problems; Coping with the Limitations of Algorithm Power: Approximation algorithms for NP-Hard problems – Traveling salesman problem – Knapsack problem.

PERIODS (THEORY): 45

SUGGESTIVE EXPERIMENTS

1. Iterative and recursive algorithms using decrease-and-conquer
2. Backtracking: subset sum, N-queeens
3. Divide-and-conquer: Mergesort, Quicksort
4. Dynamic Programming: Longest Increasing Subsequence, Floyd-Warshall
5. Greedy: Prim's, Dijkstra's
6. Iterative improvement: Stable matching, Network flow
7. Branch and Bound: Knapsack

TOTAL PERIODS(LAB): 30
TOTAL PERIODS: 75

COURSE OUTCOMES

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

1. Analyze asymptotic running time for various kinds of algorithms (K4)
2. Analyze the time and space complexity of Divide-and-Conquer and Backtracking algorithms (K4)
3. Evaluate Dynamic Programming and Greedy techniques for a given problem (K5)
4. Use iterative improvement and branch-and-bound design techniques (K5)
5. Explain the concepts of NP completeness (K2)

TEXTBOOKS

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2012.
2. Jeff Erickson, “Algorithms”, 1st Edition, 2019,

REFERENCES

1. S Dasgupta, C H Papadimitriou, U V Vazirani, “Algorithms”,1st Edition, McGraw Hill Education, 2017.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, “Introduction to Algorithms”, 3rd Edition, PHI Learning Private Limited, 2012.
3. Steven S Skiena, “The Algorithm Design Manual”, 2nd Edition, Springer, 2008.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2	2										3	
CO3	3	2	2										3	
CO4	3	2	2							3		3	3	
CO5	3	2											2	
Total	15	10	6							3		3	13	
Score	3	2	2							3		3	3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2404	DATABASE MANAGEMENT SYSTEMS	3	0	0	0	3

OBJECTIVES

- To introduce the fundamentals of database systems and conceptual modeling
- To learn SQL and relational model
- To learn database programming and relational database design
- To explore the fundamental concepts of transaction processing, concurrency control and recovery techniques
- To explain Distributed and NOSQL databases.

UNIT I DATABASE SYSTEM CONCEPTS AND CONCEPTUAL MODELING 9

Characteristics of database – Database users – Data models, Schemas – Three-schema architecture – Database system environment – Centralized and client/server DBMS architectures – Data modeling using ER model – Enhanced-ER model.

UNIT II RELATIONAL MODEL AND SQL 9

Relational Model: Concepts – Constraints – Update operations – Constraint violations; Relational Algebra; Basic SQL: Data Definition – SQL constraints – Basic retrieval queries – Insert, delete and update commands – Schema modification; More SQL: dealing NULL – Tuples, Set/Multiset comparisons – Correlated nested – EXISTS function – SQL Renaming – JOIN and Outer JOINs – Aggregate functions – Grouping.

UNIT III DATABASE PROGRAMMING AND DESIGN 9

Triggers – Views; Database Programming Techniques: Overview and Issues – Embedded SQL – JDBC – Database Stored Procedures and SQL/PSM ; Design guidelines – Functional dependencies – First, second and third Normal Forms – Boyce-Codd Normal Forms; FD: Inference rules – Minimal cover; ER-to-relational mapping.

UNIT IV TRANSACTION, CONCURRENCY AND RECOVERY 9

Transaction Processing: Concepts – ACID properties – schedules – serializability; Concurrency control: Two-phase locking technique – Timestamp Ordering; Recovery: Concepts – Deferred update – Immediate update.

UNIT V DISTRIBUTED AND NOSQL DATABASES 9

Distributed Database Concepts – Data fragmentation and Replication – Allocation techniques; Introduction to NOSQL Systems – The CAP Theorem – Document-Based NOSQL Systems and MongoDB – Column-based NOSQL systems.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the database concepts and apply ER models for a database application (K3)
2. Apply SQL for relational data model (K3)
3. Apply database programming techniques, database design theory and normalization(K3)
4. Apply concurrency control and recovery mechanisms for transaction processing systems (K3)
5. Explain the concepts of Distributed and NOSQL databases (K2)
6. Design the database schema by analyzing the data for a real time application with documentation (K6).

TEXTBOOKS

1. Ramez Elmasri, Shamkant B Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson, 2016.
2. Raghu Ramakrishnan, “ Database Management Systems”, 4th Edition, Tata McGraw Hill, 2010.

REFERENCES

1. Jeffrey D Ullman, Jennifer Widom, “A First Course in Database Systems”, 3rd Edition, Pearson Education, 2014.
2. S Sumathi, S Esakkirajan, “Fundamentals of Relational Database Management Systems”, (Studies in Computational Intelligence), Springer-Verlag, 2007.
3. Abraham Silberschatz, Henry F Korth, S Sudharshan, “Database System Concepts”, 6th Edition, Tata McGraw Hill, 2011.
4. Thomas M Connolly, Carolyn E Begg, “Database Systems – A Practical Approach to De- sign, Implementation and Management”, 6th edition, 2015, Global Edition, Pearson.
5. Hector Garcia-Molina, Jeffrey D Ullman, Jennifer Widom, “Database Systems:The Complete Book”, 2e, Pearson.

CO to PO Mapping

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2												
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2											2	
CO6		3	3						3	3				
Score	15	13	3						3	3			8	
Course Mappin g	3	3	3						3	3			2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2412	OPERATING SYSTEMS LAB	0	0	3	0	1.5

OBJECTIVES

- To learn and implement basic Unix commands using system calls
- To implement various CPU Scheduling Algorithms
- To implement Process Creation and Inter Process Communication
- To implement Deadlock Avoidance and Deadlock Detection algorithms
- To implement Page Replacement Algorithms
- To implement File Organization and File Allocation Strategies

SUGGESTIVE EXPERIMENTS

1. Basics of UNIX commands and study of system calls.
2. Implement a few UNIX commands using system calls.
3. Implement Shared memory and IPC
4. Implement the various CPU Scheduling Algorithms
5. Implement Semaphores
6. Implement Bankers Algorithm for Deadlock Avoidance
7. Develop applications using threads
8. Implement the following Memory Allocation Methods for variable sized partition: a) First Fit b) Worst Fit c) Best Fit
9. Implement the following Page Replacement Algorithms a) FIFO b) LRU c) Optimal
10. Implement the various File Organization Techniques a) Single-level b) Hierarchical
11. Implement the following File Allocation Strategies a) Sequential b) Indexed c) Linked

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Analyze the performance of various CPU scheduling algorithms (K4)
2. Develop programs to implement deadlock avoidance algorithms, semaphores and IPC (K3)
3. Develop programs to implement various page replacement algorithms, file organization and file allocation strategies (K3).

LABORATORY REQUIREMENT FOR BATCH OF 38 STUDENTS

Hardware:

1. Standalone Desktops with Linux OS - 38 Nos

Software:

1. C/C++ Compiler

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2
CO1	3	2		3									3	
CO2	3	2		3									3	
CO3	3	2		3									3	
Score	9	6		9									9	
Course Mapping	3	2		3									3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2411	DATABASE LAB	0	0	3	0	1.5

OBJECTIVES

- To understand data definitions and data manipulation commands
- To learn about the use of nested and join queries
- To understand procedural extensions of databases
- To design a database schema for an application using ER model, Normalization
- To implement a database application using Front-end tools

SUGGESTIVE EXPERIMENTS

1. Data Definition Commands
   - Creating tables with constraints, constraint violations
   - schema modifications

2. Data Manipulation Commands
   - Update operations
   - Simple SQL queries
   - Transaction Control statements - Savepoint and Rollback

3. Complex SQL Queries
   - Nested Queries
   - Correlated Subqueries
   - Joins and Outer Joins
   - Aggregate functions
   - Grouping and Ordering commands

4. Views
5. Database Programming:
   - PL/SQL - Procedures and Functions

6. Triggers

7. Database design
   - ER Model, ER-to-relational mapping
   - Normalization

8. Implement a database application by applying database design and database programming using library class.
Example: a) Timetable Management System b) Hospital Management System c) Library Management System d) Railway Reservation System e) Inventory Control System f) Online Commerce System

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Construct queries using SQL in database creation and manipulation. (K3)
2. Develop PL/SQL blocks using database programming constructs. (K3)
3. Design a database schema and develop an application using IDE that interacts with a DBMS server via API (K6)

LABORATORY REQUIREMENT FOR BATCH OF 38 STUDENTS

Hardware:

1. Server - 1 Nos
2. Standalone Desktops - 38 Nos

Software:

1. Database: Oracle 10g - 38 Clients with 1 Server Node
2. Frontend - Netbeans / Java / JDBC

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2		3									2	
CO3	3	3	3	3	2				3	2	3		2	
Score	9	7	3	6	2				3	2	3		6	
Course Mapping	3	3	3	3	2				3	2	3		2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2501	COMPUTER NETWORKS	3	0	0	0	3

OBJECTIVES

- To understand the protocol layering and physical level communication
- To understand the various components required to build different networks
- To learn the functions of network layer and the various routing protocols
- To familiarize the functions and protocols of the Transport layer
- To understand various application layer protocols.

UNIT I INTRODUCTION AND PHYSICAL LAYER 7

Introduction: Networks – Network types – Protocol layering – TCP/IP Protocol suite – OSI model; Physical Layer: Performance; Socket Programming; Transmission media.

UNIT II DATA-LINK LAYER AND MEDIA ACCESS 12

Introduction: Link-Layer addressing – Error Correction and Detection: Checksum, Hamming Code – DLC services – Data-Link layer Protocols – HDLC – Media Access Control – Wired LANs- Standard Ethernet: Characteristics, Address, Access Method – IEEE 802.11 project– Connecting devices.

UNIT III NETWORK LAYER 11

Network layer services – Switching – Performance – IPV4 Addresses – Forwarding of IP packets; Network Layer Protocols: IP – ICMP v4 – Unicast routing algorithms – Protocols – Multi- casting basics – IPV6 addressing – IPV6 protocol.

UNIT IV TRANSPORT LAYER 9

Introduction: Transport layer protocols – Services – Port numbers – User datagram protocol – Transmission control protocol.

UNIT V APPLICATION LAYER 9

Traditional applications – Electronic mail (SMTP, POP3, IMAP, MIME) – HTTP – File transfer protocol – Secure shell (SSH) – DNS.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Describe the principles, design, terminology and concepts of the network models (K2)
2. Select the protocols of data link layer and apply error control mechanisms (K3)
3. Choose the core functions of network layer protocols and apply them for data communication (K3)
4. Select the Transport Layer Protocols suitable for transmission of data. (K3)
5. Illustrate the Application Layer Protocols and their basic functionalities (K2).

TEXTBOOKS

1. Behrouz A Forouzan, “Data Communications and Networking”, 5th Edition, Tata Mc- Graw Hill, 2013.
2. Larry L Peterson, Bruce S Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan Kaufmann Publishers, 2012.

REFERENCE BOOKS

1. William Stallings, “Data and Computer Communications”, 10th Edition, Pearson Education, 2013.
2. Nader F Mir, “Computer and Communication Networks”, 2nd Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4. James F Kurose, Keith W Ross, “Computer Networking, A Top-Down Approach Featuring the Internet”, 6th Edition, Pearson Education, 2013.
5. Andrew Tanenbaum, David J Wetherall, “Computer Networks”, 5th Edition, Pearson Education, 2013.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	2	-
Total	15	10	3	-	-	-	-	-	-	-	-	2	10	-
Score	3	2	3	-	-	-	-	-	-	-	-	2	2	-

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2502	MICROPROCESSORS, MICROCONTROLLERS AND INTERFACING	3	0	0	0	3

OBJECTIVES

- To understand the Architecture of 8086 microprocessor
- To learn the design aspects of I/O and Memory Interfacing circuits
- To interface microprocessors with supporting chips
- To study the Architecture of 8051 microcontroller
- To design a microcontroller-based system.

UNIT I THE 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing – System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III I/O INTERFACING 9

Memory interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, Keyboard display interface and Alarm Controller.

UNIT IV THE 8051 MICROCONTROLLER 9

Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins ports and circuits – Instruction set – Addressing modes – Assembly language programming.

UNIT V INTERFACING MICROCONTROLLER 9

Programming 8051 Timers – Serial port programming – Interrupts programming – LCD & key- board interfacing – ADC, DAC & Sensor interfacing – External memory interface – Stepper motor and waveform generation – PIC and ARM processors.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Summarize the basic architecture, operations and apply the programming concepts of microprocessor 8086 (K3)
2. Outline the design of basic and multiprocessor systems and their bus timings (K2)

3. Build 8086 interfaces with memory, I/O and other peripheral chips (K3)
4. Summarize the basic architecture and operation of microcontroller 8051 (K2)
5. Apply programming concepts to implement microcontroller interfaces for different ap- plications (K3)

TEXTBOOKS

1. Douglas V Hall, “Microprocessors and Interfacing, Programming and Hardware”, Tata McGraw Hill, 2012.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2nd Edition, Pearson Education, 2011.

REFERENCE BOOKS

1. Yu-Cheng Liu, Glenn A Gibson, “Microcomputer Systems: The 8086/8088 Family - Architecture, Programming and Design”, 2nd Edition, Prentice Hall of India, 2007.
2. A K Ray, K M Bhurchandi,“Advanced Microprocessors and Peripherals”, 3rd edition, Tata McGraw Hill, 2012.
3. Barry B Bray, “The Intel Microprocessor 8086/8088,80186,80286,80386 and 80486 - Architecture, Programming and Interfacing”, 8th Edition, PHI, 2011.
4. Mohamed Rafiquazzaman, “Microprocessor and Microcomputer based System Design”, 2nd Edition, Universal Book Stall, 1995.
5. Kenneth J Ayala, “The 8051 Microcontroller Architecture, Programming and Applications”, 2nd edition, Penram International, 1996.

CO to PO Mapping

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO1	3	2											2	
CO2	3													
CO3 CO3	3	2	2							3			2	3
CO4	3	2											2	
CO5	3	2	2										2	3
Score	15	8	4							3			8	6
Course Mapping	3	2	2							3			2	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2504	FOUNDATIONS OF ARTIFICIAL INTELLIGENCE	3	0	2	0	4

OBJECTIVES

- To study the fundamental concepts of AI agents and environments.
- To learn the methods of problem solving in AI using various search strategies.
- To understand the concepts of knowledge representation and inference using logic.
- To understand the concepts of knowledge representation and inference under uncertainty.
- To learn some applications in text and robotics.

UNIT I FOUNDATIONS 7

Introduction: What is AI; Intelligent Agents: Agents and environments – Good behavior – The nature of environments – Structure of agents; Philosophical Foundations: Weak AI – Strong AI – Ethics and risks of developing AI; AI: The Present and Future: Agent components – Agent architectures.

UNIT II PROBLEM SOLVING & SEARCH TECHNIQUES 10

Solving Problems by Searching: Problem solving agents – Example problems – Searching for solutions – Uninformed search strategies – Informed search strategies – Heuristic functions; Beyond classical search: Local search algorithms and optimization problems; Adversarial search: Games – Optimal decisions in games – Alpha-beta pruning.

UNIT III KNOWLEDGE REPRESENTATION & REASONING 10

Logical Agents: Knowledge-based agents – Propositional logic – Propositional theorem proving; First order logic: Syntax and semantics for first order logic – Using first order logic; Inference in first order logic: Propositional versus first order logic – Unification and lifting – Forward chaining – Backward chaining – Resolution.

UNIT IV UNCERTAIN KNOWLEDGE AND REASONING 9

Quantifying Uncertainty: Acting under uncertainty – Basic probability notation – Inference using full joint distributions – Bayes' rule & its use; Probabilistic Reasoning: The semantics of Bayesian networks – Exact inference in Bayesian networks – Other approaches to uncertain reasoning.

UNIT V COMMUNICATION, PERCEIVING AND ACTING 9

Natural Language Processing: Language Models – Text Classification – Information Retrieval; Robotics: Introduction – Robot Hardware – Robotic Perception – Planning to move – Application Domains.

TOTAL PERIODS(THEORY): 45

SUGGESTIVE EXPERIMENTS

1. Uninformed Search Techniques
2. Informed Search Techniques
3. Hill Climbing algorithms
4. Adversarial Search techniques
5. Construction of AND-OR graph from knowledge base
6. Inference from knowledge base
7. Inference using full joint probability distribution
8. Inference using Bayesian network
9. One Application using AI algorithm

TOTAL PERIODS(LAB): 30
TOTAL PERIODS: 75

COURSE OUTCOMES

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

1. Explain different types of environments and agents (K2)
2. Analyze and solve AI problems using search techniques (K4)
3. Solve AI problems using logics and inference techniques (K3)
4. Solve AI problems using uncertain knowledge and probabilistic reasoning (K3)
5. Explain the concepts of Natural Language Processing and Robotics and assess the im- portance of AI using a suitable application (K5)

TEXTBOOKS

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 4th Edition, Pearson Education / Prentice Hall of India, 2015.
2. Deepak Khemani “A First Course in Artificial Intelligence”, McGraw Hill, 2014.

REFERENCE BOOKS

1. Elaine Rich, Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill, 2003.
2. Dawn W Patterson, “Introduction to Artificial Intelligence and Expert Systems”, 1st Edition, Pearson Education India, 2015.
3. Andreas Muller, Sarah Guido, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, Shroff/O’Reilly, 1st edition, 2016.
4. Prateek Joshi, “Artificial Intelligence with Python”, 1st edition, Packt Publishing Limited, 2017.
5. David Poole, Alan Mackworth, “Artificial Intelligence: Foundation of Computational Agents”, 2nd Edition, Cambridge University Press, 2017.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2	3	3									2	
CO3	3	2	3	3									2	
CO4	3	2	3	3									2	
CO5	3	3	3	3					3	3		3	3	
Total	15	11	12	12					3	3		3	11	
Score	3	3	3	3					3	3		3	3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
Ucs2503	SOFTWARE ENGINEERING	3	0	0	0	3

OBJECTIVES

- To understand the phases in a software project, estimate cost and effort.
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies
- To learn various testing techniques and maintenance measures.
- To understand agile development and Devops

UNIT I SOFTWARE PROCESS AND PLANNING 9

Introduction to Software Engineering; Objectives, Principles and Practices; The Software Development Life Cycle : Pre-development phases of the SDLC – Development specific phases of the SDLC – Post-development phases of the SDLC; Methodologies Paradigm and Practices : Process methodologies – Development paradigms – Development practices; Project Planning Process; Software Project Estimation: Decomposition techniques – Empirical estimation models – The make/buy decision – Project scheduling; Risk Management; Handling Ethical Dilemmas.

UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and non-functional – Security requirements – User requirements – System requirements – Software requirements document; Requirement Engineering Process: Feasibility studies – Requirements elicitation and analysis – Requirements validation – Requirements Management; Classical Analysis: Structured system analysis; Requirement modelling tools.

UNIT III SOFTWARE DESIGN 9

Design Concepts: Design process – Design concepts – Modularity, Coupling and cohesion – Design model – Modeling principles; Structured Design; Architectural Design: Architectural styles; Architecture for Network based Applications – Decentralized Architectures.

UNIT IV SOFTWARE TESTING 9

Software Testing Fundamentals; Internal and External Views of Testing: White box testing – Basis path testing – Control structure testing– Black box testing – Unit testing – Integration testing – Regression testing – Validation testing – System testing – Security testing; Testing Tool; Debugging; Software Implementation: Coding Practices and Principles; Maintenance: Types.

UNIT V AGILE DEVELOPMENT AND DEVOPS 9

Agile Development: Agile Teams – Team and Scrum – Branches – Pull Requests – Reviews – Integration – Agile Iterations – Reporting and fixing bugs; Dev/Ops: From development to deployment – Three-Tier – Responsiveness, Service level objectives, and Apdex – Releases and feature flags – Monitoring and finding bottlenecks – Improving rendering and database performance with caching; Security: Defending customer data in application.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Choose an appropriate process model and estimate project cost and effort required by applying software engineering principles(K5)
2. Identify and analyze the requirements and construct their models (K5)
3. Apply systematic procedure for software design (K3)
4. Compare and contrast the various testing and maintenance activities (K2)
5. Make use of agile development and Devops (K3)
6. Identify unethical issues and apply ethical practices for a given case study (K3)

TEXTBOOKS

1. Roger S Pressman, Bruce R Maxin "Software Engineering – A Practitioner's Approach", McGraw Hill International Edition, Eighth Edition, 2015.
2. Armando Fox and David Patterson, Engineering Software as a Service: An Agile Approach Using Cloud Computing", Strawberry Canyon LLC, Second Beta Edition, 2021.

REFERENCE BOOKS

1. Ian Sommerville, "Software Engineering", Pearson Education Asia,Tenth Edition, 2015.
2. Stephen R Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited,2007.
3. Brian Albee, Hands-On Software Engineering with Python, Packt Publishing, 2018.
4. Kelkar S A,"Software Engineering", Prentice Hall of India, 2007.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												3
CO2	3	3	3		3	2	3		3	3	3		2	3
CO3	3	2	2										2	2
CO4	3	2	2										3	3
CO5	3													
CO6	3							3		3		1		
Score	18	9	7		3	2	3	3	3	6	3	1	7	11
Course Mapping	3	3	3		3	2	3	3	3	3	3	1	3	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2511	NETWORKS LAB	0	0	3	0	1.5

OBJECTIVES

- To learn and use network commands.
- To learn socket programming.
- To implement and analyze various network protocols.
- To learn and use simulation tools.
- To use simulation tools to analyze the performance of various network protocols.

SUGGESTIVE EXPERIMENTS

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.
2. Write applications using TCP sockets like:
• Echo client and echo server
• Chat
• File Transfer
3. Simulate of DNS using UDP sockets.
4. Write Programs to implement flow control protocol in data link layer.
5. Simulation of error detection code (like CRC).
6. Write programs simulating ARP /RARP protocols.
7. Study of Network simulator (NS) and Simulate a wired topology using NS.
8. Simulate Distance Vector/ Link State Routing algorithm.
9. Study of TCP/UDP performance using Simulation tool.
10. Simulation of Congestion Control Algorithms using NS2 and analyse its performance.

TOTAL PERIODS (LAB): 45

COURSE OUTCOMES

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

1. Develop socket programs using TCP and UDP, to implement various application proto- cols (K3)
2. Develop socket programs to implement the functionalities of various layers in TCP / IP protocol suite (K3)
3. Analyze the performance of various protocols using a network simulator tool. (K4)

LABORATORY REQUIREMENT FOR BATCH OF 38 STUDENTS

Hardware:

1. Standalone Desktops - 38 Nos

Software:

1. C / C++ / Java / Python / Equivalent Compiler
2. Network simulator like NS2 / NS3 / GlomoSim / OPNET/ Packet Tracer / Equivalent

CO to PO Mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**
CO1	3	3	-	3	-	-	-	-		-	-	-	2	-
CO2	3	3	-	3	-	-	-	-		-	-	-	2	-
CO3	3	3	-	3	2	-	-	-		-	-	-	2	-
Total	9	9	-	9	2	-	-	-		-	-	-	6	-
Score	3	3	-	3	2	-	-	-		-	-	-	2	-

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2512	MICROPROCESSORS, MICROCONTROLLERS AND INTERFACING LAB	0	0	3	0	1.5

OBJECTIVES

- To understand simple Assembly Language Programs concepts and features
- To write Assembly Language Programming for 8086
- To understand MASM programming
- To design different, I/O interfaces with Microprocessors
- To write Assembly Language Programming for 8051

SUGGESTIVE EXPERIMENTS

8086 Programs using kits
1. Basic arithmetic and Logical operations
2. String manipulations
3. Sorting and searching
4. Code conversion, decimal arithmetic and Matrix operations.

8086 Programs using MASM
1. Floating point operations
2. Password checking, Print system date and time
3. Counters and Time Delay

Peripherals and Interfacing Experiments
1. Traffic light controller
2. Stepper motor control
3. Key board and Display controller
4. Parallel interface
5. D/A interface (Waveform Generation) and A/D interface

8051 Experiments using kits
1. Basic arithmetic and logical operations
2. Cube, 1's count and 2's complement of a number
3. Unpacked BCD to ASCII

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Develop 8086 assembly language programs for arithmetic, logical, string operations and BIOS interrupt concepts (K3)
2. Build different I/O interfaces with 8086 (K3)
3. Apply 8051 assembly language programming concepts for arithmetic and logical operations (K3)

LABORATORY REQUIREMENT FOR BATCH OF 38 STUDENTS
Hardware:

1. Standalone Desktops - 30 Nos
2. 8086 development kits - 30 Nos
3. Interfacing Units - Each 10 Nos
4. Microcontroller kits- 30 Nos

Software:

1. MASM software

CO to PO Mapping

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO1	3	2		3						3			2	
CO2	3	2	2	3						3			2	3
CO3	3	2		3						3			2	
Score	9	6	2	9						9			6	3
Course Mapping	3	2	2	3						3			2	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2601	INTERNET PROGRAMMING	3	0	0	0	3

OBJECTIVES

- To understand different client and server end technologies
- To develop web application using traditional technologies
- To understand and develop web applications using emerging web application frameworks.

