

P.S. R. ENGINEERING COLLEGE

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

Approved by AICTE, New Delhi & Accredited by NBA and
by NAAC with A+ Grade, Recognized under 12(B) of the UGC Act, 1956)

An ISO 9001: 2015 Certified Institution

Sevalpatti (P.O), Sivakasi – 626140.



Department of Computer Science and Engineering

CURRICULUM

AND

SYLLABI

UG Regulation - 2023

B.E., Computer Science and Engineering

(Full-Time)

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CURRICULUM AND SYLLABI

FOR

B.E. Computer Science and Engineering

(FULL-TIME)

INSTITUTE VISION & MISSION

Vision	● To contribute to the society through excellence in technical education with societal values and thus a valuable resource for industry and the humanity.
Mission	● To create an ambience for quality learning experience by providing sustained care and facilities. ● To offer higher level training encompassing both theory and practices with human and social values. ● To provide knowledge based services and professional skills to adapt tomorrow's technology and embedded global changes.

DEPARTMENT VISION & MISSION

Vision	● To impart holistic education in Computer Science and Engineering to cater the needs in academia, industry and society.
Mission	● Offering under graduate and post graduate Programmes by providing effective and balanced curriculum and equip themselves to gear up to the ethical challenges awaiting them. ● To confer continuous activities in technical and research that will enable the students to face the real time challenges in the field of Computer Science and Engineering. ● To provide training for the students in a socially responsible manner with inculcating integrity and human values.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- Lead a **successful career** by acquiring essential knowledge in the field of Computer Science and Engineering.
- Assess **real life problems** and deal with them confidently relevant to the society.
- Engage in **lifelong learning by pursuing higher education, Research** and as **Entrepreneurs**.
- Build interpersonal skills, **team work** with **ethical values** to meet the societal needs.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- PSO1. **Design, Implement, Test** and evaluate a **computer system, component**, or **Algorithm** to meet desired needs and to solve a computational problem.
- PSO2. **Analyze and Develop** solutions in a **wide range of Computer Science and Engineering domains** to tackle real-life problems **by applying industry-standard practices and strategies**.
- PSO3. **Promote** knowledge for identifying gaps, proposing innovative solutions, and **potentially** conducting **research to test and validate ideas**.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

- PO1. Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2. Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3. Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4. Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5. Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6. The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)
- PO7. Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8. Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9. Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10. Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11. Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
CHOICE BASED CREDIT SYSTEM – UG REGULATIONS 2023

B.E. (CSE) Curriculum & Syllabus

Total No. of Credits: 164

Semester – I

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1	HS	231IP00	Induction Programme	-	-	-	-	0
THEORY:								
2	HS	231HS11	Functional English	3	0	0	3	3
3	BS	231BS11	Matrices and Calculus	2	1	0	3	3
4	BS	231BS12	Engineering Physics	3	0	0	3	3
5	BS	231BS13	Engineering Chemistry	3	0	0	3	3
6	ES	231ES11	Basic Electrical and Electronics Engineering	3	0	0	3	3
7	ES	231ESF1	Problem Solving and Python Programming	3	0	0	3	3
8	HS	231HS12	Heritage of Tamils / தமிழர் மரபு	1	0	0	1	1
PRACTICAL:								
9	BS	231BS17	Physics and Chemistry Laboratory	0	0	3	3	1.5
10	ES	231ESF7	Python Programming Laboratory	0	0	3	3	1.5
11	EEC	231HS17	English Communication Laboratory-I	0	0	2	2	1
Total Number of Periods:				19	1	8	28	
Total Number of Credits:								23

Semester – II

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
THEORY:								
1.	HS	231HS21	English for Engineers	3	0	0	3	3
2.	BS	231BS21	Partial Differential Equations and Numerical Methods	2	1	0	3	3
3.	BS	231BS24	Material Science	3	0	0	3	3
4.	BS	231BS21	Environmental Science	3	0	0	3	3
5.	ES	231ESF2	Engineering Drawing	1	0	2	3	3
6.	PC	231CS21	Programming in C	3	0	0	3	3
7.	HS	231HS22	Tamils and Technology / தமிழர்களும் தொழில்நுட்பமும்	1	0	0	1	1
PRACTICAL:								
8.	ES	231ESF8	Engineering Practices Laboratory	0	0	3	3	1.5
9.	PC	231CS27	Programming in C Laboratory	0	0	3	3	1.5
10.	EE	231HS27	English Communication Laboratory-II	0	0	2	2	1
11.	HS	NCC-L1	NCC Credit Course Level 1*	2	0	0	2	2*
Total Number of Periods:				18	1	8	29	
Total Number of Credits:								23

Semester – III

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
THEORY:								
1	BS	231MA31	Transforms and Complex Analysis	3	0	0	3	3
2	PC	231CS31	Computer Organization and Architecture	3	0	0	3	3
3	PC	231CS32	Data Structures	3	0	0	3	3
4	PC	231CS33	Programming for Data Science	3	0	0	3	3
5	PC	231CS34	Object Oriented Programming using C++	3	0	0	3	3
THEORY–CUM–PRACTICAL:								
6	ESC	231CS35	Digital Electronics and Microprocessors	3	0	1	4	3
MANDATORY COURSE:								
7	MC	231MC0x	Mandatory Course – I*	1	0	0	1	1*
PRACTICAL:								
8	PC	231CS37	Data Structures Laboratory	0	0	3	3	1.5
9	PC	231CS38	C++ Programming Laboratory	0	0	3	3	1.5
10	EEC	231HS37	Enhancing Communication Skills	0	0	2	2	1*
Total Number of Periods:				19	0	9	28	
Total Number of Credits:								21

Semester – IV

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
THEORY:								
1	PC	231CS41	Database Management Systems	3	0	0	3	3
2	PC	231CS42	Design and Analysis of Algorithms	3	0	0	3	3
3	PC	231CS43	Programming with Java	3	0	0	3	3
4	PC	231CS44	Theory of Computation	3	0	0	3	3
THEORY–CUM–PRACTICAL:								
5	PC	231CS45	Operating Systems	3	0	2	5	4
6	PC	231CS46	Computer Networks	3	0	2	5	4
PRACTICAL:								
7	PC	231CS47	Database Management Systems Laboratory	0	0	3	3	1.5
8	PC	231CS48	Java Programming Laboratory	0	0	3	3	1.5
9	EEC	231HS47	Enhancing Aptitude and Reasoning Skills	0	0	1	1	1*
10	EEC	VACCS0x	Value Added Course – I*	0	0	1	1	1*
11	HS	NCC-L2	NCC Course Level 2*	-	-	-	-	-
Total Number of Periods:				18	0	12	30	
Total Number of Credits:								23

Semester – V

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
THEORY:								
1	PC	231CS51	Artificial Intelligence and Machine Learning	3	0	0	3	3
2	PC	231CS52	Web Technology	3	0	0	3	3
THEORY–CUM–PRACTICAL:								
3	PC	231CS53	Cloud Computing Techniques	3	0	2	5	4
PROFESSIONAL ELECTIVE:								
4	PE	231CSVxx	Professional Elective – I	3	0	0	3	3
5	PE	231CSVxx	Professional Elective – II	3	0	0	3	3
OPEN ELECTIVE:								
6	OE	231OExx	Open Elective – I	3	0	0	3	3
MANDATORY COURSE:								
7	MC	231MC0x	Mandatory Course – I	1	0	0	1	0
HONORS COURSES:								
8	PE	231CSH0x	Honors Course – I	3	0	0	3	3 [#]
9	PE	231CSH0x	Honors Course – II	3	0	0	3	3 [#]
PRACTICAL:								
10	PC	231CS57	Machine Learning Practices Laboratory	0	0	3	3	1.5
11	PC	231CS58	Web Technology Laboratory	0	0	3	3	1.5
Total Number of Periods:				19	0	8	27	
Total Number of Credits:								22