UNIT I WEB ESSENTIALS 9

Web Essentials: Clients – Servers – Communication; HTTP protocol: Request and Response Messages – Functionalities of Web Client and Web Server; Web Server: Vulnerabilities – At- tacks & its prevention; HTML5: Table – List – Image – Form – Semantic elements – CSS3: Types of style sheets – Selectors – Box Model – Rule cascading – Inheritance – Transformations – Transitions – Animations

UNIT II CLIENT SIDE PROGRAMMING 9

JavaScript: Variables – Data types – Statements – Function – Object – Array – Built-in objects (String and Date) – JSON: Parse, Stringify – Event handling: Form, Mouse and Keyboard events – DOM: Document tree – Node object – Document object – Event handling: Event propagation

UNIT III SERVER SIDE PROGRAMMING 9

Servlets: Architecture – Life Cycle – Parameter data – Sessions – Cookies and URL rewriting – AJAX: Ajax Client Server Architecture – XML Http Request Object – Call Back Methods

UNIT IV CLIENT SIDE FRAMEWORK 9

Javascript for ReactJS – React elements – ReactDOM – React Components – Mapping Arrays with JSX – Create React App – useState Hook: Refactoring for Advanced Reusability – useEffect Hook: State in component tree, Dependency Array – Rules to follow with hooks – React router: Incorporation – Nesting – Parameters

UNIT V SERVER SIDE FRAMEWORK 9

Node building blocks: Global objects, Events, Asynchronous Nature – Node and the Web: Server and Client – Build and the NodeJS using MVC: Routing, Creation of Modules, Views and Con- trollers

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Make use of HTML5 and CSS3 to design modern web site (K3)
2. Utilize Javascript and DOM to implement dynamic web page (K3)
3. Develop responsive web applications using Servlets and AJAX (K3)
4. Build web application using ReactJS framework (K3)
5. Develop web application using NodeJS framework (K3)

TEXTBOOKS

1. Jeffrey C, Jackson, “Web Technologies A Computer Science Perspective”, Pearson Edu- cation, 2011. (Units 1,2,3)
2. Alex Banks, Eve Porcello, “Learning React: Modern Patterns for Developing React Apps”, June 2020, O’Reilly Media Inc., (Unit 4)

REFERENCE BOOKS

1. David McFarland, “CSS3: The missing manual”, O’Reilly Media, December 2012. (Unit 1)
2. Matthew MacDonald, “HTML5: The missing manual”, O’Reilly Media, August 2011 (Unit 1)
3. Shelly Powers, “Learning Node 2nd Edition”, 1st Edition, O’Reilly Media, June 2016. (Unit 5)
4. Sitepoint Team, “Your First Week With Node.js”, SitePoint, February 2018. (Unit 5)
5. ”How to Hack a Web Server”,

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3										2	
CO2	3	2	3										2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2	3							3			2	
Score	15	10	9							3			10	
	3	2	3							3			2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2602	SOFTWARE SYSTEM SECURITY	3	0	0	0	3

OBJECTIVES

- To study about the essentials of computer security
- To acquire knowledge on encryption Techniques
- To understand authentication applications
- To learn various access control mechanisms
- To understand different security policies

UNIT I OVERVIEW OF SECURITY AND ENCRYPTION TECHNIQUES 9

Computer Security Concepts – Security Architecture – Attacks, Services and Mechanisms – Fundamental Security Design Principles – Attack Surfaces and Attack Trees – Algebraic structures – Modular arithmetic – Euclid's algorithm – Congruence and matrices -Groups, Rings, Fields- Finite fields Block Cipher – Data Encryption Standard – Advanced Encryption Standard – Stream Ciphers and RC4 – Cipher Block Modes of Operation

UNIT II PUBLIC KEY CRYPTOGRAPHY 9

Primes – Primality Testing –Factorization – Euler's totient function, Fermat's and Euler's Theorem – Chinese Remainder Theorem – Exponentiation and logarithm – Public-Key Cryptography and Message Authentication: Secure Hash Functions – HMAC – RSA – Diffie-Hellman – Elliptic curve arithmetic – Elliptic curve cryptography

UNIT III NETWORK PROTOCOLS 9

Protocols Using Shared Key Cryptography: Entity Authentication Protocols – Server-Less Key Establishment – Server-Based Key Establishment; Authentication and Key Transport Using Public Key Cryptography: Entity Authentication Protocols – Key Transport Protocols; Key Agreement Protocols: Diffie-Hellman Key Agreement – Diffie-Hellman Protocols with Explicit Authentication

UNIT IV SECURITY PRACTICE 9

Cloud and IoT security: Cloud Computing – Cloud Security Concepts – Cloud Security Approaches; Transport Layer Security: TLS – HTTPS – SSH; Electronic Mail security: PGP, S/MIME – IP security – Web Security; IP Security: IPSec

UNIT V SECURITY POLICIES 9

The Nature of Security Policies – Types of Security Policies – The Role of Trust; Confidentiality policy:The Bell-LaPadula Model; Integrity policy: Clark-Wilson Integrity Model; Availability policy: Denial of Service Models; Hybrid policy: Chinese Wall Model

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Examine symmetric and asymmetric ciphers (K3)
2. Examine the different authentication schemes (K3)
3. Outline the security mechanisms adapted in OS, Cloud and IoT (K2)
4. Explain the functionality of access control mechanism (K2)
5. Compare and contrast various security policies (K3).

TEXTBOOKS

1. William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Seventh Edition, Pearson, 2019. (Unit I, II)
2. William Stallings, "Network Security Essentials: Applications and Standards", Sixth edition, Pearson, 2017 (Unit IV)
3. Colin Boyd, Anish Mathuria, Douglas Stebila, "Protocols For Authentication And Key Establishment", Springer, 2020. (Unit III)
4. Matt Bishop, “Computer Security: Art and Science”, Second edition, Addison Wesley, 2019 (Unit IV, V).

REFERENCE BOOKS

1. Salomon, David , “Data Privacy and Security”, Springer
2. Dorothy Elizabeth Rob, Ling Denning , “Cryptography and data Security”, ADDISON WESLEY PUBLISHING COMPANY, 2003
3. Houbing Song , Glenn A. Fink , Sabina Jeschke , “Security and Privacy in Cyber-Physical Systems: Foundations, Principles, and Applications”, Wiley-IEEE Press, November 2017
4. Charlie Kaufman, Radia Perlman and Mike Speciner , “Network Security: Private Communication in a Public World”, Second Edition, Pearson Education, 2017.
5. Wenliang Du, “Computer Security: A Hands-on Approach”, CreateSpace Independent Publishing Platform, First Edition, 2017.
6. William Stallings, “Network Security Essentials: Applications and Standards”, Sixth Edition, Pearson, 2017.
7. Mauricio Arregoces, Maurizio Portolani, “Data Center Fundamentals”, Cisco Press, 2003.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	2	2											2	
CO3	2	2											2	
CO4	2	2											2	
CO5	2	2											2	
Total	11	10											10	
Score	3	2											2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2604	PRINCIPLES OF MACHINE LEARNING	3	0	0	0	3

OBJECTIVES

- To understand machine learning problems
- To study the various supervised, unsupervised and reinforcement learning algorithms in machine learning
- To study the dimensionality reduction techniques to represent the data and their dependencies
- To understand the need of optimisation techniques.

UNIT I INTRODUCTION 8

Introduction: Machine learning; Examples of Machine Learning Applications: Learning associations – Classification – Regression – Unsupervised learning – Reinforcement learning; Preliminaries: Weight space – Curse of dimensionality – Testing machine learning algorithms
– Turning data into probabilities – Basic statistics – Bias-variance tradeoff.

UNIT II SUPERVISED LEARNING 11

Neural Networks and Linear Discriminants: Brain and the neuron – Neural networks – Perceptron – Linear separability – Linear regression; Multi-layer Perceptron: Forward and Backward propagation; Support Vector Machines.

UNIT III PROBABILISTIC LEARNING, LEARNING WITH TREES 9

Probabilistic Learning: Gaussian mixture models – Nearest neighbour methods; Learning with Trees: Constructing decision trees – Classification and Regression trees – Classification example; Ensemble Learning: Boosting – Bagging – Random forests.

UNIT IV UNSUPERVISED LEARNING, REINFORCEMENT LEARNING 9

Unsupervised: K-means algorithm; Reinforcement learning: State and action space – Reward function – Discounting – Action selection – Policy – Markov decision process – Values – SARSA and Q-learning.

UNIT V DIMENSIONALITY REDUCTION, OPTIMISATION TECHNIQUES 9

Dimensionality Reduction Techniques: Linear Discriminant analysis, Principal Component Analysis; Optimisation and Search: Least-squares optimisation – Conjugate gradients – Search approaches – Exploitation and exploration.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the basic concepts of machine learning (K2)

2. Apply supervised algorithms for different classification problems (K3)
3. Explain the need for ensemble methods (K2)
4. Apply unsupervised and reinforcement learning techniques to various problems (K3)
5. Apply dimensionality reduction and optimisation techniques (K3)

TEXTBOOKS

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2015.
2. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, The MIT Press, 2014.

REFERENCE BOOKS

1. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014.
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
3. Richert, Willi, "Building machine learning systems with Python", Packt Publishing, 2013.
4. Tom M Mitchell, "Machine Learning", McGraw-Hill Education (India), 2013.
5. Y S Abu-Mostafa, M Magdon-Ismail, H T Lin, "Learning from Data", AML Book Publishers, 2012.

CO to PO Mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO1 1**	**PO12**	**PSO 1**	**PSO2**
CO1	3	2											2	
CO2	3	2	3									2	2	
CO3	3	2											2	
CO4	3	2	3										2	
CO5	3	2											2	
Score	15	10	6									2	10	
	3	2	3									2	2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2603	THEORY OF COMPUTATION	3	0	0	0	3

OBJECTIVES

- To learn the mathematical notations and construct finite automata of the given language
- To understand and infer the relationship of finite automate and regular expressions
- To understand the language hierarchy, relationship between context free grammar and its language and to construct a PDA of CFG.
- To understand Turing machines and their programming capability
- To infer the knowledge of undecidable problems.

UNIT I MATHEMATICAL INTRODUCTION AND FINITE AUTOMATA 8

Basic Mathematical Notation and Techniques: Introduction to Formal Proof – Additional Forms of Proof – Inductive Proofs; Finite Automata (FA): Deterministic Finite Automata (DFA) – Non- deterministic Finite Automata (NFA) – Finite automata with epsilon transitions – Equivalence of FAs.

UNIT II REGULAR LANGUAGES 9

Regular Expressions and Languages: Regular expressions – Finite automata and regular ex- pressions; Properties of Regular Languages: Proving languages not to be regular – Closure properties of regular languages – Equivalence and Minimization of Automata.

UNIT III CONTEXT FREE LANGUAGES AND PUSHDOWN AUTOMATA 10

Chomsky's Hierarchy of Languages; Context-Free Grammar and Languages: Context-Free Gram- mar (CFG) – Parse trees – Ambiguity in grammars and languages; Normal Forms for Context Free Grammars: Elimination of Useless Symbols, epsilon and unit productions – Chomsky Normal Form (CNF) – Greibach Normal Form (GNF). Pushdown Automata (PDA): Definition of the Pushdown automaton – The languages of a PDA – Equivalence of PDAs and CFGs – Deterministic Pushdown automata; Pumping Lemma for Context Free Languages.

UNIT IV TURING MACHINES 9

The Turing Machine – Programming Techniques for Turing Machines: Storage in the State – Multiple Tracks – Subroutines; Extensions to the Basic Turing Machine.

UNIT V UNDECIDABILITY 9

Undecidability: Language that is not Recursively Enumerable (RE) – Undecidable problem that is RE – Undecidable problems about Turing machines – Post's Correspondence Problem (PCP).

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Construct mathematical proofs related to computation and finite automata for a given language (K3)
2. Identify relationship between finite automata and regular expressions (K3)
3. Distinguish different types of grammars, analyse relationship between language and context free grammar and construct PDA for CFG (K4)
4. Construct Turing machine for a given language (K3)
5. Explain the decidability or undecidability of various problems and make use of it (K3)

TEXTBOOKS

1. Hopcroft J E, Motwani R, Ullman J D, "Introduction to Automata Theory, Languages and Computations", Pearson Education, 3rd Edition, 2008.

REFERENCES

1. Harry R Lewis, Christos H Papadimitriou, "Elements of the Theory of Computation", Prentice Hall of India, 2nd Edition, 2003.
2. Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishers, 3rd Edition, 2002.
3. Mishra K L P, Chandrasekaran N, "Theory of Computer Science – Automata, Languages and Computation", Prentice Hall of India, 3rd Edition, 2004.

CO to PO Mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**
CO1	3	2											3	
CO2	3	2											3	
CO3	3	2											3	
CO4	3	2											3	
CO5	3	2								2			2	
Total	15	10								2			14	
Score	3	2								2			3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
XXXX	PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP	0	0	6	0	3

OBJECTIVES

- To empower students with overall Professional and Technical skills required to solve a real-world problem.
- To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.
- To provide experiential learning to enhance the Entrepreneurship and employability skills of the students.

This course is a four month immersive program to keep up with the industry demand and to have critical thinking, team based project experience and timely delivery of modules in a project that solves world problems using emerging technologies.

To prepare the students with digital skills for the future, the Experiential Project Based Learning is introduced to give them hands-on experience using digital technologies on open-source platforms with an end-to-end journey to solve a problem. By the end of this course, the student understands the approach to solve a problem with team collaboration with mentoring from Industry and faculties. This is an EEC category course offered as an elective, under the type, “Experiential Project Based Learning”.

Highlights of this course:

- Students undergo training on emerging technologies
- Students develop solutions for real-world use cases
- Students work with mentors to learn and use industry best practices
- Students access and use Self-Learning courses on various technologies, approaches and methodologies.
- Collaborate in teams with other students working on the same topic
- Have a dedicated mentor to guide

OUTCOMES:

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

- Upskill in emerging technologies and apply to real industry-level use cases
- Understand agile development process
- Develop career readiness competencies, Team Skills / Leadership qualities
- Develop Time management, Project management skills and Communication Skills
- Use Critical Thinking for Innovative Problem Solving
- Develop entrepreneurship skills to independently work on products

The course will involve 40-50 hours of technical training, and 40-50 hours of project development. The activities involved in the project along with duration are given in Table 1.

TABLE 1: A CTIVITIES

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**

Essentially, it involves 15 weeks of learning and doing, and one week for evaluation. The evaluation will be carried out to assess technical and soft skills as given in Table 2.

TABLE 2: EVALUATION SCHEMA

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP			
Technical Skills		**Soft Skills**	
Criteria	**Weightage**	**Criteria**	**Weightage**
Project Design using Design Thinking	10	Teamwork	5
Innovation & Problem Solving	10	Time Management	10
Requirements Analysis using Critical Thinking	10	Attendance and Punctuality	5
Project Planning using Agile Methodologies	5	Project Documentation	5
Technology Stack (APIs, tools, Platforms)	5	Project Demonstration	5
Coding & Solutioning	15		
User Acceptance Testing	5		
Performance of Product / Application	5		
Technical Training & Assignments	5		
Total	**70**	**Total**	**30**
		Total Weightage	**100**
		Passing Requirement	**50**
Continuous Assessment Only			

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2611	INTERNET PROGRAMMING LAB	0	0	3	0	1.5

OBJECTIVES

- To develop web applications using traditional client and server end technologies.
- To develop web applications using Javascript frameworks.

SUGGESTIVE EXPERIMENTS

1. Build a web page using Table, Lists, Image and anchor elements. (Ex: Bio-Data)
2. Create website for an International Conference using HTML5 and CSS3 elements.
3. Validate a registration form using Javascript event handling mechanisms.
4. Develop a web application to authenticate the user with servlet and MySQL.
5. Develop a web application using Session tracking mechanisms, Servlet and MySQL. (Ex: Online Shopping application)
6. Develop a Popup Menu Application using AJAX.
7. Develop a front end of the Online Exam Web application using ReactJS
8. Develop a back end of the Online Exam Web application using NodeJS

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Build web applications using traditional client/server technologies (K3)
2. Construct web application using Javascript frameworks (K3)
3. Develop and evaluate a web application for a given set of requirements on JavaScript Framework with NodeJS Server, applying suitable design options and techniques (K6)

LABORATORY REQUIREMENT FOR BATCH OF 38 STUDENTS

Hardware:

1. Standalone Desktops - 38 Nos

Software:

1. Frontend - Netbeans/Eclipse with Java
2. Database - MySQL
3. Web Server - Tomcat Server

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3									2	
CO2	3	2	2	3									2	
CO3	3	3	3	3	3	3	3		3	3	3	3	2	
Score	9	7	7	9	3	3	3		3	3	3	3	6	
	3	3	3	3	3	3	3		3	3	3	3	2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2612	MACHINE LEARNING LAB	0	0	3	0	1.5

OBJECTIVES

- To apply and analyze the appropriate machine learning strategy for any given problem
- To have a thorough understanding of the supervised and unsupervised learning techniques
- To interpret the various non-linear learning techniques and feature selection methods

SUGGESTIVE EXPERIMENTS

1. Working with Python packages - Numpy, Scipy, Scikit-learn, Matplotlib
2. Loan amount prediction using linear regression and visualize the interpretation
3. Handwritten character recognition using neural networks
4. Classification of Email spam and MNIST data using Support Vector Machines.
5. Predicting Diabetes using decision tree
6. Applications of Random Forest and AdaBoost ensemble techniques
7. K-means clustering for Euclidean distance metric
8. k-Nearest Neighbor algorithm
9. Applications of dimensionality reduction techniques on any dataset
10. Miniproject: Analyze any two supervised / unsupervised machine learning algorithms for any of the following real-time applications:
(a) Text processing (b) Image processing (c) IoT systems

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply supervised and unsupervised learning techniques for various problems (K3)
2. Apply ensemble techniques to solve the problems and demonstrate the working of dimensionality reduction methods (K3)
3. Develop an open-ended solution with data privacy and ethical concerns, for a given real world problem (K4).

LABORATORY REQUIREMENTS

Hardware:

1. Standalone Desktops - 38 Nos

Software:

1. Python

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3									2	
CO2	3	2	2	3									2	
CO3	3	3	3	3	3	3	3	3	3	3	3		3	2
Score	9	7	7	9	3	3	3	3	3	3	3		7	2
Course Mapping	3	3	3	3	3	3	3	3	3	3	3		3	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2701	DISTRIBUTED SYSTEMS	3	0	0	0	3

OBJECTIVES

- To introduce the computation and communication models of distributed systems
- To illustrate the issues of synchronization and collection of information in distributed systems
- To educate distributed mutual exclusion and distributed deadlock detection techniques
- To elucidate agreement protocols and Fault Tolerance mechanisms in Distributed Systems
- To explain the features of Peer-to-Peer systems and memory consistency models.

UNIT I INTRODUCTION 8

Introduction: Definition-Relation to computer system components – Motivation – Relation to parallel multiprocessor/multicomputer systems – Message-passing systems versus shared memory systems – Primitives for distributed communication – Synchronous versus asynchronous executions – Design issues and challenges; A model of distributed computations: A distributed program – A model of distributed executions – Models of communication net- works – Global state of a distributed system – Cuts of a distributed computation – Past and future cones of an event – Models of process communications.

UNIT II LOGICAL TIME AND GLOBAL STATE 10

Logical Time: Physical clock synchronization: NTP – A framework for a system of logical clocks – Scalar time – Vector time; Message ordering and group communication: Message ordering paradigms – Asynchronous execution with synchronous communication – Synchronous pro- gram order on an asynchronous system – Group communication – Causal order (CO) Total order; Global state and snapshot recording algorithms: Introduction – System model and definitions – Snapshot algorithms for FIFO channels.

UNIT III DISTRIBUTED MUTEX AND DEADLOCK 10

Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart–Agrawala algorithm – Quorum-based mutual exclusion algorithms – Maekawa's algorithm – Token-based algorithms – Suzuki–Kasami's broadcast algorithm; Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp's classification of distributed deadlock detection algorithms – Mitchell and Merritt's algorithm for the single resource model – Chandy-Misra-Haas algorithm for the AND model – Chandy-Misra-Haas algorithm for the OR model.

UNIT IV CONSENSUS AND RECOVERY 10

Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure-free system (synchronous or asynchronous) – Agreement in (message-passing) synchronous systems with failures; Checkpointing and rollback recovery: Introduction – Back- ground and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Koo-Toueg coordinated checkpointing algorithm – Juang-Venkatesan algorithm for asynchronous checkpointing and recovery.

UNIT V **PEER TO PEER AND DISTRIBUTED SHARED MEMORY** **7**

Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Tapestry; Distributed shared memory: Abstraction and advantages – Memory consistency models – Lamport's Bakery Algorithm.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the foundations of distributed systems (K2)
2. Solve synchronization and state consistency problems (K3)
3. Use resource sharing techniques in distributed systems (K3)
4. Apply working model of consensus and reliability of Distributed Systems (K3)
5. Explain the fundamentals of peer-to-peer systems (K2)
6. Formulate a synchronization problem for an ad-hoc distributed system and adapt its solution (K6)

TEXTBOOKS

1. Kshemkalyani Ajay D, Mukesh Singhal. "Distributed computing: Principles, Algorithms and Systems". Cambridge University Press, 2011.
2. Mukesh Singhal, Niranjan G Shivaratri. "Advanced Concepts in Operating Systems". McGraw-Hill, 1994.

REFERENCES

1. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3. Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
4. Liu M L, "Distributed Computing, Principles and Applications", Pearson Education, 2004.
5. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO6	3	3	3	-	-	-	-	-	-	-	-	2	3	-
Score	18	13	3	-	-	-	-	-	-	-	-	2	17	-
	3	3	3	0	0	0	0	0	0	0	0	2	3	0

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2703	SOFTWARE ARCHITECTURE	3	0	0	0	3

OBJECTIVES

- Explain the various architectural views and quality attributes (K2)
- Apply suitable architectural styles based on the software quality requirements (K3)
- Analyze the ADLs and evaluate the alternate architectural solutions (K4)
- Construct new architectures based on the quality attribute requirements (K3)
- Analyze the architectural decisions for building data intensive and IoT systems (K4)

UNIT I ARCHITECTURAL VIEWS AND QUALITY ATTRIBUTES 9

Basic Concepts of Software Architecture – Architecture Business Cycle – Architectural Pat- terns – Reference Models – Architectural Structures, Views; Module Views, Component-Connector Views, Allocation Views – Understanding Quality Attributes – Functionality and Architecture – Architecture and Quality Attributes – System Quality Attributes – Quality Attribute Scenarios in Practice

UNIT II ARCHITECTURAL STYLES 9

Introduction to Architectural Styles – Simple Styles – Distributed and Networked Architectures – Architecture for Network based Applications – Decentralized Architectures.

UNIT III ARCHITECTURE DESCRIPTION, DOCUMENTATION AND EVALUATION 9

Early Architecture Description Languages – Domain and Style Specific ADLs – Extensible ADLs – Documenting Software Architectures – Architecture Evaluation – ATAM;

UNIT IV ACHIEVING ARCHITECTURAL QUALITIES 9

Introducing Tactics – Availability Tactics – Modifiability Tactics – Performance Tactics – Security Tactics – Testability Tactics – Usability Tactics – Relationship of Tactics to Architectural Patterns – Architectural Patterns and Styles.

UNIT V CASE STUDIES 9

Distributed Architectures for Data-intensive Systems that use Microservices – Architecture of Software Systems involving Internet-of-Things(IoT).

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the various architectural views and quality attributes (K2)
2. Apply suitable architectural styles based on the software quality requirements (K3)
3. Analyze the alternate architectural solutions based on the definition of ADL's (K4)
4. Construct new architectures based on the quality attribute requirements (K3)
5. Analyze the architectural decisions for building data intensive and IoT systems in teams and apply best practices with clear documentation (K4).

TEXTBOOKS

1. Len Bass, Paul Clements, Rick Kazman, “Software Architecture in Practice”, Third Edition, Addison Wesley, 2012.
2. Richard N Taylor, Nenad Medvidovic, Eric M Dashofy, “Software Architecture: Foundations, Theory and Practice”, Wiley 2010.

REFERENCES

1. Mary Shaw, David Garlan, “Software Architecture: Perspectives on an Emerging Discipline”, Pearson Education, 2008.
2. Kai Qian, “Software Architecture and Design Illuminated”, Jones and Bartlett Publishers, Canada, 2010
3. Martin Kleppman, “Designing Data-Intensive Applications”, O’Reilly Media, 2017
4. Bauer Martin, Boussard Mathieu, Bui Nicola, Loof Jourik, Magerkurth Carsten, Meissner Stefan, Nettstrater Andreas, Stefa Julinda, Thoma Matthias, Joachim Walewski, “IoT Reference Architecture”, 2013, ISBN-978-3-642-40402-3.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												2
CO2	3	2												2
CO3	3	3												2
CO4	3	3												
CO5	3	3												2
Score	15	13												8
Course	3	3												2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2702	COMPILER DESIGN	3	0	2	0	4

OBJECTIVES

- To learn various phases of a compiler
- To learn various parsing techniques
- To understand intermediate code generation
- To learn to implement code generator
- To learn to implement code Optimization.

UNIT I INTRODUCTION TO COMPILERS 9

Language processors – Phases of compiler – Role of lexical analyzer – Input buffering – Specification of tokens – Recognition of tokens – Conversion of Regular expression to DFA; Lexical analyzer generator: Structure of lex program – Lookahead operator and conflict resolution.

UNIT II SYNTAX ANALYSIS 9

Role of Parser – Writing grammars for language constructs – Types of grammars: Ambiguity – Deterministic and recursive; Top down parsers: Recursive descent parser – Predictive parser; Bottom up parsers: SLR Parser – CLR Parser – LALR Parser; Error handling and recovery in syntax analyzer; Syntax analyzer generator: Structure of yacc program – Creating yacc lexical analyzers with lex.

UNIT III INTERMEDIATE CODE GENERATION 9

Syntax directed definitions: Synthesized attribute – Inherited attribute – Dependency graph – Evaluation order of syntax directed definitions; Intermediate languages: Syntax tree – Three address code; SDD for type checking – Declarations – Evaluation of expressions and flow of control statements – Bottom-up evaluation of S-attribute definitions.

UNIT IV RUNTIME ENVIRONMENTS AND CODE GENERATION 9

Source language issues – Storage organization – Storage allocation strategies: Static, Stack and Heap – Implementation of symbol table – Issues in code generation – Design of a simple code generator.

UNIT V CODE OPTIMIZATION 9

Principal sources of optimization – DAG – Optimization of basic blocks – Global data flow analysis – Introduction to Low Level Virtual Machine (LLVM) – Design of LLVM – Core libraries – Developing plugin in LLVM.

TOTAL PERIODS(THEORY): 45

SUGGESTIVE EXPERIMENTS

1. Implementation of Lexical Analyzer using Lex Tool
2. Implementation of Arithmetic Calculator using LEX and YACC
3. Generation of TAC for a simple program using LEX and YACC
4. Use modern tools and technologies to design a new optimized compiler that takes a novel language and generate the machine language as a team.
5. Study of LLVM framework.

TOTAL PERIODS(LAB): 30

TOTAL PERIODS: 75

COURSE OUTCOMES

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

1. Construct a lexical analyzer for a sample language (K3)
2. Apply different parsing algorithms to develop the parsers for the given grammar (K3)
3. Build syntax directed translation for programming language constructs (K3)
4. Outline and develop a simple code generator (K3)
5. Make use of code optimization techniques (K3)
6. Construct a compiler for a simple language using modern tools (K6).

TEXTBOOKS

1. Alfred V Aho, Monica S Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2009.
2. Rafael Auler, Bruno Cardoso Lopes, "Getting Started with LLVM Core Libraries", Packt Publishing, 2014.

REFERENCE BOOKS

1. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence Based Approach", Morgan Kaufmann Publishers, 2001.
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 1997.
3. Keith D Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann Publishers Elsevier Science, 2011.
4. Andrew W. Appel, "Modern Compiler Implementation in C", Cambridge University Press, 1st edition, 2004.
5. Watson, Des, "A Practical Approach to Compiler Construction", 1st edition, Springer- Verlog, 2017.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2		3									2	3
CO2	3	2		3									2	3
CO3	3	2		3									2	3
CO4	3	2		3									2	3
CO5	3	2		3									2	3
CO6		3	3	3	3					2			3	3
sum	15	13	3	18	3					2			13	18
Score	3	3	3	3	3					2			3	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2718	PROJECT WORK PHASE I	0	0	6	0	3

OBJECTIVES

- To develop skills to formulate a complex engineering problem with an awareness of issues pertaining to society, health, safety, legal, environment, culture and examine the impact of the proposed solution on these issues.
- To carry out the survey on related literature and find out the research gap
- To explore use of new tools, algorithms and techniques required to carry out the projects.
- To enable the students to gain experience in organization and implementation of a project and acquire the necessary confidence to carry out the extensions of the project in the phase 2.
- To follow the guidelines and prepare technical report of the project.
- To develop team management skills and presentation skills

COURSE OUTCOMES

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

1. Formulate complex engineering problems and choose suitable technologies and tools required to solve them effectively (K4)
2. Analyse the related literature on the proposed problem and its feasibility (K4)
3. Design high level solutions by applying software engineering principles (K6)
4. Divide the work appropriately among the team members to manage time and complexity
5. Document and present the solution
6. Analyse the issues pertaining to society, health, safety, legal, environment, culture applicable to the project and examine the impact of the proposed solution on these issues.
7. Apply best practices and follow ethics in developing the solutions

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3					3	2		3	2
CO2	3	3	2	3	2					2	3	3	3	3
CO3	3	3	3	3	3						3		3	3
CO4									3					
CO5									3	3			3	3
CO6						3	3							
CO7								3						2
Sum	9	9	8	9	8	3	3	3	6	8	8	3	12	13
	3	3	3	3	3	3	3	3	3	3	3	3	3	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2716	INDUSTRIAL TRAINING / INTERNSHIP	0	0	0	6	2

OBJECTIVES

- To provide comprehensive learning opportunity to students where they can enhance their employability skills and become job-ready with corporate exposure
- To increase the teamwork skills and self-confidence of students
- To inculcate responsibility in students to execute the assigned tasks
- To expose students to hands-on work in real environment
- To gain knowledge in writing technical report, build good communication skill and to learn to practice ethics

COURSE OUTCOMES

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

1. Apply principles of engineering in solving complex engineering problems (K3)
2. Model problems and find engineering solution (K3)
3. Adapt to emerging technologies in solving engineering problems (K6)
4. Demonstrate the ability to communicate effectively
5. Develop self-confidence, team work skills, and life-long learning
6. Develop knowledge of social, ethical, cultural, global and environmental issues.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												3	
CO2		3	3	3										3
CO3				3	3									3
CO4									3	3				
CO5											3	3		3
CO6						3	3	3						
Course	3	3	3	3	3	3	3	3	3	3	3	3	3	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2818	PROJECT WORK PHASE II	0	0	16	0	8

OBJECTIVES

- To make use of the knowledge gained by the student at various stages of the degree course.
- To develop the ability to solve a specific problem right from its identification and liter- ature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination

COURSE OUTCOMES

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

1. Use suitable technologies and tools to solve complex engineering problems effectively (K4)
2. Analyse the related literature on the proposed problem and its feasibility (K4)
3. Construct suitable solutions by applying software engineering principles (K6)
4. Divide the work appropriately among the team members to manage time and complex- ity
5. Evaluate the performance of the solution using appropriate metrics (K5)
6. Analyse the impact of the proposed solution on the issues pertaining to society, health, safety, legal, environment, culture and apply ethical principles.
7. Apply ethical principles in developing the solutions and present the solution with good documentation

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3					3	2		3	2
CO2	3	3	2	3	2					2	3	3	3	3
CO3	3	3	3	3	3						3		3	3
CO4									3					
CO5			3	3									3	3
CO6						3	3							
CO7								3	3	3			-	2
Score	9	9	11	12	8	3	3	3	6	8	8	3	12	13
	3	3	3	3	3	3	3	3	3	3	3	3	3	3

HUMANITIES ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	E	C
UEN2242	FUNDAMENTALS OF LINGUISTICS	2	0	2	0	3

OBJECTIVES

- To introduce the students to Linguistics (the scientific study of language)
- To explore some basic issues and questions related to language such as what do we know when we know a language
- To discover the relation between language and brain, language and society
- To understand how a child learns a language, how the languages of the world are similar as well as different, how we can analyze language as a structure, etc.
- To provide students to a brief outline of language studies in Indian and western tradition and many applications of linguistics in different fields.

UNIT I DEFINING LANGUAGE 9

What is language and where is language?
– Language is a means of communication, a social product
– Language is a cognitive ability, relation between language and brain
• Study of Language in Indian and western traditions

UNIT II AN INSIGHT INTO LINGUISTICS 9

What is Linguistics and what is not Linguistics?
– Linguistics is not prescriptive grammar learnt in the school
– Linguistics is not learning of many languages
– Linguistics provides tools to analyze language structure scientifically

UNIT III FORM AND FUNCTION 9

• Levels of Language Analysis: Form and content
– Sound
– Word
Sentence
– Meaning
• Similarities and differences of languages

UNIT IV APPLICATIONS 9

Applications of Linguistics
– Natural Language Processing
– Clinical Linguistics
– Psycholinguistics etc.

UNIT V IMPACT ON CAREER 9

Impact of linguistics on one’s career
– An understanding of Linguistics for better use of language
– Language and personality development

– Linguistic features specific to Engineers.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Understand what is linguistics
2. Explore some basic issues and questions related to language
3. Understand the subtle difference between the use of English in Indian and western tra- dition.
4. Familiarize themselves with the unique features of language in technology
5. Understand the basics of how children acquire languages

TEXTBOOKS

1. Raj Kumar Sharma, “Fundamentals of Linguistics”, Atlantic Publishers, Chennai, 2019.

REFERENCES

1. Thomas Herbst, “English Linguistics: A Coursebook for Students of English”, De Gruyter Mouton Publication, Germany, 2010.
2. Victoria A Fromkin (ed), “Linguistics: An Introduction to Linguistic Theory”, Blackwell Publishers, USA, 2001.

3. Jeff Connor, Linto, Ralph W Fasold, “An Introduction to Language and Linguistics”, Cambridge University Press, 2014.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3		2		
CO2									2	3		2		
CO3									2	3		2		
CO4									2	3		2		
CO5									2	3		2		
Course									2	3		2		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UHS2243	FILM APPRECIATION	2	0	2	0	3

OBJECTIVES

- To introduce students to the development of film as an art and entertainment form
- To discuss the language of cinema as it evolved over a century
- To enable the students to read the script of a film and appreciate the various nuances
- To enable students, understand the evolution of film industry from the past to present
- To guide the students to study films joyfully and appreciate all aspects of the film.

UNIT I THE COMPONENT OF FILMS 9

• The material and equipment
• The story, screenplay and script
• The actors, crew members, and the director
• The process of filmmaking

UNIT II EVOLUTION OF FILM LANGUAGE 9

• Film language, form, movement etc.
• Early cinema - silent film (Particularly French)
• The emergence of feature films: Birth of a Nation Talkies
• Films and their influence on the language of people

UNIT III FILM APPRECIATION 9

• Realist theory; Auteurists
• Psychoanalytic, Ideological, Feminists
• How to read films?
• Film Criticism / Appreciation

UNIT IV DEVELOPMENT OF FILMS 9

• Representative Soviet films
• Representative Japanese films
• Representative Italian films
• Representative Hollywood film and the studio stem

UNIT V INDIAN FILMS 9

• The early era
• The important films made by the directors E-3: The regional films
• The documentaries in India
• The Indian Film Industry and the Hollywood
• The impact of Films on students in India.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. The process of the development of film as an art and entertainment form.

2. The evolution of the language of cinema as it evolved over a century.
3. The script writing techniques of a film and appreciate the various nuances.
4. The evolution of film industry from the past to present
5. How to appreciate all aspects of the film.

TEXTBOOKS

1. Jim Piper, “The Film Appreciation Book: The Film Course You Always Wanted to Take”, Allworth Press, New York, 2014.

REFERENCES

1. Stanley Cavell, “The World Viewed: Reflections on the Ontology of Film”, Enlarged Edition, Harvard University Press, 1979.
2. Joseph M Boggs, Dennis W Petrie, “The Art of Watching Films”, McGraw Hill, 2006.
3. Bernard F Dick, “Anatomy of Film”, St Martins Press, 1990.
4. Jan Bone, Ron Johnson, “Understanding the Film: An Introduction to Film Appreciation”

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3		2		
CO2									2	3		2		
CO3									2	3		2		
CO4									2	3		2		
CO5									2	3		2		
Course									2	3		2		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UHS2241	HUMAN RELATIONS AT WORK	2	0	2	0	3

OBJECTIVES

- To be aware of human relations at work and its relationship with self
- To be aware of the processes involved in interaction with people at work
- To understand the importance of psychological and physical health in maintaining hu- man relations at work and progressing in career
- To understand the ways and means to improve human relations at work
- To realize the importance of safeguarding themselves from any exploitation.

UNIT I HUMAN RELATIONS 9

Understanding and Managing Yourself - Human Relations and You - Self-Esteem and Self Confidence - Self-Motivation and Goal Setting - Emotional Intelligence - Attitudes and Happiness - Values and Ethics and Problem Solving and Creativity.

UNIT II INTERPERSONAL RELATIONSHIP 9

Dealing Effectively with People - Communication in the Workplace - Specialized Tactics for Getting Along with Others in the Workplace - Managing Conflict; Becoming an Effective Leader - Motivating Others and Developing Teamwork - Diversity and Cross-Cultural Competence

UNIT III HEALTHY LIVING 9

Staying Physically Healthy - Yoga, Pranayama - Exercise: Aerobic and anaerobic.

UNIT IV MENTAL WELL BEING 9

Staying Psychologically Healthy - Managing Stress and Personal Problems - Meditation.

UNIT V CAREER READINESS 9

Developing Career Thrust - Getting Ahead in Your Career - Learning Strategies – Perception - Life Span Changes - Developing Good Work Habits.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Enhance their awareness about human relations at work and its relationship with self.
2. Become aware of the processes involved in interaction with people at work.
3. Understand the importance of psychological and physical health in maintaining human relations at work.
4. Understand the ways and means to improve human relations at work.
5. Realize the importance of safeguarding themselves from any exploitation.

TEXTBOOKS

1. Dubrien A J, “Human Relations for Career and Personal Success: Concepts, Applications, and

Skills", 11th Ed, Upper Saddle River, NJ: Pearson, 2017.

REFERENCES

1. Greenberg J S, "Comprehensive Stress Management", 14th edition, New York: McGraw Hill, 2017.
2. Udai Y, "Yogasanaurpranayam", New Delhi:N S Publications, 2015.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3		2		
CO2									2	3		2		
CO3									2	3		2		
CO4									2	3		2		
CO5									2	3		2		
Course									2	3		2		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UHS2242	APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE	2	0	2	0	3

OBJECTIVES

- To be aware of the different applications of psychology to everyday issues of life
- To be aware of the different social issues, workplace issues, and behavioral issues
- To understand how the knowledge gained from this course can be used in their own personal and professional work life
- To understand the psychological principles relevant to human development
- To understand the impact of Psychology on human life.

UNIT I PSYCHOLOGY OF AN INDIVIDUAL 9

• Introduction: Nature and fields.
• The individual human being and his or her experiences, mental processes and behav- iors.

UNIT II DIFFERENT TYPES OF PSYCHOLOGY 9

• Psychology in industries and organizations: Job analysis; fatigue and accidents; consumer behavior.
• Different types of psychology: cognitive, forensic, social, and developmental psychology

UNIT III PSYCHOLOGY AND MENTAL HEALTH 9

• Psychology and mental health: Abnormality, symptoms and causes psychological disorders.
• Psychology for better decision making, stress management and behavior.

UNIT IV COUNSELING 9

• Psychology and Counseling: Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V SOCIAL BEHAVIOR 9

• Psychology and social behaviour: Group, group dynamics, team building, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Raise their awareness on applications of psychology to everyday issues of life
2. Deal more efficiently with different issues in society, workplace and human behavior
3. Apply principles of psychology in their own personal and professional lives
4. Use the psychological principles for their own human development
5. Appreciate the impact of Psychology on human life.

TEXTBOOKS

1. Schultz D, Schultz S E, “Psychology and Work Today”, 10th ed, New Jersey: Pearson/Prentice Hall, 2009.

REFERENCES

1. Butcher J N, Mineka S, Hooley J M, “Abnormal Psychology”, 14th ed, New York: Pearson, 2010.
2. Gladding S T, “Counselling: A Comprehensive Profession”, New Delhi: Pearson Educa- tion, 2014.
3. Aronson E, Wilson T D, Akert R M, “Social Psychology”, 7th Ed, Upper Saddle River, NJ: Prentice Hall, 2010.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3		2		
CO2									2	3		2		
CO3									2	3		2		
CO4									2	3		2		
CO5									2	3		2		
Course									2	3		2		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UEN2243	UNDERSTANDING SOCIETY AND CULTURE THROUGH	2	0	2	0	3

OBJECTIVES

- To acquire skills not only the ones necessary for one's "trade", but also the ones to acquire knowledge and become a better human being, as a means towards the end of creating a better society
- To facilitate understanding a society, its people, their mind, prevalent traditions and culture with a view to developing a holistic worldview, which is essential for a sustain- able society
- To felicitate self-reflection and deeper understanding of oneself
- To introduce students to literary works of various countries/ regions / societies and attempt to understand the respective traditions to which the works belong
- To understand the relationship between life and literature.

UNIT I LITERATURE AND LIFE 9

Traditional Knowledge - What is Literature? - Significance of studying literature - Studying society and culture through literature - Understanding morality through literature - Reading of Literary texts – The literary piece will be given to students beforehand so that they read it and become familiar with the texts before coming to the class. In the class, the text will be read once again, where doubts if any will be cleared - First Discussion – The reading will be followed by a discussion where the text will be analyzed in detail. The students will be encouraged to share their interpretation of the text.

UNIT II RESOLVING DILEMMA 9

Definition and Description of 'Dilemma' - Choice of literary texts to confront situations where one is faced with a dilemma (differentiating what is right and wrong? and develop a deeper insight into the various realities of life - Presentation of analysis of the literary text (The students will keep in mind the author's background and the socio-historical and cultural backgrounds while preparing this presentation) - Q&A Session on the Presentation (the students will be encouraged to ask questions to their respective classmates regarding the presentation/ analysis initiating a second discussion on the text.

UNIT III GENDER STUDIES 9

Literary pieces that question the current notions of gender, and raises uncomfortable questions - Literature that challenges the status quo, forcing us to think about the real meaning of equality and emancipation - Second Discussion – (Having made their presentation, and heard the presentations made by their classmates, the students would now have a fairly good idea of the various nuances of the text, making it a ripe moment to have the second detailed discussion on the text. Here the teacher may refer to those points which may have been missed by the students.)

UNIT IV READING LITERATURE 9

Reading of select Literary works - The author's Background, Historical and Social Background for a better understanding of the literary work - Study of other significant study material as required for an overall understanding of the literary work.

UNIT V REPORT SUBMISSION 9

Submission of a report – Having faced questions from their classmates, and after having a second discussion on the text, the student would come across new ideas which will be incorporated into the analysis and submitted in the form of a report.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Improvement in the awareness of various traditions
2. Not only understand not just the diversity found between various traditions but also celebrate them
3. Strengthen their analytical capability
4. Improve their language skills and also the ability to express complex ideas
5. Understand the relationship between life and literature.

TEXTBOOKS

1. Literary works will be provided by the teacher.
2. Author's background, historical and social background which are significant for a better understanding of the work will be provided by the teacher.

REFERENCES

1. Reference materials or other significant study materials as required for an overall under- standing of the literary work will be sourced out by the students in consultation with the teacher

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3		2		
CO2									2	3		2		
CO3									2	3		2		
CO4									2	3		2		
CO5									2	3		2		
Course									2	3		2		

MANAGEMENT ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	E	C
UBA2541	PRINCIPLES OF MANAGEMENT	3	0	0	0	3

OBJECTIVES

- To sketch the Evolution of Management.
- To extract the functions and principles of management.
- To learn the application of the principles in an organization.
- To study the various HR related activities.
- To analyze the position of self and company goals towards business

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization- Sole proprietorship, partner- ship, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Set- ting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non-Budgetary control techniques – Use of computers and IT in management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Have some basic knowledge on international aspect of management
2. Ability to understand management concept of organizing

3. Ability to understand management concept of directing
4. Ability to understand management concept of controlling.

TEXTBOOKS

1. Harold Koontz, Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 1998.
2. Stephen P Robbins, Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.

REFERENCES

1. Robert Kreitner, Mamata Mohapatra, “Management”, Biztantra, 2008.
2. Stephen A Robbins, David A Decenzo, Mary Coulter, “Fundamentals of Management”, Pearson Education, 7th Edition, 2011.
3. Tripathy P C, Reddy P N, “Principles of Management”, Tata McGraw Hill, 1999.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						3		3	2		3	1		
CO2						3		3	2		2	1		
CO3					3	3		3		2	2	1		
CO4						3	2	3			1	1		
Course					3	3	2	3	2	2	2	1		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UBA2542	TOTAL QUALITY MANAGEMENT	3	0	0	0	3

OBJECTIVES

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM
- Explain the TQM Principles for application
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality – Definition of TQM – Basic concepts of TQM – Gurus of TQM (Brief introduction)– TQM Framework- Barriers to TQM – Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning Customer Satisfaction – Customer Perception of Quality, Feedback, Customer complaints, Ser- vice Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal–Continuous process improvement – Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent, Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures – Cost of Quality – BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction - Benefits of ISO Registration - ISO 9000 Series of Standards - Sector - Specific Standards - AS 9100, TS16949 and TL 9000 – ISO 9001 Requirements - Implementation - Doc- umentation - Internal Audits - Registration - ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction – ISO 14000 Series Standards – Concepts of ISO 14001 – Requirements of ISO 14001- Benefits of EMS.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply TQM concepts in a selected enterprise.
2. Apply TQM principles in a selected enterprise.
3. Understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
4. Understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
5. Apply QMS and EMS in any organization.

TEXTBOOKS

1. Dale H Besterfiled, Carol B Michna, Glen H Bester Field, Mary B Sacre, Hemant Urdhwareshe, Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES

1. Joel E Ross, "Total Quality Management – Text and Cases", Routledge.,2017.
2. Kiran D R, "Total Quality Management: Key Concepts and Case Studies", Butterworth Heinemann Ltd, 2016.
3. Oakland J S, "TQM – Text with Cases", Butterworth–Heinemann Ltd, Oxford, Third Edition, 2003.
4. Suganthi L, Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt Ltd, 2006

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						3		3	2		3	1		
CO2						3		3	2		2	1		
CO3					3	3		3		2	2	1		
CO4						3	2	3			1	1		
Course					3	3	2	3	2	2	2	1		

COURSE CODE	COURSE TITLE	L	T	P	E	C
UBA2543	WORK ETHICS, CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE	3	0	0	0	3

OBJECTIVES

- To impart the value of professional practices with code of conduct and ethical values
- To discuss the various outlooks of roles and responsibilities with work ethics.
- To introduce the Indian constitutional statutes for ethical practices by citizens
- To analyze the ethical commitments to be hold by industry with protecting environment
- To insist on corporate and social responsibilities through Governance practices and regulation

UNIT I INTRODUCTION 9

Ethics - Definition & nature, Characteristics, Attributes of Ethics - Business Ethics; Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good.

UNIT II ETHICS THEORY AND BEYOND 9

Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice - ethics for managers; Role and function of ethical managers - Comparative ethical behaviour of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of ethics in Corporate ethics evaluation.

UNIT III LEGAL ASPECTS OF ETHICS 9

Political - legal environment; Provisions of the Indian constitution pertaining to Business; Political setup - major characteristics and their implications for business; Prominent features of MRTP &FERA. Social - cultural environment and their impact on business operations, Salient features of Indian culture and values.

UNIT IV ENVIRONMENTAL ETHICS 9

Economic Environment; Philosophy of economic grow and its implications for business, Main features of Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian Industries.

UNIT V CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE 9

Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market and government; Governance ratings; Future of governance- innovative practices; Case studies with lessons learnt.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

1. Understand ethical issues in workplace and have good practices in professional duties
2. Learn roles and responsibilities in professional career as a team worker

3. Understand the legal aspects in Indian constitutional for protection of societal values
4. Analyze the economic development by industry with importance to environment protection
5. Understand need of good Governance in a corporate with ethical organizational behavior.

TEXTBOOKS

1. S A Sherlekar, “Ethics in Management”, Himalaya Publishing House, 2009.
2. William B Werther, David B Chandler, “Strategic Corporate Social Responsibility”, Sage Publications Inc, 2011.
3. V V Robert, A G Monks, Nell Minow, “Corporate Governance”, John Wiley and Sons, 2011.

REFERENCES

1. V W H Shaw, “Business Ethics”, Cengage Learning, 2007.
2. Beeslory, Michel, Evens, “Corporate Social Responsibility”, Taylor and Francis, 1978.
3. Philip Kotler, Nancy Lee, “Corporate Social Responsibility: Doing the Most Good for Company and Your Cause”, Wiley, 2005.
4. Subhabrata Bobby Banerjee, “Corporate Social Responsibility: the Good, the Bad and the Ugly”, Edward Elgar Publishing, 2007.
5. Satheesh kumar, “Corporate Governance”, Oxford University, Press, 2010.
6. Bob Tricker, “Corporate Governance – Principles, Policies and Practices”, Oxford University Press, 2009
7. Larue Tone Hosmer, Richard D, “The Ethics of Management”, Irwin Inc, 1995.
8. Joseph A Petrick, John F Quinn, “Management Ethics – Integrity at Work”, Sage, 1997.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1								3	1	1		2		
CO2								3	1	1		2		
CO3						3	2	3	1	1		2		
CO4								3	1	1	3	2		
CO5								3	1	1	2	2		
Course						3	2	3	1	1	2	2		

PROFESSIONAL ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	E	C
UMA2542	MATHEMATICS FOR MACHINE LEARNING	2	1	0	0	3

OBJECTIVES

- To study the basics of vector spaces and subspaces.
- To study the linear transformation of vector spaces and to find the matrix of the linear transformation and diagonalize.
- To study the inner product, norms and Gram-Schmidt orthonormal process.
- To study various matrix decomposition techniques.
- To identify the standard distributions and apply them in solving problems.

UNIT I VECTOR SPACES 9

Vector spaces – Subspaces – Linear combinations and system of Linear equations – Linear independence and Linear dependence – Bases and Dimensions.

UNIT II LINEAR TRANSFORMATIONS 9

Linear transformations – One-to-one and onto linear transformations – Null space, Range space, Dimension theorem (statement only) - Matrix representation of linear transformation – Eigenvalues, Eigenvectors and Diagonalization.

UNIT III INNER PRODUCT SPACES 9

Inner product and norms – Gram Schmidt orthogonalization process – Orthogonal Complement – Least square approximation.

UNIT IV MATRIX DECOMPOSITION 9

Cholesky decomposition method - QR decomposition – Generalized inverse of a matrix, Sin- gular value decomposition.

UNIT V PROBABILITY AND RANDOM VARIABLES 9

Probability – Sum and Product rules, Bayes Theorem, Random Variables – Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Exponential and Normal distribution.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Solve the problems using the concepts of vector spaces and subspaces
2. Find the matrix of linear transformation and verify dimension theorem and to obtain the eigenvalues and eigenvectors to diagonalize a given matrix.
3. Apply Gram-Schmidt's orthogonalization process to find orthonormal vectors and to solve the given system of equations by least square approximations
4. Decompose the matrix using different methods.
5. Identify standard distributions and apply them.

TEXTBOOKS

1. Friedberg A H, Insel A J, Spence L, “Linear Algebra”, Prentice Hall of India, 4th Edition, New Delhi, 2004.
2. Milton J S, Arnold J C, “Introduction to Probability and Statistics”, Tata McGraw Hill, New Delhi, 4th Edition, 2014.

REFERENCES

1. Kumaresan S, “Linear Algebra – A Geometric Approach”, Prentice Hall of India, New Delhi, Reprint, 2010.
2. Strang G, “Linear Algebra and its Applications”, 4th Edition, Brooks/Cole (Thomson Publications), New Delhi, 2006.
3. Bernard Kolman, David R Hill, “Introductory Linear Algebra”, Pearson Education, New Delhi, 8th Edition, 2005.
4. Richard Branson, “Matrix Operations”, Schaum’s outline series, McGraw Hill, 1989.
5. M Tamban Nair, Arindama Singh, “Linear Algebra”, Springer, 2018.
6. Johnson R A, Gupta C B, “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 9th Edition, 2016.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2											2	
Course	3	2											2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2521	BIG DATA TECHNOLOGIES	3	0	0	0	3

OBJECTIVES

- To understand the competitive advantages of big data analytics
- To understand distributed data processing using Hadoop MapReduce
- To learn Apache spark for stream processing
- To learn Apache Kafka for building distributed data applications.
- To understand spark streaming and H2O Flow.

UNIT I INTRODUCTION TO BIG DATA TECHNOLOGOY 5

Introduction – Understanding Big Data – Big Data: Benefiting – Managing – Organizing and Analyzing Big Data: Learning and Analytics; Technology Challenges for Big Data.

UNIT II BIG DATA PROCESSING 10

Introduction – Distributed File System – HDFS Design Goals – MapReduce Overview – Writing and Testing MapReduce Programs – Installing Spark and Setting up Spark Cluster – Spark Shell – Creating Spark Session Object – Resilient Distributed Datasets (RDD) – Manipulating RDD – NoSQL – SparkSQL – GraphX.

UNIT III STREAM PROCESSING 10

Stream Processing Concepts – Distributed Stream Processing – Stream Processing Model – Streaming Architecture – Lamda and Kappa Architecture – Structured streaming – Spark Streaming – Spark Streaming Programming Model – Other Distributed Real Time Stream Processing Systems.