Semester – VI

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
THEORY:								
1	PC	231CS61	Object Oriented Software Engineering	3	0	0	3	3
THEORY–CUM–PRACTICAL:								
2	PC	231CS62	Mobile Application Development	3	0	2	5	4
3	PC	231CS63	Internet of Things	3	0	2	5	4
PROFESSIONAL ELECTIVE:								
4	PE	231CSVxx	Professional Elective – III	3	0	0	3	3
5	PE	231CSVxx	Professional Elective – IV	3	0	0	3	3
OPEN ELECTIVE:								
6	OE	231OE1x	Open Elective – II	3	0	0	3	3
	PE	231CSH0x	Honors Course – III	3	0	0	3	3 [#]
	PE	231CSH0x	Honors Course – IV	3	0	0	3	3 [#]
MANDATORY COURSE:								

7	MC	231MC0x	Mandatory Course – II	2	0	0	2	0
PRACTICAL:								
8	EEC	231CS69	Mini Project	0	0	2	2	1
Total Number of Periods:				20	0	9	26	
Total Number of Credits:								21

Semester – VII

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
THEORY-CUM-PRACTICAL:								
1.	PC	231CS71	Big Data Analytics	3	0	2	5	4
2	PC	231CS72	Deep Learning	3	0	2	5	4
PROFESSIONAL ELECTIVE:								
3	PE	231CSVxx	Professional Elective – V	3	0	0	3	3
4	PE	231CSVxx	Professional Elective – VI	3	0	0	3	3
OPEN ELECTIVE:								
5	OE	231OE1x	Open Elective – III	3	0	0	3	3
MANAGEMENT ELECTIVE:								
6	HSMC	231BAEx	Management Elective – I	3	0	0	3	3
HONORS COURSES:								
7	PE	231CSH0x	Honors Course – V					
8	PE	231CSH0x	Honors Course – VI					
PRACTICAL:								
9	EEC	231CS79	Project – I	0	0	4	4	2
10	EEC	231CS70	Internship / Field Project	0	0	1	1	1
Total Number of Periods:				18	0	9	27	
Total Number of Credits:								23

Semester – VIII

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
PRACTICAL:								
1	EEC	231CS89	Project – II	0	0	16	16	8
Total Number of Periods:				0	0	16	16	
Total Number of Credits:								8

Total Number of Credits = 23+23+21+23+22+21+23+8 = 164

LIST OF OPEN ELECTIVES

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	OE	231OE1A	Basics of Java Programming	3	0	0	3	3
2	OE	231OE1B	C Programming for all	3	0	0	3	3
3	OE	231OE1C	Introduction to Artificial Intelligence	3	0	0	3	3
4	OE	231OE1D	Fundamentals of Scripting Languages	3	0	0	3	3
5	OE	231OE1E	Data Structures using Python	3	0	0	3	3
6	OE	231OE1F	Fundamentals of Databases	3	0	0	3	3

LIST OF MANAGEMENT ELECTIVES

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	OE	231BAE1	Women Studies and Women Empowerment	3	0	0	3	3
2	OE	231BAE2	Entrepreneurship	3	0	0	3	3
3	OE	231BAE3	Professional Ethics in Engineering	3	0	0	3	3
4	OE	231BAE4	Engineering Economics & Accounting	3	0	0	3	3
5	OE	231BAE5	Essentials of Management	3	0	0	3	3
6	OE	231BAE6	Intellectual Property Rights	3	0	0	3	3

VERTICAL I – CYBER SECURITY

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	PE	231CSV11	Cryptography and Network Security	3	0	0	3	3
2	PE	231CSV12	Data Security	3	0	0	3	3
3	PE	231CSV13	Ethical Hacking	3	0	0	3	3
4	PE	231CSV14	Cryptocurrency and Blockchain Technologies	3	0	0	3	3
5	PE	231CSV15	Cyber Laws and Digital Forensics	3	0	0	3	3
6	PE	231CSV16	Multimedia Security	3	0	0	3	3
7	PE	231CSV17	Malware Analysis	3	0	0	3	3
8	PE	231CSV18	Firewalls and Intrusion Detection Systems	3	0	0	3	3

VERTICAL II – CLOUD TECHNOLOGIES AND DATA MANAGEMENT

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	PE	231CSV21	Software Defined Networks	3	0	0	3	3
2	PE	231CSV22	Cloud Architecture	3	0	0	3	3
3	PE	231CSV23	Virtualization and Cloud Deployment	3	0	0	3	3
4	PE	231CSV24	Cloud Storage and Data Management	3	0	0	3	3
5	PE	231CSV25	Cloud Optimization Techniques	3	0	0	3	3

6	PE	231CSV26	DevOps for Cloud Computing	3	0	0	3	3
7	PE	231CSV27	Cloud Services	3	0	0	3	3
8	PE	231CSV28	Cloud Security	3	0	0	3	3

VERTICAL III – COMPUTING TECHNOLOGIES

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	PE	231CSV31	Distributed Computing	3	0	0	3	3
2	PE	231CSV32	Edge and Fog Computing	3	0	0	3	3
3	PE	231CSV33	Quantum Computing: Algorithms and Limitation	3	0	0	3	3
4	PE	231CSV34	High Performance Computing	3	0	0	3	3
5	PE	231CSV35	Financial Computing	3	0	0	3	3
6	PE	231CSV36	Green Computing	3	0	0	3	3
7	PE	231CSV37	Pervasive Computing	3	0	0	3	3
8	PE	231CSV38	Multi Programming	3	0	0	3	3

VERTICAL IV – FULL STACK DEVELOPMENT

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	PE	231CSV41	Visual and Interaction Design	3	0	0	3	3
2	PE	231CSV42	Web Designing using HTML and CSS	3	0	0	3	3
3	PE	231CSV43	Java Scripts	3	0	0	3	3
4	PE	231CSV44	Modern Java Script Web Development	3	0	0	3	3
5	PE	231CSV45	Framework for Microservices	3	0	0	3	3
6	PE	231CSV46	.NET Programming	3	0	0	3	3
7	PE	231CSV47	Database Technologies	3	0	0	3	3
8	PE	231CSV48	Web Application Security	3	0	0	3	3

VERTICAL V – ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TECHNOLOGIES

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	PE	231CSV51	Optimization Techniques for Machine Learning	3	0	0	3	3
2	PE	231CSV52	Ethics in Intelligent Systems	3	0	0	3	3
3	PE	231CSV53	Soft Computing Techniques	3	0	0	3	3
4	PE	231CSV54	Computational Intelligence	3	0	0	3	3
5	PE	231CSV55	Computer Vision	3	0	0	3	3
6	PE	231CSV56	MLOps	3	0	0	3	3
7	PE	231CSV57	Artificial Intelligence in Healthcare	3	0	0	3	3
8	PE	231CSV58	Generative Artificial Intelligence	3	0	0	3	3

VERTICAL VI – DATA SCIENCE AND ENGINEERING

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	PE	231CSV61	R Programming	3	0	0	3	3
2	PE	231CSV62	Bio Informatics and Health Data Science	3	0	0	3	3
3	PE	231CSV63	Smart Video Analytics	3	0	0	3	3
4	PE	231CSV64	Business Analytics	3	0	0	3	3
5	PE	231CSV65	Predictive Data Science	3	0	0	3	3
6	PE	231CSV66	Exploratory Data Analysis	3	0	0	3	3
7	PE	231CSV67	Data Visualization Tools	3	0	0	3	3
8	PE	231CSV68	SQL for Data Science	3	0	0	3	3