UNIT IV STREAMING PROCESSING USING KAFKA 10

Apache Kafka – Installing Kafka – Producers and Consumers – Kafka Internals – Building Data Pipelines – Cross Cluster Data Mirroring – Administering and Monitoring Kafka – Getting started with Kafka Streams – Kafka Streams Development – Applications with Kafka Streams.

UNIT V BIG DATA FRAMEWORKS 10

Apache Flume – Overview and Architecture – Quick Start Guide to Flume – Basics of Sqoop – Integrating Sqoop with Hadoop – Getting to Grips with Zookeeper – Getting Started with Zookeeper API – Machine Learning using Apache Mahout – Clustering & Classification Algorithms in Mahout – Extending Spark with H2O – H2O.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Illustrate big data analytics and related technologies (K2)
2. Build distributed data processing applications using Apache Hadoop and Spark (K3)
3. Develop a streaming application using Apache Spark in teams (K3)
4. Experiment with Apache Kafka for processing stream data (K3)
5. Develop an application using Big Data Frameworks in teams applying best practices, demonstrate and write report on the work (K3).

TEXTBOOKS

1. Mike Frampton, “Mastering Apache Spark”, Packt Publishers, 2015.(Init 2)
2. Krishna Sankar, “Fast Data Processing using Spark 2”, 3rd Edition, Packt Publishers, 2016. (Unit 2)
3. Neha Narkhede, Gwen Shapira, and Todd Palino, “Kafka – Definitive Guide”, 2017. (Unit 4)

REFERENCES

1. Gerald Maas, Francois Gorillot, “Stream Processing with Apache Spark”, O’Reilly Media, 2019. (Unit 3)
2. Gaurav Vaish, “Getting Started with NoSQL”, Packt Publishing Ltd, 2013. (Unit 2)
3. William P Bejeck Jr, “Kafka Streams in Action”, Manning Publications, 2018. (Unit 4)
4. Jayani Withanawasam, “Apache Mahout Essentials”, Packt Publishers, 2015. (Unit 5)
5. Steve Hoffman, “Apache Flume: Distributed Log Collection for Hadoop”, 2nd Edition, Packt Publishers, 2015. (Unit 5)
6. Flavio Junqueira, Benjamin Reed, “ZooKeeper: Distributed Process Co-ordination Pa- perback”, O’Reilly Media, 2014 (Unit 5)
7. Kathleen Ting, Jarek Jarcec Cecho, “Apache Sqoop Cookbook: Unlocking Hadoop for Your Relational Database”, O’Reilly Media, 2013. (Unit 2)

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	2	2
CO4	3	2	-	3	-	-	-	-	-	-	-	-	2	2
CO5	3	2	3	3	-	-	-	-	-	-	-	-	2	2
Score	15	10	3	12	-	-	-	-	-	-	-	-	10	6
Course Mapping	3	2	3	3	-	-	-	-	-	-	-	-	2	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2522	SOFTWARE TESTING	3	0	0	0	3

OBJECTIVES

- To explain the software testing fundamentals
- To acquire structural and analytical testing knowledge in software code
- To understand and apply the levels of testing
- To apply quality testing and tools in software projects
- To apply testing concepts in web and mobile applications.

UNIT I TESTING FUNDAMENTALS 9

Testing activities in software life cycle, Readiness of a Product: dependability, availability, MTBF, reliability, alpha test, beta test , regression test; Validation and Verification; Basic Principles; Test and Analysis Activities Within a Software Process: The Quality Process, Planning and Monitoring, Quality Goals, Dependability Properties, Analysis, Testing, Improving the Process; Finite Models, Control Flow Graphs, Call Graphs, Finite State Machines.

UNIT II STRUCTURED AND ANALYTICAL TESTING 9

Structure Based testing : Introduction - - condition coverage – decision - - modified – multiple– path testing – APT testing – exercises; Analytical testing : static analysis – Dynamic analysis – samples ;

UNIT III QUALITY TESTING AND TOOLS 9

Quality Characteristics for technical testing : Security – reliability – efficiency – changeability –testability – portability - installability – sample questionnaire; Test tools and Automation : Test automation project – specific test tools – Test Case Selection and Adequacy ;

UNIT IV TESTING OBJECT-ORIENTED SOFTWARE 9

Testing Object-Oriented Software: Issues in Testing Object-Oriented Software, An Orthogonal Approach to Test, Intraclass Testing, Testing with State Machine Models, Interclass Testing, Structural Testing of Classes, Oracles for Classes, Testing Polymorphism and Dynamic Binding, Inheritance, Genericity and Exceptions; Fault-Based Testing: Assumptions, Mutation Analysis, Fault-Based Adequacy Criteria.

UNIT V WEB AND MOBILE APPLICATION TESTING 9

Website Testing:Fundamentals – Black Box Testing–Gray Box Testing – White Box Testing – Configuration and Compatibility Testing–Usability Testing;Challenges in mobile testing; Testing Mobile Apps: Mobile specific testing – functional Testing – Usability testing – Accessibility testing – Stress and Interrupt testing – performance testing – security testing; Mobile Test automation Tools: image recognition – OCR/text recognition – Native object recognition – current state of tools; Mobile cloud testing; case studies.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain software testing fundamentals (K2)
2. Experiment structural and analytical testing (K3)
3. Apply quality testing and tools in projects (K3)
4. Apply object-oriented concepts for developing a software project and apply object oriented testing principles. (K3)
5. Apply testing concepts in web and mobile applications (K3)

TEXTBOOKS

1. Jamie L Mitchell, Rex Black, "Advanced Software Testing: Guide to the ISTQB Advanced Certification as an Advanced Technical Test Analyst", Second edition, Vol 3, 2015 (Unit 2, 3 – chapters 1,2 4, 6).
2. Mauro Pezze , Michal Young, "Software Testing and Analysis: Process, Principles, and Techniques", Wiley publications 2007 (Unit 1, 4: chapters 1, 2, 15, 16, Unit 3: chapter 9).
3. Daniel Knott, "Hands-On Mobile App Testing", Addison- Wesley, 2015 (Unit 5).

REFERENCES

1. Aditya Mathur, "Foundations of Software Testing", Pearson Education, 2008.
2. Ron Patton, "Software Testing", 2nd Edition, Pearson Education, 2007.
3. Robert Furtell, Donald Shafer, and Linda Shafer, "Quality Software Project Management", Pearson Education Asia, 2002.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PS O2
CO1	3	2	2		1									
CO2	3	2												
CO3	3	3		3					3		3		3	
CO4	3	2												
CO5	3	3		3					3		3		3	
Score	15	12	2	6	1				6		6		6	
course mapping	3	3	2	3	1				3		3		3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2523	IMAGE PROCESSING AND ANALYSIS	3	0	0	0	3

OBJECTIVES

- To be familiar with digital image fundamentals
- To understand the basics of simple image enhancement techniques in Spatial and Fre- quency domain
- To learn the concepts of degradation function and restoration techniques
- To study image segmentation and representation techniques
- To be familiar with object recognition methods.

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Introduction to Digital Image Processing: Components – Image sensing and acquisition – Im- age sampling and quantization; Relationships between Pixels; 2D Mathematical Preliminaries: Array vs matrix operations – Linear vs nonlinear operations – Arithmetic – Logical – Statistical – Spatial operations– Vector and matrix operations.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing– Basics of Spatial Filtering – Smoothing and sharpening spatial filtering; Frequency Domain: Introduction to Fourier transform – The 2D convolutional theorem– Smoothing and Sharpening Frequency Domain Filters: Ideal – Butterworth – Gaussian filters; Homomorphic Filtering; Case Study: Medical image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration: Degradation model; Noise models; Restoration in the Presence of Noise using Spatial Filtering: Mean filters – Order statistics – Adaptive filters; Periodic Noise Reduction by Frequency Domain Filtering: Band reject filters – Band pass filters – Notch filters – Optimum notch filtering; Estimating the degradation function– Inverse filtering; Wiener filtering.

UNIT IV IMAGE SEGMENTATION 9

Edge Detection: Techniques – Edge linking via Hough transform; Thresholding: Intensity thresholding – Otsu's thresholding; Region Based Segmentation: Region growing – Region splitting and merging; Morphological Processing: Erosion and dilation; Segmentation by Morphological Watersheds: Basic concepts – Dam construction – Watershed segmentation algorithm; Case Study: License plate localization.

UNIT V FEATURE ANALYSIS AND OBJECT RECOGNITION 9

Boundary representation – Boundary Descriptors; Regional descriptors – Texture; Relational descriptors; Object Recognition: Patterns and pattern classes; Recognition based on decision theoretic methods; Case Study: Model based Tracking of animals.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the fundamentals of digital image processing, such as digitization, sampling, quantization

(K2)
2. Apply the techniques of smoothing, sharpening and enhancement in both spatial and frequency domain (K3)
3. Explain the restoration concepts and filtering techniques (K2)
4. Identify the segmentation methods and apply in suitable image processing applications (K3)
5. Develop real time applications for object recognition using the feature extraction meth- ods (K4)

TEXTBOOKS

1. Rafael C Gonzalez, Richard E Woods, “Digital Image Processing”, Pearson, 3rd Edition, 2010.
2. Anil K Jain, “Fundamentals of Digital Image Processing”, Pearson, 2002.

REFERENCES

1. Kenneth R Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C Gonzalez, Richard E Woods, Steven Eddins, “Digital Image Processing Using MATLAB”, Pearson Education, Inc., 2011.
3. S Sridhar, “Digital Image Processing”, 2nd Edition, Oxford University, 2016.
4. William K Pratt, “Digital Image Processing”, John Wiley, New York, 2002.
5. Milan Sonka, Roger Boyle, Vaclav Hlavac, “Image Processing, Analysis and Machine Vision”, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2		3									2	
CO5	3	2		3						3		2	2	
Total	15	10		6						3		2	10	
Course Mapping	3	2		3						3		2	2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2524	LOGIC PROGRAMMING	3	0	0	0	3

OBJECTIVES

- To understand the foundations of Logic programming
- To learn programming in PROLOG
- To implement informed and uninformed search algorithms in PROLOG
- To implement Expert system shell in PROLOG.

UNIT I INTRODUCTION TO LOGIC 10

Foundations of Propositional Logic: Syntax and semantics – Semantic entailment; Normal Forms; Resolution in PL; Horn Logic; Foundations of First Order Logic: Syntax and semantics; Normal Forms; Undecidability of Predicate Logic; Resolution in FOL: Unification; Refinements of resolution: P-resolution – N-resolution – Linear resolution – Unit resolution – SLD resolution.

UNIT II INTRODUCTION TO LOGIC PROGRAMMING 8

Foundations: Answer generation; Horn Clause Programs: Semantics of logic program – Procedural semantics – Model-theoretic semantics; Evaluation Strategies: Swapping lemma – PRO- LOG's evaluation strategy – DFS – BFS.

UNIT III PROGRAMMING IN PROLOG 9

Syntax & Semantics of PROLOG – Programming with relations – Facts – Questions – Variables – Conjunctions of goals – Backtracking – Rules – Structures – Recursive programs – Lists – Operators – Arithmetic – Controlling execution – The cut – Input output – Exception handling.

UNIT IV PROLOG AND ARTIFICIAL INTELLIGENCE 9

Data structures – Eight Queens Problem – Simulation of Automata; Operations on Data Structures: Representing and sorting lists – Representing sets by binary trees – Insertion & deletion in binary dictionary – Displaying trees – Graphs; Problem Solving Strategies in AI: DFS – BFS – A* Search; Problem Reduction & AND/OR Graph: Basic AND/OR search procedure; Game Playing: The minimax principle – The alpha-beta algorithm.

UNIT V PROLOG AND EXPERT SYSTEMS 9

Foundations: Introduction to expert systems – Features of expert systems – Functions of an expert system – Structure of an expert system; If-then rules for representing knowledge; Developing a Simple Shell: Implementation – Dealing with uncertainty;

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply propositional logic and predicate logic for knowledge representation (K3)
2. Apply different types of semantics for logic programming (K3)
3. Develop programs in PROLOG (K3)
4. Solve AI problems using search algorithms in PROLOG (K3)
5. Develop a simple Expert system shell in PROLOG (K3).

TEXTBOOKS

1. Uwe Schoning, “Logic for Computer Scientists”, Birkhauser, 1999 (Units I, II).
2. Ivan Bratko, “PROLOG: Programming for Artificial Intelligence”, 4th Edition, Pearson, 2011 (Units III, IV, V).

REFERENCES

1. Kees Doets, “From Logic to Logic Programming”, MIT Press 1994.
2. Patrick Blackburn, Johan Bos, Kristina Streignitz, “Learn PROLOG Now”, College Publications, 2006.
3. Dennis Merritt, “Building Expert Systems in PROLOG”, Amzi Inc. 2000
4. Helder Coelho, Jose C Cotta, “PROLOG by Example: How to Learn, Teach and Use It”, Springer–Verlag, 2011.
5. W F Clocksin, C S Mellish, “Programming in PROLOG”, Springer-Verlag, 2016. Logic Programming

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2											3	
CO2	3	2											3	
CO3	3	2											2	
CO4	3	2											3	
CO5	3	2								3		2	2	
Total	15	10								3		2	13	
Course Mapping	3	2								3		2	3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2525	UNIX INTERNALS	3	0	0	0	3

OBJECTIVES

- To understand the Unix kernel and the various subsystems.
- To understand file organization and management.
- To learn about implementation of various system calls.
- To have a thorough understanding of process architecture, process control, scheduling and interprocess communication
- To understand the different memory management policies.

UNIT I FILE SYSTEM REPRESENTATION AND CACHE 9

Introduction to the Kernel – Architecture of Unix OS. The Buffer Cache: Buffer Headers – Buffer Pool – Buffer Retrieval – Reading and Writing Disk Blocks – Advantages and Disadvantages. Internal Representation of Files – Inodes – Structure of a File – Directories – Conversion of Path Name to Inode – Super Block – Inode Assignment to a new file – Allocation of Disk Blocks
– Other File Types.

UNIT II SYSTEM CALLS FOR THE FILE SYSTEM 10

Open – Read – Write – Lseek – Close – Create – Creation of Special files – Change Directory and Change Root – Change Owner and Change Mode – Stat – Fstat – Pipes – Dup – Mount – Unmount – Link – Unlink – File System Abstraction – Maintenance.

UNIT III PROCESS MANAGEMENT 9

Structure of Processes: Process States – Transitions – Layout of System Memory – Context of a Process – Saving the Context – Manipulation of a Process Address Space – Sleep. Process Control: Process creation – Signals – Process Termination – System Boot and the INIT Process.

UNIT IV MEMORY MANAGEMENT AND I/O 9

Memory Management Policies: Swapping – Demand Paging – A Hybrid System with swapping and Demand paging; I/O Subsystem – Driver Interfaces – Disk Drivers – Terminal Drivers.

UNIT V SCHEDULING AND IPC 8

Process Scheduling and Time: Process Scheduling – System calls for Time – Clock. Interprocess Communication: Process Tracing – System V IPC

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Identify various scenarios of buffer usage and Inode manipulation (K3)
2. Illustrate the working of UNIX file subsystem and its system calls (K2)
3. Apply process control and management policies on process address space (K3)
4. Illustrate the memory management and I/O policies (K2)
5. Apply various scheduling algorithms and IPC techniques on processes (K3)

TEXTBOOK

1. Maurice J Bach, “The Design of the Unix Operating System”, Pearson Education, 2002.

REFERENCES

1. Daniel P Bovet, Marco Cesati, “Understanding the Linux Kernel”, 3rd Edition, O’Reilly, Shroff Publishers & Distributors Pvt Ltd, 2005.
2. John Lion, “Lion’s Commentary on UNIX”, 6th edition, Peer-to-Peer Communications, 2004.
3. M Beck et al, “Linux Kernel Programming”, 3rd Edition, Pearson Education Asia, 2015.
4. Steve D Pate, “Unix Internals: A Practical Approach”, Addison-Wesley, 1996.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
						-	-	-	-	-	-	-		
CO1	3	2											3	
CO2	3	2											3	
CO3	3	2											3	
CO4	3	2											3	
CO5	3	2											3	
Score	15	10											15	
Course Mapping	3	2											3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2527	ETHICAL HACKING AND TOOLS	3	0	0	0	3

OBJECTIVES

- To learn about the importance of information security
- To learn different scanning and enumeration methodologies and tools
- To understand various hacking techniques and attacks
- To be exposed to programming languages for security professionals
- To get familiarized with the different phases in penetration testing

UNIT I FUNDAMENTALS OF HACKING 9

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an At- tack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Foot printing – Information Gathering Methodology – Foot printing Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines.

UNIT II SCANNING AND ENUMERATION 9

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools.

UNIT III SYSTEM HACKING 9

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Pass- word Cracking Tools – Password Cracking Counter measures – Escalating Privileges – Executing Applications – Key loggers and Spyware.

UNIT IV PROGRAMMING FOR SECURITY PROFESSIONALS 9

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.

UNIT V PENETRATION TESTING 9

Introduction – Security Assessments – Types of Penetration testing – Phases of Penetration Testing – Tools –Test Tools – Penetration Testing Tools.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Describe Hacking attacks and protection tools (K2)
2. Examine the computer against a variety of security attacks (K2)
3. Illustrate the use of safe techniques for System security (K3)
4. Develop programs for security accomplishment (K3)
5. Experiment the different testing tools (K3).

TEXTBOOKS

1. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy”, Syngress Media, Second Revised Edition, 2013.
2. Michael T Simpson, Kent Backman, James E Corley, “Hands-On Ethical Hacking and Network Defense”, Cengage Learning, Third Edition 2017

REFERENCES

1. Jon Erickson, Hacking: “The Art of Exploitation”, No Starch Press, Second Edition, 2010.
2. ECouncil, “Ethical Hacking and Countermeasures”, Delmar Cengage Learning, 2017

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	3	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	3	-	-	-	-	-	-	-	2	-
Total	15	10	-	-	6	-	-	-	-	-	-	-	10	-
Score	3	2	-	-	3	-	-	-	-	-	-	-	2	-

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2526	ADVANCED DATABASE MANAGEMENT SYSTEM	3	0	0	0	3

OBJECTIVES

- To acquire knowledge on parallel and distributed databases and their applications
- To study the usage and applications of Object and Object Relational Databases
- To learn about XML Database
- To acquire knowledge in intelligent Databases
- To learn the concepts of emerging technologies

UNIT I PARALLEL AND DISTRIBUTED DATABASES 9

Database System Architectures: Centralized and client-server architectures – Server system architectures – Parallel systems – Distributed systems; Parallel Databases: I/O parallelism – Inter and intra query parallelism – Inter and intra operation parallelism – Design of parallel systems – Distributed database concepts – Distributed data storage – Distributed transactions – Commit protocols – Concurrency control – Distributed query processing – Case studies.

UNIT II OBJECT AND OBJECT RELATIONAL DATABASES 9

Concepts for Object Databases: Object identity – Object structure – Type constructors – Encapsulation of operations – Methods – Persistence – Type and class hierarchies – Inheritance – Complex Objects – Object database standards; Languages and Design: ODMG model – ODL – OQL – Object relational and extended; Relational Systems: Object relational features in SQL/Oracle – Case studies

UNIT III XML DATABASES 9

XML Databases: XML-Data model – DTD – XMLSchema – XML Query Languages – Storing XML in databases – XML and SQL – Native XML databases – Web databases.

UNIT IV INTELLIGENT DATABASES 9

Active Databases:Syntax and Semantics(Oracle,DB2) – Taxonomy – Applications – Design Principles for Active Rules; Deductive Databases: Logic of Query Languages – Datalog – Recursive Rules – Syntax and Semantics of Datalog Languages – Implementation of Rules and Recursion – Recursive Queries in SQL.

UNIT V EMERGING TECHNOLOGIES 9

Mobile Databases: Location and Handoff Management – Effect of Mobility on Data Management – Location Dependent Data Distribution – Mobile Transaction Models – Concurrency Control – Transaction Commit Protocols; Spatial Databases: Spatial Data Types – Spatial Relationships – Spatial Data Structures – Spatial Access Methods – Spatial DB Implementation; Geographic Information Systems.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain concepts in parallel and distributed databases (K2)

2. Develop schema and query in Object oriented and Object Relational Databases (K3)
3. Construct schema and query XML Databases (K3)
4. Apply rules to infer knowledge from databases. (K3)
5. Explain concepts in mobile and spatial databases (K2).

TEXTBOOKS

1. Elmasri, Ramez, Shamkant Navathe, “Fundamentals of database systems”, 7th Edition, Pearson, 2016
2. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007.

REFERENCES

1. Vijay Kumar, “Mobile Database Systems”, Wiley, 2016.
2. Henry F Korth, Abraham Silberschatz, S Sudharshan, “Database System Concepts”, 6th Edition, McGraw Hill, 2011.
3. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T Snodgrass, V S Subrahmanian, Roberto Zicari, “Advanced Database Systems”, Morgan Kaufmann publishers, 2006
4. Stefano Ceri, Giuseppe Pelagatti, “Distributed Databases: Principles and Systems”, McGraw Hill,2017.
5. M Tamer Ozsu, Patrick Valduriez, “Principles of Distributed Database Systems”, Second Edition, Springer

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2		3									2	
CO3	3	2		3									2	
CO4	3	2		3									2	
CO5	3	2											2	
Total	15	10		9									10	
Mapping	3	2		3									2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2621	CLOUD COMPUTING	3	0	0	0	3

OBJECTIVES

- To interpret the basics of cloud computing.
- To learn about concepts of virtualization and virtualization infrastructure.
- To understand the principles of Cloud Architecture, Design challenges and Infrastructure.
- To explore and experiment various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

UNIT I CLOUD ARCHITECTURE AND MODELS 8

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Characteristics – Cloud deployment models – Cloud service models – Pros and Cons of Cloud;

UNIT II INTRODUCTION TO VIRTUALIZATION 9

Basics of Virtualization – Virtualization Types – Implementation Levels of Virtualization – Virtualization Structures / Tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices – Virtual Clusters and Resource management – Virtualization for Data-Center Automation – Virtualization Support and Disaster Recovery – Taxonomy of Virtual Machines – Create VM Cluster using VMWare or Virtual Box and deploy an application.

UNIT III CLOUD INFRASTRUCTURE 9

Cloud Infrastructure: Architectural design of compute and storage clouds – Layered cloud architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

UNIT IV CLOUD DEPLOYMENT ENVIRONMENT 9

Parallel Programming Framework: Hadoop Map Reduce – Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack – OpenNebula – Aneka – CloudSim.

UNIT V CLOUD SECURITY 7

Data Security and Storage; Identity and Access Management(IAM) – IAM Challenges – IAM Architecture and Practice; Security Management in the Cloud – Security Management Standards – SaaS, Paas and IaaS Availability Management – Access Control; Security-As-A-Service.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Summarize about the basics of Cloud Computing (K2)
2. Apply the concept of virtualization and analyse its types (K3)
3. Solve various design challenges in cloud environment (K3)
4. Develop and deploy services on cloud and be able to set up a private cloud environment using open source software (K3)

5. Outline the security challenges in cloud environment (K2)

TEXTBOOKS

1. Kai Hwang, Geoffery C Fox, Jack J Dongarra, "Distributed and Cloud Computing: Clus- ters, Grids, Clouds and the Future of Internet", 1st Edition, Morgan Kaufman Publisher, Oxford, an Imprint of Elsevier, 2012. (Unit I, II, IV)
2. Srinivasan A, Suresh J, "Cloud Computing: A practical Approach for Learning and Implementation", Pearson Education India, 2014. (Units I, II, III, IV)

REFERENCES

1. Tim Mather, Subra Kumaraswamy, Shahed Latif , "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, 2009. (Unit V)
2. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner's Guide", McGraw-Hill Osborne Media, 2009.
3. James E Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
4. William von Hagen, "Professional Xen Virtualization", Wrox Publications, January, 2008.
5. David Marshall, Wade A Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	3	-	-	-	-	-	-	-	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
Score	15	11	-	-	3	-	-	-	-	-	-	-	9	-
	3	3	-	-	3	-	-	-	-	-	-	-	3	-

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2626	BIG DATA MODELING AND MANAGEMENT	3	0	0	0	3

OBJECTIVES

- To know the fundamental concepts of big data and analytics
- To understand the basics of data modeling and its implications
- To learn different data models adopted in big data
- To get introduced to big data management system and its variable technologies
- To learn various tools supporting big data management system.

UNIT I INTRODUCTION TO BIG DATA MODEL 5

Concept of Big Data – Sources and types of big data – Data Ingestion – Data Storage – Data Quality – Data Operations – Data Scalability and Security – Data Management in Energy, Gaming and Flight Operations.

UNIT II DATA REPOSITORY AND STORAGE FORMAT 10

Introduction to Big Data Modeling – Importance and implications of big data modeling and management – Big data storage and data models – Data model Structures and Operations – Data Model Constraints – Relational and Semi structured Data Model – CSV and JSON data – Array Data Model.

UNIT III DATA MODELS FOR DATA LAKE 10

Data Models – Categorizing Data Models – Data Model vs Data Format – Data Stream – Understanding Data Lake – Inside Data Lake – Generic Structure of Data Ponds – Applications of Data Pond – Data Warehousing vs Data Lake.

UNIT IV KEY-VALUE STORE AND GRAPH DATABASES 10

Approaches to Big Data – DBMS and non-DBMS – DBMS to BDMS – Introduction to NoSQL – Key Value Store: Redis – Graph Databases an Overview – Started with Neo4j – Modelling data for Neo4j – Use Case Examples: Recommender Systems & Impact Analysis and Simulation – Visualization for Neo4j.

UNIT V DOCUMENT BASED AND COLUMNAR MODELS 10

Database for modern Web:MongoDB – MongoDB Shell – Creating, Updating and Deleting Documents – Querying – Introduction to Cassandra – Architecture – CassendraQL (CQL) – Configuring and Managing a Cluster – Integrating with Apache Spark.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Illustrate the different data elements and able to identify data operations needed for problems (K2)
2. Explain the needs of different data models for designing big data information system (K3)
3. Build a data model to suit the characteristics of data using Data Lake in teams (K3)
4. Apply Big Data Management System for building a system using Key-Value stores and

Graph Databases in teams (K3)
5. Build a new information system using Document based and columnar models in teams, demonstrate and write report on the work (K3).

TEXTBOOKS

1. James Lee, Tao Wei, Suresh Kumar Mukhiya, "Hands-On Big Data Modeling", Packt Publishers, 2018 (Unit 1 & Unit 2).
2. Bill Inmon, "Data Lake Architecture: Designing the Data Lake and Avoiding the Garbage Dump", 1st Edition, Technics Publications, 2016 (Unit 3).
3. Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide", 3rd Edition, 2019 (Unit 5).

REFERENCES

1. Kim H Pries, Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers", CRC Press, 2015.
2. Vinoo Das, "Learning Redis", Packt Publications, 2015.(Unit 4)
3. Jerome Baton, Rik Van Bruggen, "Learning Neo4j 3.x", 2nd Edition, Packt Publishers, 2017 (Unit 4)
4. Aaron Ploetz, Tejaswi Malepati, Nishant Neeraj, "Mastering Apache Cassandra 3.x", 3rd Edition, Packt Publishers, 2018 (Unit 5).
5. Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, and Tim Hawkin, "MongoDB in Action", 2nd Edition, Manning Publications, 2016 (Unit 5).

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2		3									2	
CO3	3	2		3					3				2	2
CO4	3	2		3					3				2	2
CO5	3	2		3					-				2	2
Score	15	10		12					6				10	6
Course Mapping	3	2		3					3				2	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2622	SOFTWARE CONFIGURATION MANAGEMENT	3	0	0	0	3

OBJECTIVES

- Explain and demonstrate the key aspects of traditional configuration management
- Understand and demonstrate the microservices application
- Explore and deploy the microservice in a container
- Install and explore Docker container networking services
- Modify the configuration techniques using Kubernetes and Docker swarm

UNIT I TRADITIONAL 9

Configuration management process : monitoring and control – auditing – testing – incident and defect management – problem management – change management – automation and tools – lifecycle controls – culture and organisation; Service asset and configuration management visions and strategies; Populating a CMDB Process design : – populate your CMDB; Case study monolithic application : Build the application – Deploy the application.

UNIT II MICROSERVICES 9

An Introduction to Microservices:What Are Microservices? ; Switching to Microservices:Cost Components; Interprocess Communication:Putting It All Together; Case Study: Migration to Microservices – Planning for Migration – Planning for Migration – Applying Microservices Criteria – Converting to Microservices – Application Build and Deployment.

UNIT III CONTAINERS 9

Docker Containers:Virtual Machines – Containers – Docker Architecture and Components – The Power of Docker: A Simple Example; Docker Interface:Key Docker Commands – Docker- file – Docker Compose; Case Study: Containerizing a Helpdesk Application : Containerizing Microservices – Deploying the Catalog Microservice.

UNIT IV NETWORKING AND DISCOVERY 9

Docker Networking: Bridge Mode Networking – Host Mode Networking – Container Mode Networking – No Networking – Wrapping It Up; Service Discovery ; Service Registry.

UNIT V ORCHESTRATION 9

Container Orchestration : Kubernetes – Kubectl – Master Node – Worker Nodes – Kubernetes Cluster; Docker Swarm : Nodes – Services – Task – Example: Swarm Cluster.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain traditional software configuration principles (K2)
2. Develop microservices (K3)
3. Build a container and deploy a microservice (K3)
4. Explain networking concepts in containers (K2)
5. Choose configuration features using Kubernetes and Docker swarm (K3).

TEXTBOOKS

1. Shirley Lacy and David Norfolk, “CONFIGURATION MANAGEMENT, Expert guidance for IT service managers and practitioners”, Revised edition, BCS Learning and Development Ltd, UK, 2014.
2. Parminder Singh Kocher Boston, “Microservices and Containers”, Addison-Wesley, 2018.
3. Michael Hausenblas, “Docker Networking and Service Discovery”, O’Reilly Publication, 2016.

REFERENCES

1. Thomas Uphill, “Mastering Puppet”, Second Edition,PACKT Publishing, 2016
2. Scott Coulton, “Puppet for Containerization”, PACKT Publishing, 2016
3. Cesar de la Torre, Bill Wagner, Mike Rouses, “.NET Microservices: Architecture for Containerized .NET Applications”, Microsoft Corporation, V5.) Edition, 2020.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1		2	2										2	
CO2	3	3	2						3	3	3		2	
CO3	3	3	2						3	3	3		2	
CO4	3	2	2											
CO5		2	2										2	
Score	9	12	10						6	6	6		8	
Mapping	3	3	2						3	3	3		2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2623	PROBABILISTIC GRAPHICAL MODELS	3	0	0	0	3

OBJECTIVES

- To learn the key aspects of directed and undirected models
- To apply the techniques to represent the model, do inference and learning
- To understand the methods for learning in hidden data.

UNIT I INTRODUCTION 9

Probabilistic Reasoning: Conditional Probability – Probability Tables – Prior, Likelihood and Posterior; Graph Concept; Belief Networks: Benefits of structure – Uncertain and Unreliable Evidence – Belief concepts – Causality.

UNIT II REPRESENTATION IN GRAPHICAL MODELS 9

Bayesian Network Representation: Independence properties – Independence in graphs – From distributions to graphs; Undirected Graphical Models: Parameterization – Markov Network Independencies – Bayesian networks and Markov networks – Partially directed models.

UNIT III INFERENCE IN GRAPHICAL MODELS 9

Efficient Inference in Trees: Marginal Inference – Forms of Inference – Inference in Multi- ply Connected Graphs; Junction Tree Algorithm: Clustering variables – Clique graphs – Junction trees – Constructing junction trees for singly-Connected Distributions – Junction Trees for Multiply-Connected Distributions – Junction Tree Algorithm; Making Decisions: Expected Utility – Extending Bayesian Networks for Decisions – Solving Influence Diagrams – Markov Decision Processes – Variational Inference and Planning.

UNIT IV LEARNING IN PROBABILISTIC MODELS 9

Statistics for Machine Learning: Representing Data – Distributions – Multivariate Gaussian – Conjugate priors – Properties of Maximum Likelihood – Learning a Gaussian; Learning as Inference: Bayesian methods – Maximum Likelihood Training of Belief Networks – Bayesian Belief Network Training – Structure learning – Maximum Likelihood for Undirected models; Naive Bayes: Conditional Independence – Estimation using Maximum Likelihood – Bayesian Naive Bayes – Tree Augmented Naive Bayes.

UNIT V LEARNING IN HIDDEN ENVIRONMENT 9

Learning with Hidden Variables: Hidden Variables and Missing Data – Expectation Maximisation – Extensions of EM – Variational Bayes; Bayesian Model Selection: Comparing Models the Bayesian Way – Occam's Razor and Bayesian Complexity Penalization – Approximating the Model Likelihood – Bayesian Hypothesis Testing for Outcome Analysis.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the need for probabilistic graphical models (K2)
2. Apply various representations like directed and undirected models (K3)

3. Select inference algorithms for graphical models (K3)
4. Apply techniques to learn the structure and parameters in models (K3)
5. Outline the learning techniques for hidden data (K2)

TEXTBOOKS

1. David Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, 2020.
2. Daphne Koller, Nir Friedman, “Probabilistic Graphical Models - Principles and Technique”, MIT Press, 2007.

REFERENCES

1. Luis Enrique Sucar, “Probabilistic Graphical Models - Principles and Applications”, Advances in Computer Vision and Pattern Recognition, Springer, 2015.
2. Kiran R Karkera, “Building Probabilistic Graphical Models with Python”, Packt Publishing, 2014.

CO to PO Mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO1 1**	**PO12**	**PSO 1**	**PSO2**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2		3									2	
CO5	3	2											2	
Score	15	10		3									10	
	3	2		3									2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2627	NATURAL LANGUAGE PROCESSING AND APPLICATIONS	3	0	0	0	3

OBJECTIVES

- To learn language models
- To learn text preprocessing techniques
- To understand the levels of knowledge in language processing
- To develop NLP applications.
- To apply traditional learning and deep learning for NLP applications.

UNIT I TEXT PRE-PROCESSING AND LANGUAGE MODELLING 9

Knowledge in language processing – NLP applications; – Regular Expressions – Words – Corpora – Text Normalization – Minimum Edit distance – N-gram language models – Neural language models - RNNs as language models

UNIT II WORD LEVEL AND SYNTACTIC ANALYSIS 9

Word Level Analysis: Word classes – Part-of-Speech Tagging: HMM POS tagging; Named Entities (NE): NE Tagging – Conditional Random Field NE recognizer; Syntactic Analysis: Constituency – Context-free grammar – Grammar rules – Treebanks; Parsing: Top-down – Bottom- up – Ambiguity – CKY Parsing – Shallow parsing – Dependency parsing

UNIT III SEMANTIC ANALYSIS 9

Vector Semantics – Words and Vectors – Cosine similarity – Tf-idf – Positive PMI – Word2vec– Semantic properties of embeddings; Lexical Semantics: Word Senses – Relations between senses – WordNet – Word Sense Disambiguation

UNIT IV COREFERENCE RESOLUTION AND MACHINE TRANSLATION 9

Coreference Resolution: Coreference phenomena – Mention detection – Mention-pair architecture; RNNs for sequence labeling and classification – Stacked and Bi-directional RNN – Ma- chine Translation(MT): Lexical divergence and typology – Encoder-Decoder with RNNs – MT Evaluation;

UNIT V NLP APPLICATIONS 9

Sentiment Classification: Naive Bayes classifier – Optimizing for Sentiment Analysis – Evaluation; Information Extraction: Relation extraction; Information Retrieval; IR-based Factoid Question Answering: IR-based QA Datasets – Answer span extraction.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply text pre-processing techniques and build the language models (K3)
2. Apply basic levels of knowledge at word level and syntax level in language processing (K3)
3. Apply computational methods in lexical and vector semantics (K3)
4. Explain discourse processing and machine translation systems (K2)

5. Apply learning algorithms for various NLP applications (K3)

TEXTBOOKS

1. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2nd Edition, Prentice Hall, 2008.

REFERENCES

1. Christopher D Manning, Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.
2. Steven Bird, Ewan Klien and Edward Loper, Natural Language Processing with Python, O’Reilly, 2009.
3. Nitin Indurkhya, Fred J Damerau, "Handbook of Natural Language Processing", 2nd Edition, CRC Press, 2010.
4. Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.
5. Li Deng, Yang Liu, "Deep Learning in Natural Language Processing", Springer, 2018
6. Taweh Beysolow II, "Applied Natural Language Processing - Implementing Machine LearnIng and Deep Learning Algorithms for Natural Language Processing", Apress, 2018

CO to PO Mapping

	PO1	PO2	PO 3	PO 4	PO 5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	3		3									3	
Total	15	11		3									11	
Course Mapping	3	3		3									3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2624	CYBER FORENSICS	3	0	0	0	3

OBJECTIVES

- To learn computer forensics and understand incident response
- To know the methods to collect and store digital evidence
- To understand the approaches to analyse and validate data
- To explore the malware and threat intelligence
- To learn mobile forensics concepts

UNIT I FUNDAMENTALS 9

Understanding Incident Response: The incident response process – The incident response charter – The incident response plan – The incident response playbook – Testing the incident response framework; Managing Cyber Incidents: Investigating incidents – Incorporating containment strategies – Getting back to normal – eradication and recovery; Fundamentals of Digital Forensics – Legal aspects – Digital forensics fundamentals – The digital forensics process
– Digital forensic lab.

UNIT II EVIDENCE ACQUISITION 9

Collecting Network Evidence: An overview of network evidence – Firewalls and proxy logs – NetFlow – Packet captures – Wireshark – Evidence collection; Acquiring Host-Based Evidence Preparation : Order of volatility – Evidence acquisition – Acquiring volatile memory ; Forensic Imaging : Understanding forensic imaging – Imaging tools – Preparing a stage drive – Using write blockers – Imaging techniques.

UNIT III ANALYZING EVIDENCE 9

Analyzing Network Evidence: Network evidence overview – Analyzing firewall and proxy logs
; Analyzing System Memory: Memory analysis overview – Memory analysis methodology ; Analyzing System Storage: Forensic platforms – Autopsy – MFT analysis – Registry analysis; Analyzing Log Files : Understanding Windows logs ; Writing the Incident Report : Documentation overview.

UNIT IV MALWARE AND THREAT INTELLIGENCE 9

Malware Analysis for Incident Response: Malware classifications – Malware analysis overview
– Analyzing malware – Dynamic analysis – Leveraging Threat Intelligence – Understanding threat intelligence – Threat intelligence methodology – Threat intelligence sources – Threat intelligence platforms Using threat intelligence.

UNIT V MOBILE FORENSICS 9

Introduction to Mobile Forensics: Why do we need mobile forensics? – Mobile forensics – The mobile phone evidence extraction process – Practical mobile forensic approaches; Parsing Third-Party Application Files: Third-party application overview – Encoding versus encryption – Application data storage – Forensic methods used to extract third-party application data.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Summarize the basics of computer forensics (K2)
2. Apply different computer forensic tools to collect data (K3)
3. Apply tools to analyze and validate forensic data (K5)
4. Classify the malware and threat intelligence (K2)
5. Apply forensic tools on mobile data (K3)

TEXTBOOKS

1. Gerard Johansen, “Digital Forensics and Incident Response”, Second Edition, Packt Publishing, 2020.
2. Rohit Tamma, Oleg Skulkin, Heather Mahalik, Satish Bommisetty, “Practical Mobile Forensics”, Third Edition, Packt Publishing, 2018.

REFERENCES

1. Nelson, Phillips, Enfinger, Steuart, “Computer Forensics and Investigations”, Cengage Learning, India Edition, 2008.
2. John R Vacca, “Computer Forensics”, Cengage Learning, 2005.
3. Marjie T Britz, “Computer Forensics and Cyber Crime: An Introduction”, 3rd Edition, Prentice Hall, 2013.
4. Marcella Jr, Albert, and Doug Menendez, “Cyber Forensics: a Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes”, Auerbach Publications, 2007.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2			1								3	
CO3	3	3			1							2	3	2
CO4	3	2											2	
CO5	3	2											2	
Score	15	11			2							2	12	2
	3	3			1							2	3	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2625	IOT TECHNOLOGIES	3	0	0	0	3

OBJECTIVES

- To understand the fundamentals and architecture of Internet of Things
- To learn about the sensors and different layer protocols
- To learn the best practices in security and data analytics in IoT infrastructure
- To study the concept of Internet of Things in the real-world applications.

UNIT I INTRODUCTION TO IoT 9

Genesis – Impact and Challenges of IoT – IoT Network Architecture and Design: Need for new architectures – Basic IoT Architecture – foneM2M and IoT world forum architectures – Core IoT functional stack – IoT data management and compute stack.

UNIT II ENGINEERING IoT NETWORKS 9

Sensing Devices: Sensors – Actuators – MEMS – Smart objects – Sensor networks – Connecting smart objects; IoT Access Technologies: IEEE 802.15.4 – IEEE 802.15.4g and 802.15.4e – IEEE 1901.2a – IEEE 802.11ah – LoRaWAN – NB-IoT and other LTE variations.

UNIT III IoT NETWORK AND APPLICATION LAYER PROTOCOLS 9

IP as IoT network layer – Adoption or adaption of IP – Need for optimization – Optimizing IP for IoT – Profiles and Compliances; IoT Application Transport Methods: Non-Application Layer – SCADA – Web Based Protocols – IoT Application Layer Protocols: CoAP and MQTT.

UNIT IV DATA ANALYTICS FOR IoT 9

Introduction – Analysis of Machine Learning techniques for IoT– Big Data Analytics Tools and Technologies – Edge Streaming Analytics – Network Analytics.

UNIT V IoT SECURITY AND CASE STUDY 9

Cyber Security Vernacular – Anatomy of IoT Cyber Attacks – Physical and Hardware Security – IoT Security and Best Practices; Case Study: Smart and connected cities.

TOTAL PERIODS:45

COURSE OUTCOMES

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

1. Explain the basics and different architectures of IoT (K2)
2. Discuss various sensors and access protocols for IoT (K2)
3. Select different transport and application layer protocols based on application's requirements (K3)
4. Apply various machine learning and data analytics techniques for IoT applications (K3)
5. Use security aspects in designing real time IoT applications (K3)

TEXTBOOKS

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT

Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, Pearson, 2019.
2. Perry Lea, "Internet of Things for Architects", Packt Publishing, O'Reilly, January 2018.

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A hands-on Approach", Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
4. Jan Holler, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

CO to PO Mapping

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3 CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	2	3	-
Score	15	10	8	0	0	0	0	0	0	0	0	4	9	0
Course Mapping	3	2	2	0	0	0	0	0	0	0	0	2	3	0

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2721	BAYESIAN DATA ANALYSIS	3	0	0	0	3

OBJECTIVES

- To know the fundamental concepts of probability theory, machine learning and statis- tics
- To explore One-parameter model, normal model and multivariate model
- To analyse data using hierarchical modeling and non-parametric models
- To analyse the difference between non-bayesian model with bayesian model.
- To solve real time problems using bayesian computation.

UNIT I BASICS OF PROBABILITY THEORY, MACHINE LEARNING AND STATISTICS 9

Introduction: Bayes – Estimating Probability of a Rare Event – Building a Predictive Model; Probability: Events – Partitions – Bayes Rule – Independence – Random Variable – Joint Distribution; Bayesian Inference in Applied Statistics.

UNIT II ONE PARAMETER MODELS AND NORMAL MODEL 9

The Binomial Model: Inference – Confidence Region; The Poisson model – Posterior Inference; Exponential Families and Conjugate Priors; The Normal Model: Inference for the Mean, Conditional on the Variance – Joint Inference for the Mean and Variance – Prior Specification Based on Expectations – The Normal Model for Non-Normal Data; The Multivariate Normal Model.

UNIT III GROUP COMPARISONS AND HIERARCHICAL MODELING 9

Group Comparisons: Comparing Two Groups – Comparing Multiple Groups – Exchangeability and Hierarchical Models; The Hierarchical Normal Model: Posterior Inference – Hierarchical Modeling of Means and Variances – Analysis of Math Score Data.

UNIT IV LINEAR REGRESSION AND NON-PARAMETRIC MODEL 9

The Linear Regression Model: Least Squares Estimation for the Oxygen Uptake Data; Bayesian Estimation for a Regression Model: A Semi conjugate Prior Distribution – Default and Weakly Informative Prior Distributions; Model Selection: Bayesian Model Comparison – Gibbs Sam- pling and Model Averaging; Non-Parametric Model: Gaussian Process Models – Finite Mixture Models.

UNIT V BAYESIAN COMPUTATION 9

Monte Carlo approximation: The Monte Carlo Method – Posterior Inference for Arbitrary Functions – Sampling from Predictive Distributions – Posterior Predictive Model Checking; Posterior Approximation with the Gibbs Sampler: A Semi conjugate Prior Distribution – Discrete Approximations – Gibbs Sampling – Metropolis-Hastings Algorithm and Gibbs Sampler.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Summarize the basics of theory, machine learning and statistics (K2)

2. Apply One-parameter model to develop a system (K3)
3. Analyse data using hierarchical model (K4)
4. Compare non-bayesian model with bayesian model (K4)
5. Apply various Bayesian computation techniques to solve a problem (K3)

TEXTBOOKS

1. Peter D Hoff, “A first course in Bayesian Statistical Methods”, Springer, 2009.

REFERENCES

1. Andrew Gelman, John B Carlin, Hal S. Stern HS, David B Dunson, Aki Vehtari, Dolland B.Rubin, “Bayesian data analysis”, third edition, CRC press, 2013.
2. Richard McElreath, “Statistical Rethinking”, second edition, CRC press, 2020.
3. John Kruschke, “Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan”, second edition, Academic Press,2014

CO to PO Mapping

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO1	3												2	
CO2	3	2											2	
CO3 CO3	3	2		3									2	
CO4	3	3	3										2	
CO5	3	2	3	3					3	3			3	
Score	15	9	6	6					3	3			11	
Course Mapping	3	3	3	3					3	3			3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2722	WIRELESS ADHOC AND SENSOR NETWORKS	3	0	0	0	3

OBJECTIVES

- To understand the working of MAC Protocols and routing in ad hoc networks
- To learn the Transport layer protocols and QOS in ad hoc networks
- To understand the working of topology control and routing protocols in WSN
- To be familiar with the protocols for MAC and localization in WSN
- To learn the data centric and content based networking, transport layer protocols and QOS in WSN

UNIT I MAC AND ROUTING IN AD HOC NETWORKS 9

Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols using Directional Antennas – Multiple-Channel MAC Protocols – Power-Aware MAC Protocols – Routing in Adhoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols.

UNIT II TRANSPORT AND QOS IN AD HOC NETWORKS 9

TCP's challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc net- works – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model.

UNIT III WSN: PROTOCOLS FOR MAC AND LOCALIZATION 9

Fundamentals of MAC Protocols; Types of MAC Protocols – Low duty cycle protocols – Contention-based protocols – Schedule-based protocols; IEEE 802.15.4 MAC protocol Localization and Positioning: Properties – Approaches – Mathematical basis; Single Hop Localization – Positioning in multichop environments – Impact of anchor placement.

UNIT IV WSN: TOPOLOGY CONTROL AND ROUTING PROTOCOLS 9

Topology Control: Controlling topology in flat networks –Hierarchical networks by domination sets and clustering – Combine hierarchical topologies and power control. Routing Proto- cols: Unicast – Broadcast – Multicast – Geographical routing – Mobile nodes

UNIT V WSN: DATA CENTRIC AND CONTENT BASED NETWORKING, TRANSPORT LAYER AND QOS 9

Data-Centric and Contention-Based Networking: Data-centric routing – Data aggregation – Data-centric storage. Transport Layer and Quality of Service: Coverage and deployment – Reliable data transport – Single packet delivery – Block delivery – Congestion Control and rate control – Operating systems for wireless sensor networks – Examples.

TOTAL PERIODS:45

COURSE OUTCOMES

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

1. Explain the working of MAC Protocols and routing in ad hoc networks (K2)
2. Select various Transport layer protocols and QOS in ad hoc networks as per requirements(K3)

3. Select different topologies and routing protocols based on the application requirement in WSN (K3)
4. Choose appropriate localization and routing protocols for the given scenario in WSN (K3)
5. Choose appropriate networking approach, transport layer protocol and QoS in WSN (K3)
6. Choose and implement appropriate protocol for wireless adhoc or Sensor networks as per the requirements using a Simulator (K4).

TEXTBOOKS

1. C Siva Ram Murthy, B S Manoj, "Ad Hoc Wireless Networks – Architectures and Proto- cols", Pearson Education, 2006.
2. Holger Karl, Andreas Willing,"Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, 2005.

REFERENCES

1. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Net- works", Auerbach Publications, 2008.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition)", World Scientific Publishing, 2011.
3. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley and Sons, 2010.
4. Xiang-Yang Li , "Wireless Ad Hoc and Sensor Networks: Theory and Applications", Cambridge university Press, 2008.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	3	-	-	3	-	-	-	-	3	-	-	3	-	-
Total	18	13	-	-	3	-	-	-	-	3	-	-	13	-	-
Course	3	3	-	-	3	-	-	-	-	3	-	-	3	-	-

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2723	OBJECT ORIENTED ANALYSIS AND DESIGN	3	0	0	0	3

OBJECTIVES

- To understand and differentiate Unified Process from other approaches
- To understand object-oriented software design using UML's static diagrams
- To understand software modeling using the UML's dynamic diagrams
- To learn improving software design with design patterns
- To learn testing the software with its requirements specification.

UNIT I DEVELOPMENT PROCESS & USE-CASE DIAGRAM (STATIC) 9

Introduction to OOAD with OO Basics – Unified process – UML diagrams – Use case – Case study – The Next Gen POS system, Inception – Use case modelling – Relating use cases – Include, extend and generalization – When to use use-cases.

UNIT II UNIFIED PROCESS & CLASS DIAGRAM (STATIC) 9

Class diagram – Elaboration – Domain model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class hierarchies – Aggregation and composition – Relationship between sequence diagrams and use cases – When to use class diagrams.

UNIT III DYNAMIC & IMPLEMENTATION DIAGRAMS 9

Dynamic Diagrams: UML interaction diagrams – System sequence diagram – Collaboration diagram – When to use communication diagrams – State machine diagram and modelling – When to use state diagrams – Activity diagram – When to use activity diagrams. Implementation Diagrams: UML package diagram – When to use package diagrams – Component and deployment diagrams – When to use component and deployment diagrams.

UNIT IV DESIGN PATTERNS 9

Designing objects with responsibilities – Creator – Information expert – Low coupling – High cohesion – Controller design patterns – Creational – Factory method – Structural – Bridge – Adapter – Behavioural – Strategy – Observer – Applying GoF design patterns – Mapping design to code.

UNIT V TEST DRIVEN DEVELOPMENT AND REFACTORING 9

Object oriented methodologies – Software quality assurance – Impact of object orientation on testing – Develop test cases and test plans.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Model the given problem using Use case diagrams (K3)
2. Apply OO concepts for project development (K3)
3. Choose appropriate UML diagrams for modeling user requirements (K5)
4. Make use of the design patterns to transform UML based software design into pattern- based design (K3)

5. Develop test cases and test plans for object-oriented software (K3).

TEXTBOOKS

1. Larman, Craig, “Applying UML and Patterns”, Pearson Education Asia, 2008.
2. Ali Bahrami, “Object Oriented Systems Development”, McGraw Hill International Edition, 1999.

REFERENCES

1. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design patterns: Elements of Reusable Object Oriented Software”, Pearson Education, 2015.
2. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, 3rd edition, Addison Wesley, 2003.
3. Booch, G, Jacobson I, Rumbaugh J, “The Unified Modeling Language User Guide”, Addison Wesley, 2008.
4. Roger S Pressman, “Software Engineering – A Practitioner’s Approach”, 7th edition, 2010.
5. Aditya P Mathur, “Foundations of Software Testing – Fundamental Algorithms and Techniques”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2										2	
CO2	3	2	2										2	
CO3	3	3	3							2			2	
CO4	3	2	2										2	
CO5	3	3	2										2	
Course	3	3	3							2			2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2724	SOFT COMPUTING	3	0	0	0	3

OBJECTIVES

- To introduce the ideas of fuzzy sets and fuzzy logic
- To study the characteristics of various types of neural networks
- To provide the mathematical background for carrying out the optimization associated with neural network learning and genetic algorithms
- To gain insight in Hybrid Learning Models

UNIT I FUZZY LOGIC 10

Introduction to Neuro-Fuzzy and Soft Computing; Fuzzy Sets : Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling

UNIT II NEURAL NETWORKS 7

Supervised Learning Neural Networks: Perceptrons – Adaline – Backpropagation Multilayer Perceptron's – Radial Basis Function Networks; Unsupervised Learning Neural Networks: Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning

UNIT III CONVENTIONAL OPTIMIZATION 9

Derivative-based Optimization: Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Conjugate gradient Methods – Analysis of Quadratic Case

UNIT IV GENETIC ALGORITHMS 10

Genetic Algorithms: Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle – stopping condition – constraints – classification; Simulated Annealing – Random Search – Downhill Simplex Search – Particle Swarm Optimization – Ant Colony Optimization.