LIST OF COURSES FOR HONOURS

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	PE	231CSH01	Agile Technologies	3	0	0	3	3
2	PE	231CSH02	Network Simulation and Modelling	3	0	0	3	3
3	PE	231CSH03	Test Automation and Quality Assurance	3	0	0	3	3
4	PE	231CSH04	Identity and Access Management	3	0	0	3	3
5	PE	231CSH05	Game Programming	3	0	0	3	3
6	PE	231CSH06	Natural Language Processing and Chatbots	3	0	0	3	3

MANDATORY COURSES - I

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	MC	231MC11	Women and Gender Studies	1	0	0	1	0
2	MC	231MC12	Foreign Language	1	0	0	1	0
3	MC	231MC13	Design Thinking	1	0	0	1	0
4	MC	231MC14	Disaster Management	1	0	0	1	0
5	MC	231MC15	Essentials of First Aid	1	0	0	1	0

MANDATORY COURSES - II

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	MC	231MC21	Basics of Yoga, Ayurveda and Siddha	1	0	0	1	0
2	MC	231MC22	History of Science and Technology in India	1	0	0	1	0
3	MC	231MC23	Indian Information Technology Act	1	0	0	1	0
4	MC	231MC24	Political System in India	1	0	0	1	0
5	MC	231MC25	Report preparation using Modern Tools	1	0	0	1	0

HSMC: Humanities & Social Sciences including Management Course

BSC: Basic Science Course

ESC: Engineering Science Course

EEC: Employability Enhancement Course

PC: Professional Core Course

PSC: Professional Skill Core Course

PE: Professional Elective Course

OE: Open Elective Course

***NCC Course** Level#1 is offered to the students enrolled for NCC only. The grades earned will not be considered for the computation of CGPA



P.S.R. ENGINEERING COLLEGE, SIVAKASI – 626140.

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

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Consolidated Curriculum Structure

(UG Regulations 2023)

Programme: B.E. – COMPUTER SCIENCE AND ENGINEERING

Semester	Theory Courses						Theory - cum - Practical Courses		Non - Credit Courses	Practical Courses		Special Courses	Value Added / Mandatory Courses	Total Credits
1	231HS11 Functional English (3)	231BS11 Matrices and Calculus (3)	231BS12 Engineering Physics (3)	231BS13 Engineering Chemistry (3)	231EE11 Basic Electrical and Electronics Engg. (3)	231CSF1 Problem Solving and Python Programming (3)	231HS12 Heritage of Tamils / தமிழ் மரபு (1)	-	-	231BS17 Physics and Chemistry Laboratory (1.5)	231ESF7 Python Programming Laboratory (1.5)	231HS17 English Communication Laboratory-I (1)	-	23
2	231HS21 English for Engineers (3)	231BS21 Partial Differential Eqns. and Numerical Methods (3)	231BS22 Physics of Materials (3)	231CY24 Environmental Science (3)	231CS21 Programming in C (3)	-	231HS22 Tamils and Technology / தமிழ் தொழில் நுட்பம் (1)	231ESF2 Engineering Drawing (3)	NCC Credit Course Level 1*	231ESF8 Engineering Practices Laboratory (1.5)	231CS27 C Programming Laboratory (1.5)	231HS27 English Communication Laboratory-II (1)	-	23

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3	231MA31 Transforms and Complex Analysis (3)	231CS31 Computer Organization and Architecture (3)	231CS32 Data Structures (3)	231CS33 Programming for Data Science (3)	231CS34 Object Oriented Programming using C++ (3)	-		231EC35 Digital Electronics and Micro-processors (3)	-	231CS37 Data Structures Laboratory (1.5)	231CS38 C++ Programming Laboratory (1.5)	231HS37 Enhancing Communication Skills (0)	Mandatory Course – I	22
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Curriculum and Syllabi (UG Regulations – 2023)

Sem - ester	Theory Courses						Theory-cum-Practical Courses		Non-Credit Courses	Practical Courses		Special Courses	Value Added / Mandatory Courses	Total Credits
4	231CS41 Database Management Systems (3)	231CS42 Design and Analysis of Algorithms (3)	231CS43 Programming with Java (3)	231CS44 Theory of Computation (3)		-	231CS45 Operating Systems (4)	231CS46 Computer Networks (4)	NCC Credit Course Level 2*	231CS47 Database Management Systems Laboratory (1.5)	231CS48 Java Programming Laboratory (1.5)	231HS47 Enhancing Aptitude and Reasoning Skills	Value Added Course – I	23
5	231CS51 Artificial Intelligence and Machine Learning (3)	231CS55 Web Technology (3)	231CSE* Elective – I (3)	231CSE* Elective – II (3)	231OE** Open Elective – I (3)	-	231CS72 Cloud Computing Techniques (4)	-	-	231CS57 Machine Learning Practices Laboratory (1.5)	231CS58 Web Technology Laboratory (1.5)	-	Mandatory Course – II	22
6	231CS61 Object Oriented Software Engineering (3)	231CSE* Elective – III (3)	231CSE* Elective – IV (3)	231OE** Open Elective – II (3)	-	-	231CS62 Mobile Platform Technologies (4)	231CS63 Internet of things (4)	-	-	231CS69 Mini Project (1)	-	Value Added Course – II	21
7	231CSE* Elective – V (3)	231CSE* Elective – VI (3)	231OE** Open Elective – VII (3)	231BAE* Mgmt. Elective – I (3)	-	-	231CS71 Big Data Analytics (4)	231CS72 Deep Learning (4)	-	231CS79 Project – I (2)	231CS70 Internship (1)	-	-	23
8	-	-	-	-	-	-	-	-	-	231CS89 Project – II (8)	-	-	-	8
Total Credits														164

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Cyber Security	Vertical II Cloud Technologies and Data Center Management	Vertical III Computing	Vertical IV Full Stack Development	Vertical V Artificial Intelligence and Machine Learning Technologies	Vertical VI Data Science and Engineering
231CSV11 – Cryptography and Network Security	231CSV21 – Software Defined Networks	231CSV31 – Distributed Computing	231CSV41 – Visual and Interaction Design	231CSV51 – Optimization Techniques for Machine Learning	231CSV61 – R Programming
231CSV12 – Data Security	231CSV22 – Cloud Architecture	231CSV32 – Edge and Fog Computing	231CSV42 – Web Designing using HTML and CSS	231CSV52 – Ethics In Intelligent Systems	231CSV62 – Bio Informatics and Health Data Science
231CSV13 – Ethical Hacking	231CSV23 – Virtualization and Cloud Deployment	231CSV33 – Quantum Computing Architecture	231CSV43 – Java Scripts	231CSV53 – Soft Computing	231CSV63 – Image and Video Analytics
231CSV14 – Cryptocurrency and Blockchain Technologies	231CSV24 – Cloud Storage and Data Management	231CSV34 – High Performance Computing	231CSV44 – Modern Java Script Web Development	231CSV54 – Computational Linguistics	231CSV64 – Business Analytics
231CSV15 – Cyber Law and Digital Forensics	231CSV25 – Cloud Optimization Techniques	231CSV35 – Financial Computing	231CSV45 – Framework for Microservices	231CSV55 – Computer Vision	231CSV65 – Predictive Analytics
231CSV16 – Multimedia Security	231CSV26 – DevOps for Cloud Computing	231CSV36 – Green Computing	231CSV46 – .NET Programming	231CSV56 – ML Model Deployment and MLOps	231CSV66 – Exploratory Data
231CSV17 – Malware Analysis	231CSV27 – Cloud Services	231CSV37 – Pervasive Computing	231CSV47 – Database Technologies	231CSV57 – Healthtech Artificial Intelligence	231CSV67 – Data Visualization Tools

231CSV18 – Firewalls and Intrusion Detection Systems	231CSV28 – Cloud Security	231CSV38 – Multi Programming	231CSV48 – Web Application Security	231CSV58 – Trustworthy and Generative Artificial Intelligence	231CSV68 – SQL for Data Science
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231IP00	INDUCTION PROGRAMME				
Programme:	B.E. Computer Science and Engineering	Sem:	1	Category:	-
This is a mandatory 2-week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.					
The induction programme has been introduced by AICTE with the following objective: “Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen, and a human being. Besides the above, several meta-skills and underlying values are needed.” “One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity, and understanding of the self, people around them, society at large, and nature. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.					
(i) Physical Activity This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.					
(ii) Creative Arts Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.					
(iii) Universal Human Values This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. The methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real-life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.					
(iv) Literary Activity The literary activity would encompass reading, writing, and possibly, debating, enacting a play, etc.					
(v) Proficiency Modules This would address some lacunas that students might have, for example, English, computer familiarity, etc.					

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the underprivileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking, etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests/assessments during this programme.

References:

1. Guide to Induction program from AICTE

231HS11		FUNCTIONAL ENGLISH			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	1	Category:		HS
Pre-/Co-requisite:		Basic Language Proficiency						
Aim:	To acquire basic Language Skills (LSRW) in order to communicate confidently in academic, professional, and social contexts							
Course Outcomes: The Students will be able to								
CO1:	Understand the extensive vocabulary usage in formal English Learning.							
CO2:	Read and comprehend the content in general and professional contexts.							
CO3:	Write definitions, descriptions, narrations, and essays on various topics.							
CO4:	Express their opinions effectively in both oral and written communication.							
CO5:	Develop listening skills and participate effectively in conversations.							
CO6:	Apply basics of Language & Grammar relating to English communication.							
GENERAL READING AND FREE WRITING								9
Listening – Listening to comprehension (story), native accents Speaking - Greetings, introducing one’s self, one’s family, asking for directions Reading – Casual reading, skimming & scanning, summarizing, note taking, reading comprehension. Writing - Paragraph writing, letter writing (formal & informal), Grammar - Parts of Speech. Vocabulary - Synonyms & Antonyms								
DEVELOPING CONVERSATIONAL ABILITY								9
Listening - Listening to short and long conversations from different domains, telephonic conversations. Speaking -Narrating personal experiences/events; Interviewing celebrity, task based speeches, giving instructions. Reading - Detecting meaning from context, reading biographies, travelogues, newspaper reports, and technical blogs. Writing - e-mail writing, report writing. Grammar - Subject Verb Agreement; WH question, Yes or No type questions. Vocabulary - misplaced modifiers.								
OPINION READING AND WRITING								9
Listening –Watching animated stories, and documentaries & responding to questions, Speaking - Product description, stress, and intonation- pronunciation skills, discussing various current issues (GD). Reading –Critical reading, short stories, verbal reasoning, reading editorials & opinion blocks. Writing -Writing definitions; instructions and interpreting charts. Grammar -Degrees of comparison; relative pronoun. Vocabulary –Homonyms and Homophones,								
ACCENTS AND MEDIA WRITING								9
Listening – Listening to the talks of great personalities, news videos, and phonetic sounds. Speaking –summarizing documentaries, interviews, podcasts, and mini presentations. Reading – Newspaper articles; Journal reports –and Non Verbal Communication (tables, pie charts etc.) Writing – Note-making/Note taking (*studies skills to be taught, not tested)Writing recommendations; from nonverbal (chart, graph, etc, to verbal mode) Grammar – Articles; simple tenses Vocabulary - Root words								
DESCRIPTIVES AND NARRATIVES								9
Listening –Listening to debates, discussions, scientific lectures & educational videos. Speaking – Picture descriptions, Debates, Role play. Reading – silent reading (newspapers, books, pamphlets), understanding captions. Writing – Essay Writing (Descriptive or narrative). Grammar – Continuous and Perfect tenses. Vocabulary -Idioms and Phrases.								
Total Periods: 45								
Text Book:								
1. Dr.Veena Selvam, Dr.Sujatha Priyadarshini , “English for Engineering Students S. Chand Edition Jan-2005								

2. Sean Susan, “*English for Science and Technology*”, Cambridge University Press, 2021

References:

1. “*Technical Communication–Principles and Practices*” by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.
2. Kumar Kul Bhushan, “*Effective Communication Skills*”, Khanna Book Publishing, 2016
3. Viswamohan Aysha “*English for Technical Communication*”, Mcgraw Hill Education, May 2008

Extensive Reading:

1. Shiv Khera, *You Can Win*, Macmillan Books, New Delhi, 2003.

COs	Program Outcomes (POs) 231HS11 FUNCTIONAL ENGLISH											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						1		2	3	1	2	2	1	
CO2						1		2	3	1	2	1		
CO3						1		2	3	1	2	1		
CO4						1		2	3	1	2	2	1	
CO5						1		2	3	1	2	3	2	1
CO6						1		2	3	1	2	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BS11		MATRICES AND CALCULUS			L	T	P	C
					2	1	0	3
Programme:		B.E./B.Tech. (Common to all branches)		Sem:	1	Category:		BS
Pre-/Co-requisite:		Basic knowledge in matrices, differentiation, and integration at the school level.						
Aim:	To acquire knowledge and skills in handling matrices and calculus in their field of specialization.							
Course Outcomes: The Students will be able to								
CO1	Solve the problems using matrices.							
CO2	Solve the ordinary differential equation.							
CO3	Apply the concept of multi variable calculus to solve the problems.							
CO4	Us Use double and triple integrals to compute areas and volumes.							
CO5	Apply the concepts of Differentiation and Integration in Vectors.							
CO6	Compute areas and volumes by the application of vector calculus theorems.							
MATRICES								9
Review of Basic Matrices -Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley – Hamilton theorem (Statement and applications only) Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation.								
ORDINARY DIFFERENTIAL EQUATIONS								9
Higher order linear differential equations with constant coefficients – Method of variation of Parameters – Cauchy’s and Legendre’s linear equations.								
MULTIVARIABLE CALCULUS								9
Partial Derivatives – Total Derivative – Differentiation of Implicit function – Jacobian – Taylor’s Expansion - Maxima/Minima for function of two variables – Method of Lagrange’s multipliers.								
MULTIPLE INTEGRALS								9
Double integration – Change the order of integration – Change of variables(Polar Co-ordinators) – Area as double integral – Triple integration – Volume as Triple Integral.								
VECTOR CALCULUS								9
Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green’s and Gauss divergence theorems (without proof) – Verification of the above theorems and evaluation of integrals using them.								
Total Periods:								45
The students may be practiced to solve the problems using Software packages.								
Text Book:								
1. Grewal B.S., “Higher Engineering Mathematics ”, 44 th Edition, Khanna Publishers, New Delhi, 2018. 2. Kreyszig E, "Advanced Engineering Mathematics ", 10 th Edition, John Wiley, New Delhi, India, 2018.								
References:								
1. Veerarajan.T., “Engineering Mathematics for First Year”, Fourth Edition, Tata Mc-Graw – Hill, New Delhi, 2008. 2. G.B. Thomas and R.L. Finney, “Calculus and Analytic Geometry” 9 th Edition, Pearson, Reprint, 2002.								

3. N.P. Bali and Manish Goyal, “A Text Book of Engineering Mathematics”, Laxmi Publications, Reprint, 2008.
4. Ramana B V, “Higher Engineering Mathematics”, 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.