UNIT V NEURO FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems: Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN; Coactive Neuro Fuzzy Modeling: Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply fuzzy logic for solving real world problems (K3)
2. Demonstrate the use of neural networks in solving computational problems (K2)
3. Apply derivative based optimization techniques on computational problems (K3)
4. Explain genetic algorithms and evolutionary optimization (K2)

5. Analyse and compare neuro-fuzzy hybrid models (K4)

TEXTBOOKS

1. J S R Jang, C T Sun, E Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / Pearson Edu- cation 2004.

REFERENCES

1. S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications”, Prentice-Hall of India Pvt. Ltd., 2006.
2. Timothy J Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, International Editions, Electrical Engineering Series, Singapore, 1997.
3. Davis E Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.
4. Samir Roy, “Introduction to Softcomputing : NeuroFuzzy and Genetic Algorithms”, First edition, Pearson Publishers, 2015.
5. R Eberhart, P Simpson, R Dobbins, “Computational Intelligence - PC Tools”, AP Professional, Boston. 1996.
6. Stamatios V Kartalopoulos, “Understanding Neural Networks and Fuzzy Logic Basic concepts & Applications”, IEEE Press, PHI, New Delhi, 2004.
7. Vojislav Keeman, “Learning & Soft Computing Support Vector Machines, Neural Net- works, and Fuzzy Logic Models”, Pearson Education, New Delhi, 2006.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											3	
CO2	3	2											3	
CO3	3												1	
CO4	3	2											3	
CO5	3	2	3		2				3	3		3	3	
Score	15	8	3		2				3	3		3	13	
Course Mapping	3	2	3		2				3	3		3	3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2725	DEEP LEARNING	3	0	0	0	3

OBJECTIVES

- To understand the basics of deep neural networks
- To understand CNN and RNN architectures of deep neural networks
- To comprehend advanced deep learning models
- To learn the evaluation metrics for deep learning models.

UNIT I DEEP NETWORKS BASICS 9

Linear Algebra: Scalars – Vectors – Matrices and tensors; Probability Distributions – Gradient- based Optimization – Machine Learning Basics: Capacity – Overfitting and underfitting – Hyperparameters and validation sets – Estimators – Bias and variance – Stochastic gradient de- scent – Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization – Optimization.

UNIT II CONVOLUTIONAL NEURAL NETWORKS 9

Convolution Operation – Sparse Interactions – Parameter Sharing – Equivariance – Pooling – Convolution Variants: Strided – Tiled – Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions – Loss Functions – Regularization – Optimizers – Gradient Computation.

UNIT III RECURRENT NEURAL NETWORKS 10

Unfolding Graphs – RNN Design Patterns: Acceptor – Encoder – Transducer; Gradient Com- putation – Sequence Modeling Conditioned on Contexts – Bidirectional RNN – Sequence to Sequence RNN – Deep Recurrent Networks – Recursive Neural Networks – Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM.

UNIT IV MODEL EVALUATION 8

Performance metrics – Baseline Models – Hyperparameters: Manual Hyperparameter – Automatic Hyperparameter – Grid search – Random search – Debugging strategies.

UNIT V AUTOENCODERS AND GENERATIVE MODELS 9

Autoencoders: Undercomplete autoencoders – Regularized autoencoders – Stochastic encoders and decoders – Learning with autoencoders; Deep Generative Models: Variational autoencoders – Generative adversarial networks.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the basics in deep neural networks (K2)
2. Apply Convolution Neural Network for image processing (K3)
3. Apply Recurrent Neural Network and its variants for text analysis (K3)
4. Apply model evaluation for various applications (K3)
5. Apply autoencoders and generative models for suitable applications (K4)

TEXTBOOKS

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

REFERENCES

1. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, “A Guide to Convolutional Neural Networks for Computer Vision”, Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.
2. Yoav Goldberg, “Neural Network Methods for Natural Language Processing”, Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.
3. Francois Chollet, “Deep Learning with Python”, Manning Publications Co, 2018.
4. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Punlishing, 2018.
5. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
6. Taweh Beysolow II, "Applied Natural Language Processing with Python - Implementing Machine Learning and Deep Learning Algorithms for Natural Language Processing", Apress, 2018.
7. Li Deng, Yang Liu, "Deep Learning in Natural Language Processing", Springer, 2018

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2											2	
CO2	3	3		3	3				3				3	2
CO3	3	3		3	3				3				3	2
CO4	3	2											2	
CO5	3	3		3	3								3	2
Total	15	13		9	9				6				13	6
Course Mapping	3	3		3	3				3				3	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2726	MULTICORE ARCHITECTURES AND PROGRAMMIN	3	0	0	0	3

OBJECTIVES

- To understand the need for multi-core processors, and their architecture
- To understand the challenges in parallel and multi-threaded programming
- To learn about the various parallel programming paradigms
- To develop OpenMP programs and design parallel solutions
- To develop an application using MPI programming.

UNIT I MULTI-CORE PROCESSORS 9

Single core to Multi-Core Architectures; SIMD and MIMD Systems; Interconnection Networks; Symmetric and Distributed Shared Memory Architectures – Cache Coherence – Performance Issues – Parallel Program Design.

UNIT II PARALLEL PROGRAMMING 9

Performance – Scalability; Synchronization and Data Sharing – Data Races – Synchronization Primitives (mutexes, locks, semaphores, barriers); Deadlocks and Livelocks; Communication Between Threads (condition variables, signals, message queues and pipes).

UNIT III SHARED MEMORY PROGRAMMING WITH OPENMP 9

OpenMP Execution Model: Memory model – OpenMP Directives – Work-Sharing Constructs – Library Functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

MPI program execution: MPI constructs – Libraries; MPI Send and Receive – Point-to-point and collective communication; MPI derived datatypes – Performance evaluation.

UNIT V PARALLEL PROGRAM DEVELOPMENT 9

Case studies: n-Body solvers; Tree Search – OpenMP and MPI implementations and comparison.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Summarize the limitations of single core processors and the concepts behind various multi-core architectures (K2)
2. Explain the issues in programming parallel processors (K2)
3. Develop programs using OpenMP (K3)
4. Develop programs using MPI (K3)
5. Compare and contrast programming for serial processors and parallel processors (K2)

TEXTBOOKS

1. Peter S Pacheco, “An Introduction to Parallel Programming”, Morgan Kaufmann/Elsevier,

2011.
2. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris”, Pearson, 2011.

REFERENCES

1. Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.
2. Victor Alessandrini, “Shared Memory Application Programming, Concepts and Strategies in Multicore Application Programming”, 1st Edition, Morgan Kaufmann, 2015.
3. Yan Solihin, “Fundamentals of Parallel Multicore Architecture”, CRC Press, 2015.
4. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, Dror Maydan and Jeff McDonald, “Parallel Programming in OpenMP”, 1st Edition, Morgan Kaufmann, 2000.
5. Gerassimos Barlas, “Multicore and GPU Programming”, Morgan Kaufmann, 2014.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2	3													
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2								3			2	
Score	15	6								3			6	
Course Mapping	3	2								3			2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2727	NETWORK AND SERVER SECURITY	3	0	0	0	3

OBJECTIVES

- To study about the essentials of computer security
- To acquire knowledge on TCP/IP security, firewalls, IPSec, Virtual Private Networks, and intrusion detection systems
- To understand how various security mechanisms work, and correlate these security mechanisms with security principles
- To learn the security aspects of data center
- To learn the security protocols and technologies with respect to infrastructure.

UNIT I INTRODUCTION 9

Computer Security Concepts – Security Attacks – Security Services - Security Mechanisms - A Model for Network Security- Standards. Attack on Public Key Cryptography – Public Key Certificates: X.509 Authentication services – Attacks on PKI – Types of Digital Certificates.

UNIT II SECURITY PRACTICES & SYSTEM SECURITY 9

Internet Firewalls for Trusted System: Roles of Firewalls – Types of Firewalls – Netfilter – IPtables – Firewall design Principles – DNS Attacks – Cache Poisoning – SET (Secure Electronic Transaction) for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures.

UNIT III E-MAIL, IP & WEB SECURITY 9

E-mail Security: Security Services for E-mail-attacks possible through E-mail – Establishing keys privacy authentication of the source – Message Integrity-Non-repudiation – Pretty Good Privacy – S/MIME; IPSecurity: Overview of IPSec – IP and IPv6 – Authentication Header – Encapsulation Security Payload (ESP) – Internet Key Exchange; Web Security: SSL/TLS Basic Protocol – Computing the keys – Client authentication – PKI as deployed by SSLAttacks fixed in v3 – Exportability-Encoding - SET.

UNIT IV DATA CENTER SECURITY OVERVIEW 9

Data center security overview: Need for a secure data center – Vulnerabilities and common attacks; Network Security Infrastructure; Security Fundamentals; Data center security frame- works: Security policies – Security lifecycle; Secure Management Framework.

UNIT V SECURITY PROTOCOLS AND TECHNOLOGIES 9

Security Protocols and Technologies: Cryptography – PKI – Transport Security – Authentication Protocols and Technologies; Network management security; Integrating security into the infrastructure: Defining security zone – Internet Edge – Intranet Server Farm – Server-Farm Design Alternative – Management Network.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Summarize the essentials of computer security (K2)

2. Explain the various applications of network security (K2)
3. Outline the essentials of security practices and system security (K2)
4. Explain the security aspects in designing a datacenter (K2)
5. Design the security protocols for the infrastructure (K3).

TEXTBOOKS

1. William Stallings, "Network Security Essentials: Applications and Standards", Sixth Edition, Pearson, 2017.
2. Mauricio Arregoces, Maurizio Portolani, "Data Center Fundamentals", Cisco Press, 2003.

REFERENCES

1. Charlie Kaufman, Radia Perlman and Mike Speciner , "Network Security: Private Communication in a Public World", Second Edition, Pearson Education, 2017.
2. Wenliang Du, "Computer Security: A Hands-on Approach", CreateSpace Independent Publishing Platform, First Edition, 2017.

CO to PO Mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO1 1**	**PO12**	**PSO 1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-
Total	15	10	-	-	-	-	-	-	-	-	-	-	10	-
Score	3	2	-	-	-	-	-	-	-	-	-	-	2	-

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2739	HEALTHCARE DATA ANALYTICS	3	0	0	0	3

OBJECTIVES

- Discuss the role of basic and advanced data analytics in healthcare systems
- Describe the statistical and computational methods and techniques used for data analytics in EHR, Image and Sensor data
- Describe the statistical and computational methods and techniques used for data analytics in Signal, Genome and Text Data
- Describe the Advanced Data Analytics techniques used to analyze and interpret health-care data effectively in Healthcare Organizations
- Identify techniques to communicate insights gained from data analysis in Healthcare Applications

UNIT I INTRODUCTION TO HEALTHCARE DATA ANALYTICS 9

Introduction – Healthcare Data Sources and Basic Analytics – Advanced Data Analytics for Healthcare – Applications and Practical Systems for Healthcare – Resources for Healthcare Data Analytics

UNIT II HEALTHCARE DATA SOURCES AND BASIC ANALYTICS: PART I 9

Electronic Health Records: A Survey: Components of EHR – Coding Systems – Challenges of Using EHR Data – Phenotyping Algorithms; Biomedical Image Analysis: Biomedical Imaging Modalities – Object Detection – Image Segmentation – Image Registration – Feature Extraction; Mining of Sensor Data in Healthcare: A Survey: Mining Sensor Data in Medical Informatics: Scope and Challenges – Challenges in Healthcare Data Analysis – Sensor Data Mining Applications – Nonclinical Healthcare Applications.

UNIT III HEALTHCARE DATA SOURCES AND BASIC ANALYTICS: PART II 9 9

Biomedical Signal Analysis: ECG Signal Analysis – Denoising of Signals – Multivariate Biomedical Signal Analysis – Cross-Correlation Analysis; Genomic Data Analysis: Genomic Data Generation – Methods and Standards for Genomic Data Analysis; Natural Language Processing and Data Mining for Clinical Text: Mining Information from Clinical Text – Challenges of Processing Clinical Reports – Clinical Applications: EHR and Decision Support.

UNIT IV ADVANCED DATA ANALYTICS FOR HEALTHCARE 9

A Review of Clinical Prediction Models: Basic Statistical Prediction Models – Alternative Clinical Prediction Models – Survival Models – Evaluation and Validation; Temporal Data Mining for Healthcare Data: Association Analysis – Temporal Pattern Mining – Sensor Data Analysis – Other Temporal Modeling Methods; Visual Analytics for Healthcare: Introduction to Visual Analytics and Medical Data Visualization – Visual Analytics in Healthcare; Predictive Models for Integrating Clinical and Genomic Data: Issues and Challenges in Integrating Clinical and Genomic Data – Different Types of Integration – Different Goals of Integrative Studies – Validation.

UNIT V APPLICATIONS AND PRACTICAL SYSTEMS FOR HEALTHCARE 9

Fraud Detection in Healthcare: Definition and Types of Healthcare Fraud – Identifying Health- care Fraud from Data – Knowledge Discovery-Based Solutions for Identifying Fraud; Data Analytics for Pharmaceutical Discoveries: Introduction – Chemical and Biological Data – Spontaneous Reporting Systems (SRSs); Clinical Decision Support Systems: Various Types of CDSS, Diagnostic Decision Support.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the basic and advanced data analytics in public health (K2)
2. Integrate patient data from multiple sources into data models using analytics tools for EHR, Image and Sensor Data (K3)
3. Integrate patient data from multiple sources into data models using analytics tools for Signal, Genome and Text Data (K3)
4. Apply meaningful patterns and trends in advanced data analytics systems (K3)
5. Apply descriptive and inferential methodologies according to the type of study design in Healthcare practical systems (K3)

TEXTBOOKS

1. Chandan K. Reddy and Charu C. Aggarwal, “Healthcare Data Analytics”, CRC Press, Tay- lor & Francis Group, LLC., 2015

REFERENCES

1. Trevor L. Strome, “Healthcare Analytics for Quality and Performance Improvement”, John Wiley & Sons, 2013
2. Sergio Consoli, Diego Reforgiato Recupero and Milan Petkovi, “Data Science for Health- care Methodologies and Applications”, Springer Nature Switzerland AG., 2019
3. Joseph M. Woodside , “Applied Health Analytics and Informatics Using SAS”, SAS Insti- tute, O’Reilly, 2018

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2												
CO2	3	2											3	
CO3	3	2		3								2	3	
CO4	3	2											3	
CO5	3	2											3	
Score	15	10		3								2	12	
Course Mapping	3	2		3								2	3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2728	USER EXPERIENCE DESIGN	3	0	0	0	3

OBJECTIVES

- To understand the goals and principles of interface design
- To study life cycle models and identify the requirements for interface design
- To learn effective prototypes for construction of user interface design
- To know about user testing
- To use tools to develop UI design for mobile app.

UNIT I FOUNDATIONS OF INTERACTION DESIGN 9

Interaction design – Good and poor design – Goals of interaction design – Design and usability principles; Conceptual models – Interface metaphors – Interaction paradigms – From conceptual models to physical design.

UNIT II PROCESS AND REQUIREMENTS 9

Activities of interaction design – Key characteristics of interaction design process – Lifecycle models; Establish requirements – Different kinds of requirements – Data gathering; Data interpretation and analysis – Task description – Task analysis.

UNIT III DESIGN AND CONSTRUCTION 9

Prototyping and construction – Low-fidelity prototyping – High-fidelity prototyping – Com- promises in prototyping – Construction: from design to implementation; Conceptual Design: Moving from requirements to first design – Perspectives for developing a conceptual model – Expanding the conceptual model – Scenarios and prototypes in conceptual design; User- centered approach – Ethnography in design.

UNIT IV EVALUATION AND TESTING 9

What, why, and when to evaluate – Hutchworld case study; Evaluation paradigms and techniques; User testing – Experiments – Predictive models.

UNIT V MOBILE HCI 9

Mobile Ecosystem: Platforms – Application frameworks; Types of Mobile Applications: Widgets – Applications – Games; Mobile Information Architecture – Mobile 2.0 – Mobile Design: Elements of Mobile Design– Tools.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the fundamentals of user interaction design (K2)
2. Identify the user requirements and interpret data (K3)
3. Develop an efficient prototype to communicate and model the design definitions. (K3)
4. Apply UX design in a case study. (K3)
5. Examine the customer experience. (K4)

TEXTBOOKS

1. Preece J, Rogers Y, Sharp H, “Interaction design: Beyond Human-Computer Interaction”, 4th edition John Wiley & Sons Ltd, 2015. (Unit 1 to 4)
2. Brian Fling, “Mobile Design and Development”, 1st Edition , O’Reilly Media Inc, 2009. (Unit 5)

REFERENCES

1. Preece J, Rogers Y, Sharp H, Baniyon D, Holland S and Carey T, “Human Computer Interaction”, Addison-Wesley, 1994.
2. B. Shneiderman, “Designing the User Interface”, Addison Wesley 2000 (Indian Reprint).
3. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2004.
4. Bill Scott and Theresa Neil, “Designing Web Interfaces”, 1st Edition, O’Reilly, 2009.

CO to PO Mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO1 1**	**PO12**	**PSO 1**	**PSO2**
CO1	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	3	-	-	-	-	-	-	2	-	-	-	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	11	-	-	-	-	-	-	2	-	-	-	6
	3	2	3							2	0	0	0	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2741	SOCIAL NETWORK ANALYSIS AND APPLICATIONS	3	0	0	0	3

OBJECTIVES

- Understand the fundamentals of social network analysis
- Representing formally the social networks
- Be acquainted with the working of various community detection algorithms
- Learn to analyze social networks using SNA tools
- Learn to do visualization for social networks using Visualization tools

UNIT I INTRODUCTION 9

Social Network Analysis: Development of social network analysis – Key concepts and measures in network analysis – Electronic Sources for Network Analysis: Electronic discussion networks – Blogs and online communities – Web-based networks – Social Network Data: Introduction – Boundary specification and sampling – Types of networks – Network data – Measurement and collection.

UNIT II MATHEMATICAL REPRESENTATION OF SOCIAL NETWORKS 9

Notations for Social Networks: Graph theoretic notations – Sociometric notations – Algebraic notations – Two sets of actors – Graph and matrices.

UNIT III COMMUNITY DETECTION METHODOLOGIES, APPLICATIONS 9

Introduction – Definition of communities – Evaluating communities – Methodologies of Net- work Community Mining: Optimization based algorithms – Heuristic methods – Other methods – Applications of community mining algorithms – multi-Relational characterization of dynamic social network communities.

UNIT IV PRACTICAL APPROACH TO SOCIAL NETWORK ANALYSIS 9

Graph Theory: Introduction – Adjacency matrices – Graph Traversals and Distances – Graph Distance; SNA Tool: Get oriented with Python and NetworkX – Centrality; Clique, Clusters and Components: Components and Subgraphs – Triads – Cliques – Hierarchical Clustering; 2-Mode networks; A dynamic model in Python.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9

Visualizing online social networks – Visualizing social networks with matrix-based representations – Node-Edge diagrams – Matrix and Node-Link Diagrams – Hybrid representations; Applications: Covert networks – Community welfare – Collaboration networks – Co-citation networks.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Describe social network concepts, measures and data (K2)
2. Apply social networks concepts using formal methods (K3)

3. Compare the working of community detection algorithms (K2)
4. Apply SNA concepts for social networks using NetworkX tool (K3)
5. Design and analyse social networks using visualization tools to solve real world problems (K4)

TEXTBOOKS

1. Stanley Wasserman, Katherine Faust, "Social Network Analysis Methods and Applications", 1st Edition, Cambridge University Press, 1999. (Unit I and Unit II)
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010. (Unit III and Unit V)

REFERENCES

1. Peter Mika, "Social Networks and the Semantic Web", 1st Edition, Springer, 2007 (Unit I).
2. Maksim Tsvetovat and Alexander Kouznetsov, "Social Network Analysis for Startups", O'Reilly, 2011 (Unit IV).
3. Edward L. Platt, "Network Science with Python and NetworkX Quick Start Guide: Ex- plore and visualize network data effectively", Packt Publishing, 2019.
4. Stephen P Borgatti, Martin G Everett, Jeffrey G Johnson, "Analyzing Social Networks", SAGE Publications, 2nd Edition, 2018.
5. Charles Kadushin, "Understanding Social Networks: Theories, Concepts, and Findings", 1st Edition, Kindle Edition, Oxford University Press, 2012.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											3	
CO4	3	2											2	
CO5	3	3	3	3	3				3	3			3	2
Score	15	11	3	3	3				3	3			12	2
Mapping	3	3	3	3	3				3	3			3	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2735	PRINCIPLES OF REINFORCEMENT LEARNING	3	0	0	0	3

OBJECTIVES

- To understand the basics of reinforcement learning techniques
- To explore various methods used in reinforcement learning
- To apply reinforcement learning techniques for various case studies.

UNIT I INTRODUCTION 9

Reinforcement Learning – Examples – Elements of Reinforcement Learning – Limitations and Scope – Tic-Tac-Toe; Multi-armed Bandits; Finite Markov Decision Processes.

UNIT II TABULAR SOLUTION METHODS 11

Dynamic Programming; Monte Carlo Methods: Prediction – Estimation of Action Values – Control – Control without Exploring Starts – Off-policy Prediction via Importance Sampling – Incremental Implementation – Off-policy Monte Carlo Control; Temporal-Difference Learning.

UNIT III INTEGRATION OF TABULAR METHODS 9

n-step Bootstrapping: TD Prediction – Sarsa – Off-policy Learning; Planning and Learning with Tabular Methods.

UNIT IV APPROXIMATE SOLUTION METHODS 10

On-policy Prediction with Approximation; On-policy Control with Approximation; Eligibility Traces: The λ-return – TD(λ) – n-step Truncated λ-return Methods – Online λ-return Algorithm – True Online TD(λ); Policy Gradient Methods.

UNIT V APPLICATIONS AND CASE STUDIES 6

TD-Gammon; Watson's Daily-Double Wagering; Optimizing Memory Control; Human-level Video Game Play.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Illustrate the basics of reinforcement learning problem (K2)
2. Solve various problems using tabular solution methods (K3)
3. Apply the integrated tabular methods for problem solutions (K3)
4. Illustrate approximate solution methods for larger state space problems (K2)
5. Apply reinforcement learning techniques for various case studies (K3)

TEXTBOOKS

1. Richard S Sutton & Andrew G. Barto, "Reinforcement Learning: An Introduction", The MIT Press, 2nd Edition, 2018.
2. Marco Wiering, Martijn van Otterlo, "Reinforcement Learning State-of-the-Art", Springer, 2012.

REFERENCES

1. Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi & Jan Peters, “Reinforcement Learning Algorithms: Analysis and Applications”, Springer, 1st edition, 2021.
2. Micheal Lanham, “Hands-On Reinforcement Learning for Games”, Packt Publishing Ltd., 2020.
3. Taweh Beysoloqw II, “Applied Reinforcement Learning with Python”, Apress, 2019.
4. Dimitri Bertsekas, “Reinforcement Learning and Optimal Control”, Athena Scientific, 2019.

CO to PO Mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO1 1**	**PO12**	**PSO 1**	**PSO2**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2											2	
CO5	3	2								3		3	2	
Score	15	10								3		3	10	
Course Mapping	3	2								3		3	2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2729	BLOCKCHAIN TECHNOLOGIES	3	0	0	0	3

OBJECTIVES

- To understand blockchain technology and distributed systems
- To learn how decentralization of trust is achieved
- To study the technologies behind cryptocurrencies
- To impart knowledge of distributed ledgers in business
- To acquire knowledge in emerging concepts using blockchain

UNIT I INTRODUCTION 9

The growth of blockchain technology – Distributed Systems – P2P – Distributed Ledger – Cryptographically Secure - Generic Element of Blockchain – Benefits and limitation of blockchain – Tiers of BT – Types of Blockchain - Consensus – CAP Theorem and Blockchain.

UNIT II DECENTRALIZATION 9

Methods of Decentralization – Routes to Decentralization – Smart Contract – Decentralized Organization – Platforms for Decentralization – Consensus Algorithms.

UNIT III CRYPTOCURRENCIES 9

Cryptographic Hash Functions – Cryptography basic and Concepts – Introduction Bitcoin – Bitcoin Network and Payments – Bitcoin clients and APIs – Alternative Coins.

UNIT IV DISTRIBUTED LEDGERS FOR BUSINESS 9

Ethereum: Introduction – Ethereum Network – Components – Programming Languages; Hyperledger: Introduction – Reference Architecture – Fabric – Sawtooth Lake – Corda.

UNIT V BLOCKCHAIN DEVELOPMENT TOOLS AND FRAMEWORKS 9

Compilers: Solidity Complier – Ganache – Metamask – Truffle; Languages: Solidity – Go – Java – NodeJS; Blockchain Use case: Financials – Insurance - Supply Chain Management – HealthCare – IoT.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the importance of distributed ledgers and need of blockchain (K2)
2. Describe decentralization concepts and apply consensus algorithms (K3)
3. Explain the basics of cryptography and its applications in cryptocurrencies (K2)
4. Apply various distributed ledgers for business (K4)
5. Make use of appropriate techniques for designing trust-based business networks (K4)

TEXTBOOKS

1. Van Haren Publishing (Editor), “Introduction to Blockchain Technology: The Many Faces of Blockchain Technology in the 21st Century”, Paperback Import, 2019.
2. Imran Bashir, “Mastering Blockchain” Packt 2nd Ediction, 2018.
3. Adrian Mcnulty, “Blockchain: The Complete and Comprehensive Guide to Understand- ing Blockchain Technologies”, Createspace Independent Pub, 2018.

REFERENCES

1. Don, Alex Tapscott, “Blockchain Revolution”. Portfolio Penguin 2016.
2. William Mougayar, “Business Blockchain Promise, Practice and Application of the Next Internet Technology”, John Wiley & Sons 2016.
3. Tiana Laurence, “Blockchain for Dummies” John Wiley & Sons, 2017.