COs	Program Outcomes (POs) 231BS11 MATRICES AND CALCULUS											Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	1	1					2	2		
CO2	2	3	2	1	1	1					2	2		
CO3	3	3	2	1	1	1					2	3	2	1
CO4	3	3	2	1	1	1					2	2	1	
CO5	3	3	2	1	1	1					2	2		
CO6	3	3	2	1	1	1					2	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BS12		ENGINEERING PHYSICS				L	T	P	C
						3	0	0	3
Programme:		B.E./B.Tech. (Common to all branches)		Sem:	1	Category:		BS	
Pre-/Co-requisite:		Basic Knowledge in Physics at the School level							
Aim:	To endow the students with the fundamentals of Physics for a better understanding of Engineering and Technology.								
Course Outcomes: The Students will be able to									
CO1:	Acquire fundamental knowledge on elasticity and its applications relevant to the field of engineering.								
CO2:	Gain knowledge about the basic concepts of Acoustics and Ultrasonic.								
CO3:	Know and acquire the basic concepts of Laser, types of lasers and applications.								
CO4:	Understand the principles behind fiber optic communications and fiber optic sensors.								
CO5:	Apply the advanced physics concepts of quantum theory to characterize the matters.								
CO6:	Get a clear idea about the basics of crystals, structures, and crystal growth techniques								
PROPERTIES OF MATTER									9
Elasticity-Stress-strain diagram and its uses-Poisson's ratio- Factors affecting elastic modulus and tensile strength - Twisting couple - shaft - 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									
ACOUSTICS AND ULTRASONICS									9
ACOUSTICS: Classification of Sound-Loudness and Intensity-Weber-Fechner Law-standard intensity and intensity level-Decibel-Reverberation-Reverberation time-Jaeger’s method-Absorption coefficient and its determination–Factors affecting acoustics of buildings focusing, interference, echo, Echelon effect, resonance -Noise and their remedies.									
ULTRASONICS: Ultrasonic - Production – Magnetostriction and piezoelectric methods - Acoustical grating –Industrial applications-NDT.									
LASERS AND FIBER OPTICS									9
LASERS: Population of energy levels, Einstein's A and B coefficients derivation-pumping methods-resonantcavity, optical amplification (qualitative)- three level and four level laser-CO2 Laser-Semiconductor lasers: Homo junction and Hetero junction. Industrial Application-Cutting, welding, soldering, drilling.									
FIBER OPTICS: Principle, Numerical aperture, and Acceptance angle - Types of optical fibers (material, refractive index, mode)-Fiber Optical Communication system(Block diagram) –Fiber optic sensors: pressure and displacement.									
QUANTUM PHYSICS									9
Blackbody radiation-Planck’s theory (derivation)–Photoelectric Effect-wave particle duality–DE Broglie wavelength - Concept of the wave function and its physical significance - Schrödinger's wave equation-Time independent and Time dependent equations-Particle in a box (one dimensional motion)									
CRYSTAL PHYSICS									9
Single crystalline, Polycrystalline and Amorphous materials - Unit cell, crystal systems, Braais lattices, directions and planes in a crystal -Miller indices – Inter planar distance – Calculation of number of atoms per unit cell-Atomic radius-Coordination number - Packing factor for SC, BCC, FCC and HCP structures –Polymorphism and allotropy Crystal growth techniques-Solution, melt (Bridgeman and Czochralski).									
Total Periods:									45
Text Book:									

1. M.N. Avadhanulu & P.G. Kshirshagar, “A Text Book of Engineering Physics”, S. Chand & Co Ltd. 2021.
2. R.K.Gaur & S.L.Gupta, “Engineering Physics”.Dhanpat Rai Publishers, 2012.

References:

1. D. Halliday, Resnick & J.Walker, “ Principles of Physics”, Wiley, 2015.
2. R.A. Serway, & J.W.Jewett, “Physics for Scientists and Engineers”, Cengage Learning,2010.
3. N. K.Verma, “Physics for Engineers”, PHI Learning Private Limited, 2014.
4. P.A.Tipler & G.Mosca, “Physics for Scientists and Engineers”, W.H.Freeman,2020.

COs	Program Outcomes (POs) 231BS12 ENGINEERING PHYSICS											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1									1	2		
CO2	3	3	3			2		1			1	1		
CO3	3	2	3	3		1		1			1	2	1	
CO4	3	3	3	3		1		1			1	3	2	
CO5	3	2	2	1		1					1	1	1	
CO6	3	1	2	1		1		1			1			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BS13		ENGINEERING CHEMISTRY				L	T	P	C
						3	0	0	3
Programme:		B.E./B.Tech. (Common to all branches)		Sem:	1	Category:		BS	
Pre-/Co-requisite:		Basic Knowledge in Chemistry at the School level.							
Aim:	To impart a required knowledge on the principles of chemistry involving the different applications required for the engineering fields.								
Course Outcomes: The Students will be able to									
CO1:	Demonstrate the essential concept of water, its properties, and applications.								
CO2:	Know the treatment of water for potable and industrial purposes.								
CO3:	Acquire knowledge of electrochemistry, corrosion, and its control.								
CO4:	Understand the basic principles, preparatory methods, and applications of nanomaterials.								
CO5:	Elaborate different types of important polymers, techniques, and their uses.								
CO6:	Explain the concepts of batteries and lubricants.								
WATER AND ITS TREATMENT									9
Hardness –Types and Estimation by EDTA method – alkalinity – types of alkalinity and determination. Domestic water treatment – disinfection methods – Boiler feed water – internal conditioning – external conditioning – desalination and reverse osmosis.									
ELECTROCHEMISTRY AND CORROSION									9
Electrode Potential – Nernst Equation– reference electrode – glass electrode – measurement of pH – electrochemical series – significance – Conductometric titrations (strong acid vs strong base and weak acid vs strong base). Corrosion: Types of corrosion – Factors influencing corrosion – Corrosion control – Sacrificial anode and impressed current cathodic methods – Corrosion inhibitors.									
NANOCHEMISTRY									9
Basics: Distinction between molecules, nanomaterials, and bulk materials; Types of nanomaterials: Definition, properties, and uses of nanoparticle, nanocluster, nanorod, nanowire, and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, chemical vapour deposition, electrochemical deposition, and hydrothermal. Applications of nanomaterials in medicine, agriculture, energy, electronics, and catalysis.									
POLYMER CHEMISTRY									9
Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical); condensation and copolymerization. Techniques of polymerization: Bulk, emulsion, solution, and suspension. Preparation, properties and uses of Nylon 6, 6, Bakelite, and Epoxy resin.									
ENERGY STORAGE DEVICES AND LUBRICANTS									9
Batteries – Primary battery – Dry cell and Lithium battery – Secondary battery – Lead acid battery, Ni-Cd battery, and Lithium-ion battery – Fuel cells – H ₂ -O ₂ fuel cells. Lubricants – mechanism of lubrication, liquid lubricants – properties (viscosity index, flash point, fire point, cloud point, pour point, and oiliness) – solid lubricants – graphite and molybdenum disulphide – semisolid lubricants and emulsions.									
Total Periods:									45
Text Book:									
1. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2023.									
2. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi, (2015).									

References:	
1. S.S. Dara, S.S. Umare, “<i>Engineering Chemistry</i>”, S. Chand & Company Ltd., New Delhi 2013. 2. B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal, <i>Principles of Physical Chemistry</i>, Vishal Publishing Co., Punjab, 47th Edition, 2017. 3. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “<i>Text book of Nanoscience and Nanotechnology</i>”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018. 4. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, “<i>Polymer Science</i>”, New Age International P (Ltd.), Chennai, 2021.	

COs	Program Outcomes (POs) 231BS13 ENGINEERING CHEMISTRY											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2		1					2	2	2			
CO2	2	2	2			2		1			2			
CO3	2	1	1	1			2				1			
CO4	2	1	1	1								1		
CO5	2	1		1			1							
CO6	2	2				1	2				1			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231ES11		BASIC ELECTRICAL AND ELECTRONICS ENGINEERING			L	T	P	C
					3	0	0	3
Programme:		B.E./B.Tech. (Common to CSE, AIDS, IT, CIVIL, MECH & BT)		Sem:	1	Category:		ES
Pre-/Co-requisite:		Basic knowledge in solving problems with Algebra and Calculus.						
Aim:	To provide comprehensive ideas on AC and DC circuit analysis, principles, and applications of basic electrical machines, electronics, and measurements.							
Course Outcomes: The Students will be able to								
CO1:	Mention the basic Electric Laws and the various representation of AC signals.							
CO2:	Explain the operation of Electrical machines and their applications.							
CO3:	Describe the types of Measuring Instruments and their applications.							
CO4:	Explain the construction and principle of various diodes along with their applications.							
CO5:	Summarize the concepts of Bipolar Junction Transistors and their applications.							
CO6:	Understand the concepts of Digital Electronics and its applications.							
ELECTRICAL CIRCUITS								9
Ohm’s Law – Kirchhoff’s Laws – Reduction of series and parallel circuit – Introduction to AC measurements - RMS, Average, Form factor and peak factor - phasor representation – Single Phase AC series circuits with R, RL, RC - Resistance and Impedance – Power and Power factor.								
ELECTRICAL MACHINES								9
DC Machines – Generators – construction, operation, and types; Motors – working principle and applications; AC Machines –Types and applications.								
ELECTRICAL MEASURING INSTRUMENTS								9
Fundamental Elements – Types – MI, MC – Wattmeter – Energy meter – Calibration – Applications								
SEMICONDUCTOR DEVICES (Qualitative treatment only)								9
Introduction to semiconductors – PN Junction Diode – characteristics and applications - Half wave and Full wave rectifiers, Zener Diode – characteristics and application; Bipolar Junction Transistor – operation – CE & CC Configurations.								
DIGITAL ELECTRONICS (Qualitative treatment only)								9
Number Systems – Binary, BCD, Hexadecimal – Logic Gates – Half and Full Adders – Encoder and Decoder – Flip-Flops – Counters – up/down binary counters – Shift registers – Right/Left Shift registers.								
Total Periods:								45
Text Book:								
1. Muthusubramanian R, Salivahanan S, “Basic Electrical, Electronics and Computer Engineering”, McGraw Hill, New Delhi, 2017. 2. B L Theraja, AK Theraja, “A Textbook of Electrical Technology: Volume 2 AC and DC Machines”, S.Chand, 2021.								
Reference:								
1. V N Mittle, Arvind Mittle “Basic Electrical Engineering”, McGraw Hill, New Delhi, 2020. 2. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford University press, 2016. 3. V K Mehta, Rohitmehta “Principles of Electronics”, S.Chand & Company Ltd, 2015. 4. Prof. M.B Patil, “Basic Electronics”, NPTEL Video Lecture Notes, IIT Bombay.								

COs	Program Outcomes (POs) 231ES11 BASIC ELECTRICAL AND ELECTRONICS ENGG.											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3									2	1		3
CO2	3										1	1		3
CO3	3										1	2	1	3
CO4	3										2			3
CO5	3										2			3
CO6	3	3	2								2			3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231ESF1		PROBLEM SOLVING AND PYTHON PROGRAMMING				L	T	P	C
						3	0	0	3
Programme:	B.E./B.Tech. (CSE, EEE, AI&DS, IT)				Sem:	1	Category:		ESC
Prerequisite:	Nil								
Aim:	To provide an awareness to Computing and Programming								
Course Outcomes: The Students will be able to									
CO1:	Recall basic programs using fundamental computational problems.								
CO2:	Demonstrate the programs using various collections of data types and expressions.								
CO3:	Outline the Python programming control flow and functions.								
CO4:	Illustrate the strings concepts in python programming language.								
CO5:	Rephrase compound data using Python lists, tuples, dictionaries etc.								
CO6:	Summarize the simple applications using files, Modules and packages in python.								
COMPUTATIONAL THINKING AND PROBLEM SOLVING									9
Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.									
DATA TYPES, EXPRESSIONS, STATEMENTS									9
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.									
CONTROL FLOW, FUNCTIONS									9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion;									
STRINGS									9
Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.									
LISTS, TUPLES, DICTIONARIES									9
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.									
FILES, MODULES, PACKAGES									9
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).									
Total Periods:									45
Text Book:									

1. Allen B. Downey, “*Think Python: How to Think like a Computer Scientist*”, 2/e, O’Reilly Publishers, 2016.
2. Karl Beecher, “*Computational Thinking: A Beginner’s Guide to Problem Solving and Programming*”, 1/e, BCS Learning & Development Limited, 2017.

References:

1. Paul Deitel and Harvey Deitel, “*Python for Programmers*”, Pearson Education, 1/e, 2021.
2. G Venkatesh and Madhavan Mukund, “*Computational Thinking: A Primer for Programmers and Data Scientists*”, 1/e, Notion Press, 2021.
3. John V Guttag, “*Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data*”, 3/e, MIT Press, 2021.
4. Eric Matthes, “*Python Crash Course, A Hands – on Project Based Introduction to Programming*”, 2/e, No Starch Press, 2019.
5. <https://www.python.org/>
6. Martin C. Brown, “*Python: The Complete Reference*”, 4/e, Mc-Graw Hill, 2018.

COs	Program Outcomes (POs) 231ESF1 PROBLEM SOLVING AND PYTHON PROG.											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1									2	1	
CO2	3	3	3	1								3	2	1
CO3	3	3										3	3	1
CO4	3	3	3	2								3	3	2
CO5	3	3	3	1									3	2
CO6	3	3	3	2								3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231HS12		HERITAGE OF TAMILS/ தமிழர் மரபு			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:	1	Category:	ESC
Prerequisite:		Read and Write in English or Tamil						
Aim:	Know about the heritage of Tamil language.							
Course Outcomes: The Students will be able to								
CO1:	Understand of the heritage of Tamil language and its literature.							
CO2:	Know about the Tamil ethics and Bakthi literature.							
CO3:	Know about the development of sculptures, Musical instruments and Handicrafts.							
CO4:	Understand about the folk and martial arts of ancient tamils.							
CO5:	Know about the thinai concepts being followed in Sangam literature of Tamil.							
CO6:	Contribution of Tamils in national movement and Indian culture and Medicinal system.							
LANGUAGE AND LITERATURE								3
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature- Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.								
HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE								3
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils								
FOLK AND MARTIAL ARTS								3
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils								
THINAI CONCEPT OF TAMILS								3
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas								
CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE								3
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books								
Total Periods:								45

Text Book:
1. jkpof tuyhW – kf;fSk; gz;ghLk; - Nf.Nf. gps;is (ntspaPL jkpo;ehL ghlEhy; kw;Wk; fy;tpapay; gzpfs; fofk;) 2. fzpdpj; jkpo; - Kidth; ,y.Re;juk; (tpfld; gpuRuk;) 3. fPob - itif ejpf;fuiapy; rq;ffhy efu ehfhpfk; (njhy;ypay; Jiw ntspaPL) 4. nghUie – Mw;wq;fui ehfhpfk; (njhy;ypay; Jiw ntspaPL) 5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL –

(in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

COs	Program Outcomes (POs) 231HS12 HERITAGE OF TAMILS/ தமிழர் மரபு											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						3	1			2				
CO2						3	1			2				
CO3						3	1			2				
CO4						3	1			2				
CO5						3	1			2				
CO6						3	1			2				