CO to PO Mapping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	2	2
CO5	3	2	-	-	1	-	-	-	-	-	-	-	2	2
Score	15	10	-	-	2	-	-	-	-	-	-	-	10	4
Course Mapping	3	2	-	-	1	-	-	-	-	-	-	-	2	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2736	EMBEDDED SYSTEM DESIGN	3	0	0	0	3

OBJECTIVES

- To learn the architecture and programming of ARM processor
- To be familiar with the embedded computing platform design and analysis
- To study interfacing concepts
- To learn an embedded firmware and its designs
- To design embedded systems and to develop programs.

UNIT I EMBEDDED COMPUTING AND ARM PROCESSORS 9

Embedded Computing: Complex systems and microprocessors – Embedded system design process – Formalisms for system design – Model train controller; Instruction Sets: Preliminaries – ARM processor; CPUs: Programming input and output – Supervisor mode, exceptions and traps – Co-processors – Memory system mechanisms – CPU performance – CPU power consumption.

UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 9

Bus-Based Computer Systems: CPU Bus – Memory devices and systems – Designing with computing platforms – Consumer electronics architecture – Platform-level performance analysis; Program Design and Analysis: Components for embedded programs – Models of programs – Assembly, linking and loading – Compilation techniques – Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size – Program validation and testing.

UNIT III SENSOR INTERFACING WITH ARDUINO 9

Basics of hardware design and functions of basic passive components – Sensors and Actuators – Arduino code – Library file for sensor interfacing – Construction of basic applications.

UNIT IV EMBEDDED FIRMWARE 9

Reset Circuit, Brown-out Protection Circuit-Oscillator Unit – Real Time Clock-Watchdog Timer – Embedded Firmware Design Approaches and Development Languages.

UNIT V EMBEDDED C PROGRAMMING 9

Introduction – Reading switches – Adding Structure to the code; Meeting Real-Time Constraints: Creating hardware delays using Timer 0 and Timer 1 – Generating a Minimum and Maximum delay-Example – Creating a portable hardware delay – Timeout mechanisms – Creating loop timeouts – Testing loop timeouts – Hardware timeouts – Testing a hardware time- out.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the architecture and programming of ARM processor (K2)
2. Summarize the concepts of embedded systems (K2)
3. Build basic applications using peripherals and sensors (K3)
4. Apply the system design techniques to develop firmware (K3)

5. Make use of C programming for solving the problems in embedded systems (K3).

TEXTBOOKS

1. Marilyn Wolf, “Computers as Components – Principles of Embedded Computing System Design”, 3rd Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Michael J Pont, “Embedded C” , 2nd Edition, Pearson Education, 2008.

REFERENCES

1. Shibu K V, “Introduction to Embedded Systems”, McGraw Hill, 2014.
2. Jonathan W Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, 3rd Edition Cengage Learning, 2012.
3. Raj Kamal, “Embedded Systems-Architecture, Programming and Design”, 3rd edition, TMH, 2015.
4. Lyla, “Embedded Systems”, Pearson, 2013.
5. J. M. Hughes, “Arduino: A Technical Reference”, O’Reilly Media, 2016

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2								3		3	3	
CO4	3	2											3	
CO5	3	2											3	3
Score	15	10								3		3	13	3
Course Mapping	3	2								3		3	3	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2742	GRAPHICS AND MULTIMEDIA	3	0	0	0	3

OBJECTIVES

- To gain knowledge on different display devices and its working principles
- To understand the 2D and 3D dimensional graphics representation and object transformations
- To understand illumination principles and color models used in output devices
- To understand basic concepts of multimedia
- To explore Blender graphics tool and design animations.

UNIT I DISPLAY SYSTEMS AND OUTPUT PRIMITIVES 8

Introduction to computer graphics – Applications; Overview of graphics systems: Video dis- play devices – Raster scan systems – Random scan systems; Output primitives: Points and lines – Loading the frame buffer – Line drawing algorithms: DDA and Bresenham's line drawing algorithms – Circle and ellipse generating algorithms – Pixel addressing and object geometry.

UNIT II TWO-DIMENSIONAL GRAPHIC 9

Two dimensional geometric transformations: Basic transformations – Matrix representations and homogeneous coordinates – Composite transformations; Two-dimensional viewing: Viewing pipeline – viewing coordinate reference frame – Window to viewport coordinate transformation – Clipping operations: Point and text clipping – Line and polygon clipping algorithms.

UNIT III THREE-DIMENSIONAL GRAPHICS 10

Three dimensional concepts; Three-dimensional object representations: Polygon surfaces – Polygon tables – Plane equations – Polygon meshes – Curved lines and surfaces – Quadratic surfaces– Blobby objects; Three Dimensional Geometric and Modeling Transformations: Translation – Rotation – Scaling – Composite transformations; Three Dimensional Viewing: Viewing pipeline – Viewing coordinates – Projections – View volumes – Clipping.

UNIT IV ILLUMINATION MODELS AND ANIMATION 8

Light sources – Basic illumination models: Ambient, Diffuse, Specular Components of the Phong model; Color Models: Properties of light – Standard primaries and chromaticity diagram – RGB, YIQ, CMY, HSV and HLS color models; Computer Animation: Design of animation sequences – Keyframe systems – Motion specifications.

UNIT V MULTIMEDIA 10

Multimedia Systems Design: Multimedia elements – Multimedia applications – Multimedia systems architecture – Defining objects for multimedia systems – Multimedia data interface standards; Compression and decompression; Data and File Format Standards; Hypermedia Messaging; Case Study – Blender Graphics: Fundamentals – Drawing Basic Shapes – Modelling – Shading & textures.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply algorithms to manipulate output primitives such as line, circle, ellipse (K3)
2. Apply transformations, representations and clipping on 2D objects and map window to viewport

transformations (K3)
3. Apply three dimensional representations, geometric transformations, and projections on 3D objects (K3)
4. Demonstrate the working of different illumination and color models used to render an animation scene (K2)
5. Compare different types of multimedia file formats, compression techniques and demonstrate modelling, shading and textures on basic shapes using multimedia tools (K2)

TEXTBOOKS

1. Donald Hearn, Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi, 2007.
2. Andleigh P K, Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003.

REFERENCES

1. Foley, Vandam, Feiner, Hughes, "Computer Graphics: Principles and Practice", 2nd Edition, Pearson Education, 2003.
2. Jeffrey McConnell, "Computer Graphics: Theory into Practice", Jones and Bartlett Publishers, 2006.
3. Hill F S Jr, "Computer Graphics", Maxwell Macmillan, 1990.
4. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, AK Peters, "Fundamentals of Computer Graphics",CRC Press, 2010.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											3	
CO2	3	2											3	
CO3	3	2											3	
CO4	3	2											3	
CO5	3	2			2							2	3	
Score	15	10			2							2	15	
	3	2			2							2	3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2743	BUSINESS INTELLIGENCE	3	0	0	0	3

OBJECTIVES

- To understand business analytics and its related technology
- To understand the competitive advantages of business analytics
- To provide information about estimation, regression and testing of hypothesis
- To learn data mining methods
- To gain knowledge about business intelligence tools

UNIT I INTRODUCTION TO BUSINESS ANALYTICS 9

Introduction - Types of Digital Data - OLAP & OLTP - Business View of Information Technology Application - Descriptive Analytics - Prescriptive Analytics - Application of Analytics

UNIT II BUSINESS INTELLIEGENCE 9

Introduction - BI Definition and Concepts - Data Integration - Multidimensional Data Modeling

UNIT III UNDERSTANDING PROBABLITY AND STATISTICS 9

Probability - Sampling and Estimation - Confidence Intervals - Hypothesis Testing - Analysis of Variance - Correlation Analysis - Understanding Statistics

UNIT IV DATA MINING ALGORITHMS 9

Simple Linear Regression - Multiple Linear Regression - Logistic Regression - Decision Tree - Forecasting Techniques - Clustering - Mining Frequent Patterns – Associations and Correlations – Mining Methods – Pattern Evaluation Method

UNIT V BUSINESS ANALYTICS TOOLS 9

SAP Business Intelligence - Zoho Analytics - Microsoft Power BI - Tableau - Oracle BI - IBM Cognos Analytics.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain various types of business analytics (K2)
2. Apply business intelligence concepts for data modelling (K3)
3. Apply statistical tests in testing hypothesis on data (K3)
4. Analyse data by utilizing various data mining approaches (K4)
5. Build applications using business analytics tools (K3)

TEXTBOOKS

1. R N Prasad, Seema Acharya, “Fundamentals of Business Analytics”, 2nd Edition published by Wiley 2016.
2. U Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, published by Wiley 2017

REFERENCES

1. Philipp K. Janert, “Data Analysis with Open Source Tools”, O’Reilley, 2010.
2. Wes McKinney, “Python for Data Analysis”, O’Reilley, 2012.
3. Robert Nisbelt, John Elder, and Gary Miner, “Handbook of Statistical Analysis and Data Mining Applications”, Academic Press, 2009.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Businesses”, Wiley, 2013.
5. David Ruppert, “Statistics and Data Analysis for Financial Engineering”, Springer, 2011.

CO to PO Mapping

	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	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2		3	1								2	2
CO5	3	2			1								2	2
Score	15	10		3	2								10	4
Course Mapping	3	2		3	1								2	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2731	AGILE METHODOLOGIES	3	0	0	0	3

OBJECTIVES

- To understand the basic concepts of Agile software process
- To learn about agile requirement engineering
- To learn planning and management in agile software development
- To study various agile methods
- To learn the principles of agile testing and quality assurance.

UNIT I INTRODUCTION 9

Iterative and Evolutionary Development; Introduction to Agile: Agile development – Classification of methods – Agile manifesto and principles – Communication and feedback – Specific agile methods – Agile modelling; Theories for Agile Management; Management Accounting for Systems; Agile Project Management: Traditional versus RAD model for project management – Task planning and effort tracking – The project manager's new work.

UNIT II REQUIREMENTS ENGINEERING FOR AGILE METHODS 9

Traditional and Agile Requirement Engineering; Methods and Tools for Agile Practitioners: Requirements elicitation – Requirements representation and documentation – Requirements analysis – Requirements management; Agile Approaches to Requirements Engineering: The customer – Requirements evolution – Non-functional requirements; Tools for Requirements Management in AMs.

UNIT III AGILE PROJECT PLANNING AND DEVELOPMENT MANAGEMENT 9

Agile Project Planning: The Project buffer and its usage – Logical collection of inventories – Critical path – Parallel path – Critical chain – Project tracking metrics; Agile Development Management: Identifying and monitoring the flow – Bottleneck; Agile Maturity Model: A new maturity model.

UNIT IV AGILE METHODS 9

Scrum: Method overview – Life cycle – Work products – Values – Roles and practices – Process mixtures – Adoption strategies; Extreme Programming; Unified Process; EVO.

UNIT V AGILE TESTING AND QUALITY ASSURANCE 9

Agile testing: Nine principles and six concrete practices for testing on agile teams; Agile Metrics: Feature driven development (FDD) – Financial and production metrics in FDD – Agile approach to quality assurance – Test driven development; SMM: A process improvement frame- work for agile requirements engineering practices–case study.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain evolutionary, iterative and adaptive development methods (K2)
2. Apply agile software process in requirement engineering (K3)

3. Outline agile methods for project planning and development (K2)
4. Choose agile methods for software design (K3)
5. Apply agile based testing with quality assurance (K3).

TEXTBOOKS

1. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.
2. Craig Larman, "Agile and Iterative Development: A Manager's Guide", Addison-Wesley, 2004.
3. Elisabeth Hendrickson, "Agile Testing", Quality Tree Software Inc 2008.

REFERENCES

1. Hazza, Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, 2009. (Unit 5)
2. Chetankumar Patel, Muthu Ramachandran, "Story Card Maturity Model (SMM): A Process Improvement Framework for Agile Requirements Engineering Practices", Journal of Software, Academy Publishers, Vol 4, No 5, 422-435, Jul 2009. (Unit 5)
3. Kevin C Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Butterworth-Heinemann, 2007.
4. Didar Zowghi, Zhi Jin, "Requirements Engineering", Springer, chapter 15, 2014. (Unit 2)
5. Aybuke Aurum, Claes Wohlin, "Engineering and Managing Software Requirements", Springer 2005, chapter 14. (Unit 2)

CO to PO Mapping

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2	PSO 1	PSO 2
CO1	3	2											2	
CO2	3	2	2										2	
CO3	3	2	2										2	
CO4	3	2	2										2	
CO5	3	3	3										2	3
Score	15	11	9										10	3
Course Mapping	3	3	3										2	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2732	TIME SERIES ANALYSIS AND FORECASTING	3	0	0	0	3

OBJECTIVES

- To study the statistical background for forecasting.
- To explore the models for regression analysis and forecasting
- To comprehend the exponential Smoothing Methods
- To learn Autoregressive Integrated Moving Average (Arima) models
- To explore transfer Functions and Intervention Models.

UNIT I INTRODUCTION TO FORECASTING 9

Introduction to Forecasting: The Nature and Uses of Forecasts – Some Examples of Time Series – The Forecasting Process – Data for Forecasting – Resources for Forecasting – Statistics Background for Forecasting: Graphical Displays – Numerical Description of Time Series Data – Use of Data Transformations and Adjustments – General Approach to Time Series Modeling and Forecasting – Evaluating and Monitoring Forecasting Model Performance.

UNIT II REGRESSION ANALYSIS AND FORECASTING 9

Least Squares Estimation in Linear Regression Models Expert judgement – Statistical Inference in Linear Regression – Prediction of New Observations – Model Adequacy Checking – Variable Selection Methods in Regression – Generalized and Weighted Least Squares – Regression Models for General Time Series Data – Econometric Models.

UNIT III EXPONENTIAL SMOOTHING METHODS 9

First-Order Exponential Smoothing – Modeling Time Series Data – Second-Order Exponential Smoothing – Higher-Order Exponential Smoothing – Forecasting – Exponential Smoothing for Seasonal Data – Exponential Smoothing of Bio surveillance Data – Exponential Smoothers and Arima Models.

UNIT IV ARIMA MODELS 9

Linear Models for Stationary Time Series – Finite Order Moving Average Processes – Finite Order Autoregressive Processes – Mixed Autoregressive – Moving Average Processes – Non- stationary Processes – Time Series Model Building – Forecasting Arima Processes.

UNIT V TRANSFER FUNCTIONS AND INTERVENTION MODELS 9

Transfer Function Models – Transfer Function – Noise Models – Cross-Correlation Function – Model Specification – Forecasting with Transfer Function – Noise Models – Intervention Analysis.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the statistical background for forecasting (K2)
2. Apply various models for regression analysis and forecasting (K3)
3. Apply exponential smoothing methods on time series data (K3)

4. Build time series Autoregressive Integrated Moving Average (Arima) models (K3)
5. Apply transfer functions for time series modeling (K3)

TEXTBOOKS

1. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci, “Introduction to Time Series Analysis and Forecasting”, 2nd Edition, Wiley, 2015.

REFERENCES

1. Peter J Brockwell, Richard A Davis, “Introduction to Time Series and Forecasting”, 2ndh Edition, Springer, 2010.
2. George E P Box, Gwilym M Jenkins, Gregory C. Reinsel, Greta M. Ljung, ”Time Series Analysis: Forecasting and Control”, 5th Edition, Wiley, 2015
3. Robert Yaffee, Monnie McGee, ”An Introduction to Time Series Analysis and Forecast- ing”, 1st Edition, Elsevier, 2000
4. Aileen Nielsen, ”Practical Time Series Analysis”, O’Reilly , Elsevier, 2019
5. Shmueli G, K C Lichtendahl Jr, ”Practical Time Series Forecasting with R: A Hands-On Guide”, Axelrod Schnall Publisher, 2015.

CO to PO Mapping

	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	3	2											2	
CO2	3	2											3	
CO3	3	2		3									3	
CO4	3	2											3	
CO5	3	2											3	
Score	15	10		3									14	
Course Mapping	3	2		3									3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2737	COMPUTER VISION	3	0	0	0	3

OBJECTIVES

- To explore the Low-level vision features
- To learn and detect the Intermediate level features
- To familiarize the 3D vision, Depth estimation and 3D reconstruction methods
- To develop applications for Object recognition
- To implement computer vision applications using Deep learning techniques

UNIT I IMAGE BASED FEATURE EXTRACTION 9

Introduction to Computer Vision and the challenges; Image based feature extraction: Thresholding Techniques – Region growing methods – Thresholding – Adaptive thresholding – Approaches to threshold selection – Global valley approach to thresholding; Edge detection: Differential Gradient operator – Hysteresis thresholding – Canny operator – Laplacian operator – Active contours – Level set – Graph cut approach; Corner and Interest point detection: Second order derivative schemes – Harris Interest point operators – Local invariant feature detectors and descriptors; Texture;

UNIT II SHAPES AND REGIONS 9

Binary shape analysis: Skeletons and thinning – Other measures for shape recognition; Boundary Pattern analysis: Boundary tracking procedures – Centroidal profiles; Line detection: Hough transform – Foot of normal method; Circle and Ellipse detection: Hough based scheme – Ellipse detection methods; Case study: Human Iris Location;

UNIT III 3D VISION - DEPTH ESTIMATION AND 3D RECONSTRUCTION 9

Feature-based alignment: 2D and 3D feature-based alignment – pose estimation – Geometric intrinsic calibration; Structure from Motion: Triangulation – Two-frame structure from Motion – Factorization – Bundle adjustment; Stereo Correspondence: Epipolar geometry – Sparse and Dense correspondence – Multiview stereo; 3D Reconstruction: Shape from X – Active range finding – Surface representations – Point-based representations.

UNIT IV OBJECT RECOGNITION 9

Object detection: Face detection – Pedestrian detection; Face recognition: Eigen faces – Active appearance and 3D shape models; Instance recognition: Geometric alignment; Category recognition: Bag of words – Part based models; Context and scene understanding: Learning and large image collection; Applications for object recognition.

UNIT V DEEP LEARNING TECHNIQUES FOR COMPUTER VISION 9

Introduction to CNNs; Visualization of Kernels; Backprop-to-image/Deconvolution Methods; CNNs for Detection: Background of Object Detection – R-CNN – Fast R-CNN – Faster R-CNN; CNNs for Segmentation: FCN – SegNet – U-Net – Mask-RCNN; Recurrent Neural Networks (RNNs): CNN and RNN Models for Video Understanding: Spatio-temporal Models – Action/Activity Recognition

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply various low level feature detection methods (K3)
2. Apply various feature analysis methods and transforms for intermediate level vision (K3)
3. Explain depth estimation and 3D reconstruction (K2)
4. Analyse different object recognition methods (K4)
5. Analyse deep learning models for a real time computer vision application (K4)

TEXTBOOKS

1. Davies E Roy, “Computer and Machine Vision: Theory, Algorithms, Practicalities”. Academic Press, 2012.
2. Shanmugamani, Rajalingappaa, “Deep Learning for Computer Vision: Expert Techniques to Train Advanced Neural Networks Using TensorFlow and Keras”. Packt Publishing Ltd, 2018.

REFERENCES

1. Szeliski Richard, “Computer Vision: Algorithms and Applications”. Springer Science & Business Media, 2010.
2. D L Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.
3. Jan Erik Solem, “Programming Computer Vision with Python: Tools and Algorithms for Analyzing Images”, O’Reilly Media, 2012.
4. Mark Nixon, Alberto S Aquado, “Feature Extraction and Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2		3									2	
CO3	3	2											2	
CO4	3	2		3									2	
CO5	3	2		3						3		2	2	
Total	15	10		9						3		2	10	
Mapping	3	2		3						3		2	2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2738	SPEECH PROCESSING AND SYNTHESIS	3	0	0	0	3

OBJECTIVES

- To explore the fundamentals of digital speech processing
- To understand the basic concepts and algorithms of speech processing
- To be familiar with the various speech signal representation, coding and recognition techniques
- To study the concepts and evaluation methods of speech synthesis.

UNIT I FUNDAMENTALS OF DIGITAL SPEECH PROCESSING 9

Introduction: Discrete-time signals and systems – Transform representation of signals and systems – Fundamentals of digital filters – Sampling; Process of speech production – Acoustic theory of speech production – Digital models for speech signals.

UNIT II SPEECH SIGNAL ANALYSIS IN TIME DOMAIN 9

Time-dependent processing of speech – Methods for extracting the Parameters: Energy – Average magnitude – Zero-crossing rate; Silence discrimination using ZCR and energy – Short-time autocorrelation function – Pitch period estimation using autocorrelation function.

UNIT III SPEECH SIGNAL ANALYSIS IN FREQUENCY DOMAIN 9

Short time fourier analysis – Fourier transform and linear interpretations – Sampling rates – Spectrographic displays – Formant extraction – Pitch extraction – Linear predictive coding: Autocorrelation method – Covariance method; Solution of LPC equations – Durbin's Recursive solution – Application of LPC parameters – Pitch detection.

UNIT IV SPEECH RECOGNITION 9

Introduction – Preprocessing – Parametric representation – Speech segmentation – Dynamic time warping – Vector quantization – Hidden Markov Model – Language Models – Developing an isolated digit recognition system.

UNIT V SPEECH SYNTHESIS 9

Attributes of speech synthesis – Formant speech synthesis – Concatenative speech synthesis – Prosodic modification of speech – Source filter models for prosody modification – Evaluation of TTS system.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Illustrate how the speech production is modelled (K2)
2. Utilize the speech signal in time domain (K3)
3. Utilize the speech signal in frequency domain (K3)
4. Develop a speech recognition system using statistical approach (K3)
5. Compare various methods of speech synthesis (K2)

TEXTBOOKS

1. L R Rabiner, R W Schafer, “Digital Processing of Speech Signals”, Pearson Education, Delhi, India, 2004.
2. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, “Spoken Language Processing – A guide to Theory, Algorithm and System Development”, Prentice Hall PTR, 2001.

REFERENCES

1. L R Rabiner, B H Jhuang, B Yegnanarayana, “Fundamentals of Speech Recognition”, Pearson Education, 2009.
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing”, Pearson Education, 2002.
3. Ben Gold, Nelson Morgan, “Speech and Audio Signal Processing”, John Wiley and Sons Inc, 2004.
4. J R Deller Jr, J H L Hansen, J G Proakis, “Discrete-Time Processing of Speech Signals”, Wiley-IEEE Press, NY, USA, 1999.
5. Daniel Jurafsky, James H Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2nd edition, Pearson education, 2013.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2											2	
CO4	3	2	3		3								2	
CO5	3	2											2	
Score	15	10	3		3								2	
	3	2	3		3								2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2733	MOBILE COMPUTING	3	0	0	0	3

OBJECTIVES

- Understand the basic concepts of mobile computing
- Know the functionalities of layers in protocol stack
- Learn the basics of mobile telecommunication system
- Build and deploy mobile applications in mobile platforms
- Develop full-fledged mobile applications

UNIT I INTRODUCTION 9

Introduction to Mobile Computing; Media Access Control (MAC): Motivation for a specialized MAC– SDMA – FDMA – TDMA – CDMA – Comparison of S/T/F/CDMA; Wireless LAN: Infrastructure based and adhoc networks – IEEE 802.11 – Bluetooth.

UNIT II NETWORK AND TRANSPORT LAYER 9

Mobile IP: Goals, assumptions and requirements – Entities and terminology – IP packet delivery – Agent discovery – Registration –Tunneling and encapsulation – Optimizations; DHCP; AdHoc: Routing – Proactive routing protocol-DSDV – Reactive routing protocol - DSR, AODV – Hybrid routing – ZRP; Traditional TCP – Classical TCP improvements.

UNIT III MOBILE TELECOMMUNICATION SYSTEMS 9

Introduction; GSM Overview; 3GPP; UMTS and IMT-2000: Architecture – User Equipment – RNS – UTRAN – Node B – RNC Functions – IP Multimedia Subsystem; 4G Cellular Network: LTE Network Architecture – EPS Interfaces – EPS Protocols and Planes – LTE Protocol Stack – SDU and PDU – RRC – PDCP – RLC – MAC – PHY.

UNIT IV SETTING UP AND DEPLOYMENT OF MOBILE APPLICATIONS 8

iOS: iOS Architecture Layers – iOS Simulator; Android: Introduction to Android – Android's Development Environment: Introducing the Android SDK – Exploring the development environment – Building an Android application – Using the Android emulator - Developing simple applications using mobile platforms.

UNIT V APPLICATION DEVELOPMENT FOR MOBILE OS 10

User Interfaces – Intents and services – Storing and Retrieving data – Notifications and alarms – Location – Putting Android to work in a field service application.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Outline the vulnerabilities of wired and wireless networks (K2)
2. Examine security mechanisms followed in Bluetooth, Wi-Fi and Ad Hoc Networks (K3)
3. Compare security mechanisms of telecommunication networks (K3)
4. Explain hardware security architectures in mobile devices (K2)
5. Examine Android and iOS Based Security (K3).

TEXTBOOKS

1. Jochen H Schller, “Mobile Communications”, Pearson Education, New Delhi, 2nd Edition, 2007 (Unit I–III).
2. Ableson W F, Sen R, King C, “Android in Action Second Edition”, Manning Publications Co, 2011 (Unit IV,V)

REFERENCES

1. El Nashar A, El-Saidny M A, Sherif M, “Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach”, John Wiley & Sons, 2014 (4G).
2. Helal, Sumi, Raja Bose, and Wendong Li. “Mobile Platforms and Development Environments”, Synthesis Lectures on Mobile and Pervasive Computing, 2012 (iOS).
3. Helal, Abdelsalam A, et al. “Any time, anywhere computing: Mobile computing concepts and technology”, Vol. 522. Springer Science & Business Media, 1999.
4. Dharma Prakash Agarval, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.
5. C.K.Toh, “AdHoc Mobile Wireless Networks”, First Edition, Pearson Education, 2002.

CO to PO Mapping

	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	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	3	-	-	-	-	-	3	-	-	3	2
Score	15	10	-	3	-	-	-	-	-	3	-	-	8	2
Course Mapping	3	2	-	3	-	-	-	-	-	3	-	-	3	2

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2734	MOBILE AND WIRELESS SECURITY	3	0	0	0	3

OBJECTIVES

- To Understand vulnerabilities of wired and wireless networks
- To acquire knowledge on Bluetooth, Wi-Fi and Ad Hoc Networks Security
- To Understand the security in cellular networks
- To learn about mobile hardware and software security

UNIT I VULNERABILITIES OF WIRED AND WIRELESS NETWORKS 9

Introduction: Security in the digital age – Threats and risks to telecommunications systems – From wireline vulnerabilities to vulnerabilities in wireless communications. Fundamental Security Mechanisms : Basics on security – Authentication –Access control.