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BS17		PHYSICS AND CHEMISTRY LABORATORY				L	T	P	C
						0	0	3	1.5
Programme:		B.E. Computer Science and Engineering			Sem:	1	Category:		BS
Prerequisite:		Engineering Physics and Chemistry							
Aim:		To understand the basic concepts in Physics and Chemistry through experiments.							
Course Outcomes: The Students will be able to									
CO1:	Understand the basic concept of LASER application, Interference, and velocity of sound & Compressibility of liquid.								
CO2:	Gain knowledge on elastic properties of beams & strings and the thermal conductivity of a bad conductor.								
CO3:	Interpret the fundamentals of the viscosity of a liquid, the wavelength of the mercury spectrum by diffraction, the band gap of the semiconductor, and the Photoelectric effect.								
CO4:	Analyze the quality of water samples with respect to their alkalinity, hardness, and DO.								
CO5:	Determine the amount of metal ions through volumetric and gravimetric techniques.								
CO6:	Determine the amount of particles in an unknown solution.								
LIST OF EXPERIMENTS - PHYSICS PART (A minimum of six to seven experiments shall be offered)									
S. No	NAME OF THE EXPERIMENT								
1.	Determination of wavelength of the LASER source								3
2.	(a) Determination of Particle Size using Diode LASER. (b) Determination of Acceptance angle and Numerical aperture of an optical fiber.								3
3.	Determination of thickness of thin wire–Air wedge method								3
4.	Determination of Velocity of sound and compressibility of liquid–Ultrasonic Interferometer.								3
5.	Determination of Young’s modulus of the material-Non uniform bending								3
6.	Torsional pendulum – Determination of rigidity modulus.								3
7.	Determination of viscosity of liquid – Poiseuille’s method.								3
8.	Determination of wavelength of mercury spectrum- Spectrometer Grating.								3
9.	Determination of Band Gap of semiconductor material.								3
10.	Determination of Planck's constant - Photoelectric effect								3
LIST OF EXPERIMENTS – CHEMISTRY PART (A minimum of six to seven experiments shall be offered)									
S.No	NAME OF THE EXPERIMENT								
1.	Estimation of Total Hardness of water by EDTA method.								3
2.	Determination of types and amount of Alkalinity of a water sample.								3
3.	Determination of DO content of water sample by Winkler’s method.								3
4.	Determination of Chloride content of water sample by Argentometric method.								3
5.	Estimation of copper content of the given solution by Iodometry.								3
6.	Estimation of TDS of a water sample by gravimetric.								3
7.	Determination of strength of given hydrochloric acid using pH meter.								3

8.	Determination of strength of acids in a mixture of acids using pH meter.	3
9.	Conduct metric titration of barium chloride against sodium sulphate (Precipitation titration)	3
10.	Estimation of Iron content of the given solution using a Potentiometer.	3
Total Periods :		45

References:

1. “Experiments in Physics”, Indian Academy of Sciences, India (2018)
2. Engineering Physics Laboratory Manual.
3. A. Ravikrishnan “Practical Engineering Chemistry”, Sri Krishna Publications, Chennai (2002).
4. Engineering Chemistry Laboratory Manual.

COs	Program Outcomes (POs) 231BS17 PHYSICS & CHEMISTRY LAB											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1		2		1				1	1		
CO2	1	2	2				1				1	1		
CO3	2	2	2				1				1	2	1	
CO4	2	2	1		1		2				1			
CO5	3	2	1	2	2		1				2			
CO6	2	1	3		2		2				2			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSF7	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY				L	T	P	C
					0	0	3	1.5
Programme:	B.E. Computer Science and Engineering		Sem:	1	Category:		ESC	
Prerequisite:	Nil							
Aim	To provide a familiarization to Python Programming.							
Course Outcomes: The Students will be able to								
CO1	Develop algorithmic solutions to simple computational problems							
CO2	Develop and execute simple Python programs.							
CO3	Implement programs in Python using conditionals and loops for solving problems.							
CO4	Deploy functions to decompose a Python program.							
CO5	Process compound data using Python data structures.							
CO6	Utilize Python packages in developing software applications.							
LIST OF EXPERIMENTS:								
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here. 1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.) 2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points). 3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern) 4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library / Components of a car/Materials required for construction of a building – operations of list & tuples) 5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries) 6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape) 7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters) 8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy) 9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word) 10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter’s age validity, student mark range validation) 11. Exploring Pygame tool. 12. Developing a game activity using Pygame like bouncing ball, car race etc.								
Total Periods:								60

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	3	2	1									2	1	
CO2	K2	3	3	3	1								3	2	1
CO3	K3	3	3										3	3	1
CO4	K2	3	3	3	2								3	3	2
CO5	K2	3	3	3	1									3	2
CO6	K3	3	3	3	2								3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231HS17	ENGLISH COMMUNICATION LABORATORY – I				L	T	P	C
					0	0	2	1
Programme:	B.E. Computer Science and Engineering			Sem:	1	Category:		EEC
Prerequisite:	Basic Language Proficiency.							
Aim:	To acquire basic Language Skills (LSRW) in order to communicate confidently in academic, professional and social contexts.							
Course Outcomes:	The Students will be able to							
CO1:	Introduce self and others confidently in English, discuss the events, and fill out forms.							
CO2:	Understand the documentaries, narrate the events, experiences, places of visit, and interview others in English							
CO3:	Describe a product and picture and their uses, devise an advertisement of a product.							
CO4:	Listen to video lectures and make summaries and inferences.							
CO5:	Make event and travel plans and describe arrangements.							
CO6:	Perform debates, panel discussions, express views and opinions on the issues.							
INTRODUCTION								6
Self-Introduction, Introducing Others, Conversation on the events, Listening and Filling forms.								
NARRATION AND SUMMATION								6
Listen to the documentaries and event narration, Narrating personal experiences and events, Interviewing others, Describing the Places of Interest.								
DESCRIPTION OF A PROCESS / PRODUCT								6
Listen to the description of a product, Advertisement of a product, Description of a Picture, and use of the products.								
CLASSIFICATIONS AND RECOMMENDATIONS								6
Listen to lectures and educational videos, making and describing the plans, arrangements of an event, travel plans, etc.								
EXPRESSIONS								6
Listen to debates, panel discussions, expressing the views on an issue, giving brief talk on a topic, giving opinions.								
Total Periods:								30
Text Book:								
1. Dr.P.Rathna and Jewelcy Jawahar ,English Communication Laboratory .June 2023.								
Reference:								
1. https://www.skillsyouneed.com/ips/conversational-skills.html								

COs	Program Outcomes (POs) 231HS17 ENGLISH COMMUNICATION LABORATORY - I											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1					2	1	1	2	3		2			
CO2					2	3	1	1	3		2		2	
CO3					2	2	1	1	3		2			
CO4					2	3	1	1	3		2			
CO5					2	2	1	1	3	3	2			
CO6					2	3	1	3	3		2			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231ESF2		ENGINEERING DRAWING			L	T	P	C
					1	0	4	3
Programme:		B.E. Computer Science and Engineering		Sem:	1	Category:		ES
Prerequisite:		Nil						
Aim:	To develop basic graphic skills in students to understand the drawings in Engineering fields.							
Course Outcomes: The Students will be able to								
CO1:	Trace the plane curves and draw its tangent and normal.							
CO2:	Construct the orthographic projections of points, lines, and planes.							
CO3:	Draw the projections of simple solids.							
CO4:	Visualize the sectional views of solids.							
CO5:	Develop the surfaces of solids.							
CO6:	Practice isometric and orthographic projections							
Concepts and conventions (Not for Examination)								
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout, and folding of drawing sheets – Lettering and dimensioning.								
PLANE CURVES								14
Conics – Construction of ellipse, Parabola, and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.								
PROJECTION OF POINTS, LINES, AND PLANE SURFACES								14
Projection of Points in all four quadrants - Projection of straight lines located in the first quadrant – inclined to both planes – Determination of true lengths and true inclinations – Projection of regular polygonal and circular lamina inclined to both reference planes.								
PROJECTION OF SOLIDS								14
Projection of simple solids like Prisms, Pyramids, Cylinder, and Cone when the axis is inclined to one reference plane.								
SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES								14
Sectioning of above solids in a simple vertical position by cutting planes inclined to HP and perpendicular to VP – Obtaining true shape of section; Development of lateral surfaces of truncated solids – Prisms, Pyramids, Cylinder, and Cone.								
ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS								14
Principles of isometric projection – isometric scale – isometric projections of truncated Prisms, Pyramids, cylinders, and cones; Conversion of Isometric Views to Orthographic Views and Vice-versa.								
Total Periods:								75
Text Book:								
1. Basant Agarwal and Agarwal C.M., “ <i>Engineering Drawing</i> ”, Tata McGraw Hill Publishing Company Limited, New Delhi, (2022).								
References:								
1. Venugopal K. and Prabhu Raja V., “ <i>Engineering Graphics</i> ”, New Age International (P) Limited (2022).								