UNIT II WIRELESS SECURITY 9

Bluetooth technical specification – Bluetooth security. Wi-Fi Security: Attacks on wireless networks – Security in the IEEE 802.11– Security in 802.1x – Authentication in wireless net- works – Layer 3 security mechanisms. Security in Ad Hoc Networks : Attacks to routing protocols – Security mechanisms.

UNIT III SECURITY IN MOBILE TELECOMMUNICATION NETWORKS 9

Security in the GSM: Security mechanisms in GSM – Security flaws in GSM radio access – Security flaws in GSM signaling; GPRS security: GPRS architecture – GPRS security mechanisms – 3G security: UMTS infrastructure – UMTS security ; 4G Security.

UNIT IV MOBILE HARDWARE SECURITY 9

Platform Boot Integrity – Secure Storage – Isolated Execution – Device Identification – Device Authentication – Hardware Security Architectures – TEE Standards.

UNIT V MOBILE PLATFORM SECURITY 9

Android Based Security: Attacks and Threats – Security extensions for Android. iOS Based security: Limits of Apple's application vetting process – iOS security extensions.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Outline the vulnerabilities of wired and wireless networks (K2)
2. Examine the security mechanism followed in Bluetooth, Wi-Fi and Ad Hoc Networks (K3)
3. Compare the security mechanisms of telecommunication networks (K3)
4. Explain Hardware Security Architectures in mobile devices (K2)
5. Examine the Android and iOS Based Security (K3).

TEXTBOOKS

1. Hakima Chaouchi, Maryline Laurent-Maknavicius, “Wireless and Mobile Network Security-Security Basics, Security in On-the-shelf and Emerging Technologies”, Wiley-ISTE, June 2009 (Unit I–III).
2. N. Asokan, Lucas Vincenzo Davi, Alexandra Dmitrienko, Stephan Heuser, Kari Kostiainen, Elena Reshetova, Ahmad-Reza Sadeghi, “Mobile Platform Security”, Synthesis Lectures on Information Security, Privacy, and Trust, Morgan &Claypool Publishers,
2013 (Unit IV, V).

REFERENCES

1. Xiao, Yang, Shen, Xuemin Sherman, Du, Ding-Zhu, “ Wireless Network Security”, Springer, 2007.
2. Noureddine Boudriga, “Security of Mobile Communications”, CRC Press, 2019
3. Levente Buttyan, Jean-Pierre Hubaux, “Security and Cooperation in Wireless Networks”, Cambridge University Press, 2012
4. James Kempf, “Wireless Internet Security: Architectures and Protocols”, Cambridge University Press, 2010
5. Patrick Traynor, Patrick McDaniel, Thomas La Porta, “Security for Telecommunications Networks”, Springer, 2008

CO to PO Mapping

		PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	K2	3	2											3	
CO2	K2	3	2											3	
CO3 CO3	K3	3	2											3	
CO4	K3		2											3	
CO5	K3	3	2											3	
Score		12	10											15	
Course Mapping		3	2											3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2821	BIOINFORMATICS TECHNOLOGIES	3	0	0	0	3

OBJECTIVES

- Understand the concept and need of Bioinformatics
- Transform biological data into knowledge and perform data analysis
- Learn the machine learning algorithms for bioinformatics
- Learn hidden Markov modeling and probabilistic modeling
- Know the importance of microarray data analysis

UNIT I INTRODUCTION 9

Introduction to Bioinformatics: Need for Bioinformatics technologies – Overview of Bioinformatics technologies; Overview of structural bioinformatics: Organization of Structural bioinformatics – Primary resource: protein data bank – Secondary resources and applications.

UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS 9

Data warehousing in Bioinformatics: Bioinformatics data – Transforming data to knowledge – Data warehousing architecture – Data quality; Data mining for Bioinformatics: Biomedical data analysis – DNA data analysis – Protein data analysis.

UNIT III MACHINE LEARNING IN BIOINFORMATICS 9

Machine learning in Bioinformatics: Artificial Neural network – Neural network architecture and applications – Genetic algorithm – Fuzzy system.

UNIT IV MODELING FOR BIOINFORMATICS 9

Modeling for Bioinformatics: Hidden Markov modeling for biological data analysis – Comparative modeling – Probabilistic modeling – Molecular modeling.

UNIT V MICROARRAY DATA ANALYSIS 9

Microarray Data Analysis: Microarray technology for genome expression study – Image analysis for data extraction – Data Analysis for Pattern Discovery.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain the concept and need of bioinformatics (K2)
2. Identify the genome and protein data and its equivalent storage and mining process (K3)
3. Apply machine learning algorithms on bioinformatics data (K3)
4. Apply Hidden Markov Modeling and probabilistic modeling for bioinformatics data (K3)
5. Infer the importance of microarray data analysis (K2)

TEXTBOOKS

1. Yi-Ping Phoebe Chen (Ed), “Bioinformatics Technologies”, First Indian Reprint, Springer Verlag, 2007.

REFERENCES

1. Arthur M Lesk, “Introduction to Bioinformatics”, Fourth Edition, Oxford University Press, 2008
2. Rui Jiang, Xuegong Zhang, Michael Q Zhang, “Basics of Bioinformatics”, Tsinghua University Press, Springer, 2013

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2
CO1	3												2	
CO2	3	2		3									2	
CO3	3	2		3									3	
CO4	3	2											3	
CO5	3	2											2	
Total	15	8		6									12	
Score	3	2		2									3	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2822	FORMAL SYSTEM VERIFICATION	3	0	0	0	3

OBJECTIVES

- To understand the need of logics for specification and verification of computer systems
- To learn program correctness using Hoare Logic
- To learn the skill of writing formal specifications in LTL and CTL
- To learn model checking algorithms for LTL and CTL
- To learn model checking for Timed Systems.

UNIT I FOUNDATIONS 9

Propositional Logic: Syntax – Semantics – Natural deduction; Predicate Logic: Syntax – Semantics – Natural deduction; Linear-time Temporal Logic: Syntax – Semantics – Specifications in LTL; Branching-time Logic: Syntax – Semantics – Specifications in CTL; CTL* and the expressive powers of LTL and CTL.

UNIT II HOARE LOGIC AND PROGRAM CORRECTNESS 9

A Framework for Program Correctness: A core programming language – Hoare triples – Partial and total correctness – Program variables and logical variables; Proof Calculus for Partial Correctness: Proof rules – Proof tableaux; Proof Calculus for Total Correctness.

UNIT III MODEL CHECKING 9

Model-checking Algorithms: The CTL model-checking algorithm – CTL model checking with fairness – The LTL model-checking algorithm; CTL* Model-checking Algorithm; Model Checking using Automata; Checking Emptiness; Translating LTL into Automata; On-the-fly Model checking.

UNIT IV SYMBOLIC MODEL CHECKING 9

Binary Decision Diagrams: Representing Boolean formulas – Representing Kripke structures; Fixpoint Representations; Symbolic Model Checking for CTL; Fairness in Symbolic Model Checking; Counterexamples and Witnesses; Relational Product Computations; Symbolic Model Checking for LTL; NuSMV.

UNIT V MODEL CHECKING TIMED SYSTEMS 9

Timed Automata: Semantics – Time divergence – Timelock – Zenoness; Timed Computation Tree Logic; TCTL Model Checking: Eliminating timing parameters – Region transition systems – The TCTL model-checking algorithm; Model checkers for Timed Automata: UPPAAL – KRONOS.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Analyse and compare various model checking algorithms (K3)
2. Construct proofs for partial correctness of simple programs using Hoare logic (K3)
3. Develop formal properties and specifications in CTL and LTL (K3)
4. Develop and verify simple systems using NuSMV (K3)

5. Develop and verify simple systems using UPPAAL (K3)

TEXTBOOKS

1. M Huth, M Ryan, “Logic in Computer Science – Modeling and Reasoning About Systems”, 2nd Edition, Cambridge University Press, 2004 (Units I, II and III).
2. Edmund Clarke, Orna Grumberg, Doron Peled, “Model Checking”, The MIT Press, 1999 (Units III and IV).
3. C Baier, J Katoen, “Principles of Model Checking”, The MIT Press, 2008 (Unit V).

REFERENCES

1. Michael Clarke, Thomas Henzinger, Helmut Veith, Roderick Bloem, “Handbook of Model Checking”, Springer 2018.
2. Orna Grumberg, Helmut Veith, “25 Years of Model Checking: History, Achievements, Perspectives” Springer-Verlag, 2008.
3. Zohar Manna, Amir Pnueli, “Temporal Verification of Reactive Systems: Safety”, Springer-Verlag, 2012.
4. Krzysztof R. Apt, Frank S. de Boer, Ernst-Rudiger Olderog, “Verification of Sequential and Concurrent Programs”, Springer, 3rd edition, 2009.

CO to PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2										2	2	-
CO2	3	2											2	-
CO3	3	2											2	-
CO4	3	2											2	-
CO5	3	2							3	3			3	-
Total	15	10							3	3		2	11	-
Score	3	2							3	3		2	3	-

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2823	SERVICE ORIENTED ARCHITECTURE	3	0	0	0	3

OBJECTIVES

- To learn the fundamentals of XML
- To understand Service Oriented Architecture, Web services and their importance
- To know the web services standards and technologies
- To study the web service extensions
- To develop SOA based applications using service-oriented analysis and design.

UNIT I XML TECHNOLOGIES 9

XML Document Structure: Well-formed and valid documents – DTD – XML schema; Parsing XML using DOM – SAX; XPath – XML transformation and XSLT – XQuery.

UNIT II SERVICE ORIENTED ARCHITECTURE BASICS 9

Characteristics of SOA – Benefits of SOA – Comparing SOA with client server and distributed architectures – Principles of service orientation – Service layers.

UNIT III WEB SERVICES AND STANDARDS 8

Web Services Platform – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Service level interaction patterns – Orchestration and choreography.

UNIT IV WEB SERVICES EXTENSIONS 8

WS-Addressing – WS-Reliable messaging – WS-Policy – WS-Coordination – WS-Transactions – WS-Security – Examples – XML web services for .Net.

UNIT V SERVICE ORIENTED ANALYSIS AND DESIGN 11

Service oriented enterprise applications – Service Oriented Analysis and Design: Need for models – Principles of service design – Design of activity services – Design of data services – Design of client services – Design of business process services.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply appropriate XML technologies to solve a given problem (K4)
2. Explain service orientation, benefits of SOA (K2)
3. Describe web services and WS standards (K2)
4. Apply web services extensions to develop solutions (K3)
5. Apply service modeling, service-oriented analysis and design for application development in teams (K3).

TEXTBOOKS

1. Thomas Erl, “Service Oriented Architecture: Concepts, Technology, and Design”, Pear- son Education, 2005.

2. Sahankar Kambhampaly, “Service-Oriented Architecture for Enterprise Applications”, Wiley India Pvt.Ltd, 2008

REFERENCES

1. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, “Java Web Services Architecture”, Elsevier, 2003.
2. Ron Schmelzer et al, “XML and Web Services”, Pearson Education, 2002.
3. Frank P Coyle, “XML, Web Services and the Data Revolution”, Pearson Education, 2002.
4. Sandeep Chatterjee, James Webber, “Developing Enterprise Web Services: An Architect’s Guide”, Prentice Hall, 2004.
5. Eric Newcomer, Greg Lomow, “Understanding SOA with Web Services”, Pearson Education, 2005.

CO to PO Mapping

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2												3
CO2	2	2												3
CO3	3	2												3
CO4	3	3												3
CO5	3	2												3
Course	3	3												3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2824	INFORMATION RETRIEVAL TECHNIQUES	3	0	0	0	3

OBJECTIVES

- To understand the basics of information retrieval with pertinence to modeling
- To understand various components of IR system
- To understand machine learning techniques for text classification and clustering
- To explore various IR applications.

UNIT I INTRODUCTION AND MODELING 9

Basic Concepts: Retrieval process – Architecture – Boolean retrieval; IR Models: Taxonomy and characterization of IR models – Classical IR models – Alternative algebraic models – Models for Browsing – Retrieval Evaluation: Performance evaluation.

UNIT II INDEXING AND QUERYING 9

Indexing: Inverted indices – Suffix trees – Suffix arrays – Compression; Querying: Query languages; Query Operations: Relevance feedback and query expansion – Automatic local and global analysis.

UNIT III SEARCHING 9

Searching: Sequential searching – Pattern matching; Searching the Web: Characterizing the Web – Search engines – Browsing – Searching using hyperlinks.

UNIT IV CLASSIFICATION AND CLUSTERING 9

Text Classification: Naive Bayes; Vector Space Classification: Rocchio – k-Nearest Neighbour; Flat Clustering: K-Means – Model-based clustering – Hierarchical clustering – Matrix decom- positions and latent semantic indexing.

UNIT V APPLICATIONS 9

XML Retrieval – Multimedia IR – Parallel and Distributed IR – Digital Libraries – Social Media Retrieval – Content-based Image Retrieval – Online Public Access Catalogs (OPACs).

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Apply the IR modeling techniques for the document retrieval problem and measure the performance of IR systems by making use of IR evaluation metrics (K3)
2. Construct the basic components of an IR system namely indexing and querying (K3)
3. Explain the searching techniques for IR and Web (K2)
4. Apply machine learning techniques to text classification and clustering for efficient Information Retrieval (K3)
5. Develop an IR application by applying best practices with proper documentation in teams (K4)
6. Demonstrate the use of IR applications in different domains (K2)

TEXTBOOKS

1. Ricardo Baeza Yates, Berthier Ribeiro Neto, “Modern Information Retrieval: The Concepts and Technology behind Search”, ACM Press Books, 2nd Edition, 2011.
2. Christopher D Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval”, Cambridge University Press, 1st South Asian Edition, 2008.

REFERENCES

1. Stefan Buttcher, Charles L A Clarke, Gordon V Cormack, “Information Retrieval – Implementing and Evaluating Search Engines”, The MIT Press, Cambridge, Massachusetts London, England, 2010.
2. Cheng Xiang Zhai, Sean Massung, “Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining”, ACM Books, 2016.
3. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, “Social Media Mining: An Introduction”, 1st Edition, Cambridge University Press, 2014.
4. Vipin Tyagi, “Content-Based Image Retrieval: Ideas, Influences, and Current Trends”, 1st Edition, Springer, 2017.
5. Marcia J Bates, “Understanding Information Retrieval Systems: Management, Types, and Standards”, CRC Press, 2012.

CO to PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											2	
CO2	3	2											2	
CO3	3	2												
CO4	3	2		3								2	2	
CO5	3	2												
Total	15	10		3								2	6	
Course Mapping	3	2		3								2	2	

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2825	INTRODUCTION TO ROBOTICS	3	0	0	0	3

OBJECTIVES

- To understand the basic concepts associated with the design, functioning, applications and social aspects of robots
- To study about the electrical drive systems and sensors used in robotics for various applications
- To learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector
- To learn about various motion planning techniques and the associated control architecture
- To understand the implications of AI and other trending concepts of robotics.

UNIT I FOUNDATION 9

Introduction – Brief history – Definition – Anatomy – Types – Classification – Specification and need based applications – Role and need of robots for the immediate problems of the society – Future of mankind and automation-ethical issues – Industrial scenario local and global – Case studies on mobile robot research platform and industrial serial arm manipulator.

UNIT II BUILDING BLOCKS OF A ROBOT 9

Types of electric motors : DC – Servo – Stepper; Specification – Drives for motors – Speed & direction control and circuitry – Selection criterion for actuators – Direct drives – Non- traditional actuators - Sensors for localization – Navigation – Obstacle avoidance and path planning in known and unknown environments – Optical – Inertial – Thermal – Chemical – Biosensor – Other common sensors – Case study on choice of sensors and actuators for maze solving robot and self-driving cars.

UNIT III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END-EFFECTORS 9

Robot kinematics – Geometric approach for 2R, 3R manipulators – homogenous transformation using D-H representation – Kinematics of WMR – Lagrangian formulation for 2R robot dynamics – Mechanical design aspects of a 2R manipulator, WMR – End-effector: Common types and design case study.

UNIT IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTUR 9

Mapping & Navigation – SLAM, Path planning for serial manipulators – Types of control architectures – Cartesian control – Force control and hybrid position/force control – Behaviour based control – Application of Neural network, fuzzy logic, optimization algorithms for navigation problems – Programming methodologies of a robot.

UNIT V AI AND OTHER RESEARCH TRENDS IN ROBOTICS 9

Application of Machine learning – AI – Expert systems – Tele-robotics and Virtual reality – Micro & Nanorobots – Unmanned vehicles – Cognitive robotics – Evolutionary robotics – Humanoids.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Summarize the concepts of industrial robots (K2)
2. Apply different sensors and actuators for applications like maze solving and self-driving cars (K3)
3. Model a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots (K3)
4. Apply the navigation and path planning techniques for robot motion planning (K3)
5. Outline the impact and progress of AI in the field of robotics (K2).

TEXTBOOKS

1. Roland Siegwart, Illah Reza Nourbakhsh, "Introduction to Autonomous Mobile Robots", MIT Press, 2011.
2. Saeed B Niku, "Introduction to Robotics, Analysis, System, Applications", Pearson educations, 2002.

REFERENCES

1. Richard David Klafter, Thomas A Chmielewski, Michael Negin, "Robotic engineering: An Integrated Approach", Prentice Hall, 1989.
2. Craig, J J, "Introduction to Robotics: Mechanics and Control", 2nd Edition, Addison- Wesley, 1989.
3. K S Fu, R C Gonzalez and C S G Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw-Hill, 1987.
4. Wesley E Snyder R, "Industrial Robots, Computer Interfacing and Control", Prentice Hall International Edition, 1988.
5. Robin Murphy, "Introduction to AI Robotics", MIT Press, 2000.

CO to PO Mapping

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO1	3												2	
CO2	3	2											2	
CO3	3	2											3	
CO4	3	2								3		3	3	
CO5	3	2											3	3
Score	15	8								3		3	13	3
Course Mapping	3	2								3		3	3	3

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2827	SOFTWARE DEFINED NETWORKING	3	0	0	0	3

OBJECTIVES

- To understand the need for SDN and it's data plane operations
- To understand the functions of control plane
- To comprehend the the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts of network virtualization

UNIT I SDN: BACKGROUND AND DATA PLANE 9

Evolving Network Requirements – The SDN Approach – SDN- and NFV-Related Standards – SDN Data Plane – OpenFlow Logical Network Device – OpenFlow Protocol.

UNIT II SDN CONTROL PLANE 9

SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – Open Daylight – REST – Cooperation and Coordination Among Controllers.

UNIT III SDN APPLICATION PLANE 9

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking – Mobility and Wireless – Information-Centric Networking.

UNIT IV NETWORK FUNCTION VIRTUALIZATION 9

NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use Cases – SDN and NFV.

UNIT V NETWORK VIRTUALIZATION 9

Virtual LANs – OpenFlow VLAN Support – Virtual Private Networks – Network Virtualization – Open Daylight's Virtual Tenant Network – Software-Defined Infrastructure.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Describe the motivation for SDN and its data plane (K2)
2. Identify the functions of control plane (K3)
3. Apply SDN motivations to networking applications (K3)
4. Apply various operations of network function virtualization (K3)
5. Explain various use cases of SDN (K2)

TEXTBOOKS

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud",

Pearson, 1st Edition, 2015.

REFERENCES

1. Thomas D. Nadeau, Ken Gray,“SDN: Software Defined Networks”, O’Reilly Media, 2013.
2. Fei Hu , “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014.
3. Paul Goransson Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2nd Edition, Morgan Kaufmann Press, 2016.
4. Oswald Coker, Siamak Azodolmolky,"Software-Defined Networking with OpenFlow", 2nd Edition, O’Reilly Media, 2017.

CO to PO Mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO10**	**PO1 1**	**PO12**	**PSO 1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	-	-	3	-	-	-	-	-	-	2	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	2	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-
Total	15	11	-	-	3	-	-	-	-	-	-	6	10	-
Score	3	2	-	-	3	-	-	-	-	-	-	2	2	-

COURSE CODE	COURSE TITLE	L	T	P	E	C
UCS2826	PARALLEL ALGORITHMS	3	0	0	0	3

OBJECTIVES

- To understand the design of parallel algorithms
- To select suitable procedures for parallel algorithms
- To understand different parallel architectures and models of computation
- To introduce the various classes of parallel algorithms
- To study parallel algorithms for basic problems.

UNIT I INTRODUCTION 9

Theoretical models of parallel computation: variants of the PRAM model, interconnection networks, synchronous and asynchronous models - Computational Models- Interacting Variables - Performance of parallel algorithms.

UNIT II TECHNIQUES 9

Basic techniques: balanced trees - recursive doubling - divide and conquer - partitioning - pipelining - accelerated cascading - symmetry Breaking

UNIT III LIST TECHNIQUES 9

List ranking - the Euler tour technique - tree contraction - Lowest Common Ancestors - Searching - Merging - sorting

UNIT IV GRAPH ALGORITHMS 9

Connected Components - Colouring - Minimal spanning tree - Shortest path algorithm - Parallel algorithms on interconnection networks and other architectures

UNIT V LIMITS TO PARALLELIZABILITY 9

String Matching - Text analysis - Pattern Matching - Limits to parallelizability - NC-reductions - P-completeness

TOTAL PERIODS: 45

COURSE OUTCOMES

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

1. Explain why communication and coordination are critical to ensure correctness (K2)
2. Explain the parallelism inherent in a simple sequential algorithm (K2)
3. Apply suitable procedures for parallel algorithms (K3)
4. Apply parallel algorithms for standard problems and applications(K3)
5. Analyse efficiency of different parallel algorithms (K4).

TEXTBOOKS

1. J. Jaja, An Introduction to Parallel Algorithms, Addison Wesley, 1992.
2. F. T. Leighton, Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann Publishers, San Mateo, California,1992.

REFERENCES

1. J. H. Reif, Synthesis of Parallel Algorithms, Morgan Kaufmann Publishers, San Mateo, California.
2. S. G. Akl, Parallel Computation: Models and Methods, Prentice Hall, 1996.

CO to PO Mapping

PO/PSO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2										2		
CO2	3	2										2		
CO3	3	2										2		
CO4	3	2										2		
CO5	3	2										2		
Course	3	2										2		

OPEN ELECTIVES (OFFERED BY OTHER DEPARTMENTS)

OPEN ELECTIVE I (SEMESTER VI)

CODE	COURSE TITLE	L	T	P	E	C
	BME					
UBM2041	Principles of Biomedical Instrumentation	3	0	0	0	3
UBM2042	Materials for Biomedical Applications	3	0	0	0	3
UBM2043	Hospital planning and Waste Management	3	0	0	0	3
	Chemical	3	0	0	0	3
UCH2041	e-Waste Management	3	0	0	0	3
UCH2042	Nanoscience for Engineers	3	0	0	0	3
UCH2043	Sustainable Development	3	0	0	0	3
	Civil					
UCE2041	Green Building Design	3	0	0	0	3
UCE2042	Sustainable Infrastructure	3	0	0	0	3
UCE2043	Integrated Water Resource Management	3	0	0	0	3
UCE2044	Environmental Impact Assessment	3	0	0	0	3
	ECE					
UEC2041	Foundation course on Digital Signal Processing	3	0	0	0	3
UEC2042	Introduction to Communication systems	3	0	0	0	3
UEC2043	Development of Nano sensors	3	0	0	0	3
UEC2045	Introduction to Sensors and Actuators	3	0	0	0	3
	EEE					
UEE2041	Autonomous Vehicles	3	0	0	0	3
UEE2042	Sensors and Instrumentation	3	0	0	0	3
UEE2043	Energy Management	3	0	0	0	3
	IT					
UIT2041	Introduction to AR and VR	2	0	2	0	3
	Mechanical					
UME2041	Six Sigma Data analysis	2	0	2	0	3
UME2042	Product Engineering	3	0	0	0	3
UME2043	Operations Management	3	0	0	0	3
	MBA					
PBA2041	Entrepreneurship	3	0	0	0	3
PBA2042	Supply Chain and Logistics Management	3	0	0	0	3
PBA2043	Design Thinking	2	0	2	0	3
	Maths					
UMA2041	Graph theory and Applications	3	0	0	0	3
UMA2042	Introduction to Linear algebra	3	0	0	0	3
UMA2043	Numerical Methods for Engineering	3	0	0	0	3
	English					
UEN2041	English for Career needs	3	0	0	0	3
UEN2042	Word power for Academic needs	3	0	0	0	3
UEN2043	Writing skills for university admission	3	0	0	0	3

OPEN ELECTIVE II (SEMESTER VIII)

CODE	COURSE TITLE	L	T	P	E	C
	BME					
UBM2044	Brain Machine Interface	3	0	0	0	3
UBM2045	Biomedical Physics	3	0	0	0	3
UBM2046	Telehealth Technology	3	0	0	0	3
	Chemical					
UCH2044	Industrial Safety	3	0	0	0	3
UCH2045	Industrial Waste Management and Audit	3	0	0	0	3
UCH2046	Energy Conservation and Audit	3	0	0	0	3
	Civil					
UCE2045	Experimental Techniques and Instrumentation	3	0	0	0	3
UCE2046	Air Pollution and Control Engineering	3	0	0	0	3
UCE2047	Remote Sensing and GIS	3	0	0	0	3
UCE2048	Environmental Geo-technology	3	0	0	0	3
	ECE					
UEC2047	Introduction to Wireless Networks	3	0	0	0	3
UEC2049	Consumer Electronics	3	0	0	0	3
UEC2051	Introduction to Bio Electromagnetics	3	0	0	0	3
	EEE					
UEE2044	Cyber Security in Smart Grid	3	0	0	0	3
UEE2045	FEA and CAD for Electromagnetic Design	3	0	0	0	3
UEE2046	Renewable Energy Systems	3	0	0	0	3
	IT					
UIT2053	Web services and DevOps	3	0	0	0	3
	Mechanical					
UME2044	Enterprise Resource Planning	3	0	0	0	3
UME2045	Project Management and Planning	3	0	0	0	3
UME2046	Introduction to Industrial Engineering	3	0	0	0	3
	MBA					
PBA2044	Innovation and Creativity	3	0	0	0	3
PBA2045	Intellectual Property Rights	3	0	0	0	3
	Physics					
UPH2041	Optical and Luminescence Characteristics of Materials	3	0	0	0	3
UPH2046	Nanoscience and Nanomaterials	3	0	0	0	3
UPH2047	Astrophysics	3	0	0	0	3
	English					
UEN2044	Creative Writing	3	0	0	0	3
UEN2045	Introduction to Children’s Literature	3	0	0	0	3