2. Shah M.B. and Rana B.C., “*Engineering Drawing*”, Pearson Education (2022).
3. John K.C., “*Engineering Graphics for degree*” PHI Learning Pvt. Ltd., New Delhi, (2022).
4. Kumar M.S., “*Engineering Graphics*”, D.D. Publications, (2022).

COs	Program Outcomes (POs) 231ESF2 ENGINEERING DRAWING											Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3			1	2	1					1			
CO2	3	2	1		2	1					1	1		
CO3	3			1	2	1					1			
CO4	3	2		1	2	1					1			
CO5	3		1		2	1					1			
CO6	3	2	1		2	1					1			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231HS21		ENGLISH FOR ENGINEERS			L	T	P	C
					1	0	4	3
Programme:		B.E. Computer Science and Engineering	Sem:	1	Category:		HS	
Prerequisite:		Basic Language Proficiency.						
Aim:	To mould the Learners’ style of Language Proficiency with modern aspects of communicative elements which an engineer requires.							
Course Outcomes: The Students will be able to								
CO1:	Use the grammatical rules and semantic structures for flawless communication.							
CO2:	Recognize the importance of listening and to comprehend the connect between interactors.							
CO3:	Apply the professional aspects of language pattern and to formulate the stylish accent.							
CO4:	Analyze the various exposure levels of multi-dimensional skill-based language usage.							
CO5:	Evaluate the situational attempts with better learning mechanism.							
CO6:	Create the extended mode of thinking in expressions both in oral and written communication.							
SENTENTIAL SEMANTICS							14	
Listening – Cambridge English Listening practice for beginners (A Level),celebrity interview; Speaking - Greetings- self introductory session – collaborative task based topics; Reading – Reading editorials, magazines, newspapers, Writing – Enlist wish list, Blog writing, Processing technical reports; Grammar - Sentence pattern, Types of sentences, Simple, Complex and compound; Vocabulary - Conjunctions								
VERBAL OPERATORS							14	
Listening – British Council Listening (B1) level, Broadcasting network audios – Cambridge prep up audio clips; Speaking – Sharing experiences, Narratives on anecdotes Reading – Phonics reading practices, Reading pamphlets and catalogues; Writing – Fill up the templates/forms (Airline booking, reservations on train, hotel registration), Mapping out articles on press and media, Progress report writing; Grammar - Verbs and Verbals – Infinitives- Gerunds – Participles, Voice– Active and Passive voice; Vocabulary - Phrasal verbs, one word substitution								
CONTEXTUAL EXPRESSIONS							14	
Listening –TED Talks , Excerpts from literary pieces, listening podcasts related to recent trends in mass media and communication- Speaking – Persuasive speech techniques- gimmicks and entrepreneurial speech strategies; Reading – exploratory reading and techniques on expository text reading Writing – Controversial essay writing, Review Writing; Grammar –, Mixed tenses, If conditionals; Vocabulary – Minimal pairs								
TECHNICAL BRIEFINGS							14	
Listening – Virtual webinars on language consciousness, Oratory speech; Speaking – Short script deliverance, Thematic speech; Reading – Deciphering technical texts; Writing - Announcement / declaration letter writing, Technical content creations; Grammar – Speech – Direct and Indirect speech, Spot the error; Vocabulary - Connotation and denotation, Mismatched words								
STIPULATE WRITINGS							14	

Listening – Practicing audios on competitive elements – Peer/ Panel discussion, Event and specializations;; Speaking –Pros and Cons of Advanced technological systems , Dimensions of engineering and its aspects, Reading – Industrial blogs, Meme theory; Writing – Profile development- Resume – Project proposal writing , Conceptual writing; Grammar - Semi-modal auxiliaries, Question tags; Vocabulary – Idiomatic expressions, Spelling and Punctuation		
Total Periods:		75
Text Book:		
1. Allen, Alex. 1999. Communication at the English Speaking Union world members conference, Sydney, August. 2. Austin, J.L.1965, <i>How To Do Things With Words</i>, Oxford University Press. 3. Mayhugh, Paul W. "A Chinese-English intermediate Greek grammar." Theological Research Exchange Network (TREN), 1990. 4. McCarthy, Michael and Felicity O'Dell. <i>English Vocabulary in Use</i>: advanced. Cambridge: CUP, 2002. South Asian Edition, 2008. 5. Soundararaj, Francis.2012. <i>Basics of Communication in English</i>. New Delhi: Macmillan		
References:		
1. PushpaLata, Sanjay Kumar, English Language and Communication Skills for Engineers, 2018. 2. Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. 3. John Seely. The Oxford Guide to Effective Writing and Speaking. OUP, 2005.		

COs	Program Outcomes (POs) 231HS21 ENGLISH FOR ENGINEERS											Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PSO 1	PSO2	PSO3
CO1					2	1		1	1		3	2		
CO2					2	1		1	1		3	2		
CO3					2	1		1	1		3	2		
CO4					2	1		1	1		3	2		
CO5					2	1		1	1		3	2		
CO6					2	1		1	1		3	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231HS21		PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS				L	T	P	C
						2	1	0	3
Programme:		B.E. Computer Science and Engineering			Sem:	1	Category:		BSC
Prerequisite:		Basic knowledge in ordinary and partial differential equations at school level.							
Aim:	To enable the students to understand the basic solving techniques in partial differential equations and to obtain numerical solutions of ordinary equations and differential equations.								
Course Outcomes: The Students will be able to									
CO1:	Solve the partial differential equations.								
CO2:	Apply the techniques of solving the equations and eigen value problems.								
CO3:	Apply the numerical techniques of interpolation in various intervals.								
CO4:	Solve differentiation and integration by numerical methods.								
CO5:	Understand the methods for solving ordinary differential equations.								
CO6:	Compute the boundary value problems by numerical methods.								
PARTIAL DIFFERENTIAL EQUATIONS									12
Formation of partial differential equations – Lagrange’s linear equation – Solutions of standard types of first order partial differential equations (without reducing the standard type) –Linear homogenous partial differential equations of second and higher order with constant coefficients.									
SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS									12
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Iterative method of Gauss Seidel - Eigen values of a matrix by Power method.									
NUMERICAL INTERPLATION , NUMERICAL DIFFERENTIATION AND INTEGRATION									12
Taylor’s series method – Euler’s method – Modified Euler’s method – Fourth order Runge-Kutta method – Milne’s predictor – corrector methods for solving first order equations – Finite difference methods for solving second order equation.									
NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS									12
Taylor’s series method – Euler’s method – Modified Euler’s method – Fourth order Runge-Kutta method – Milne’s predictor – corrector methods for solving first order equations – Finite difference methods for solving second order equation.									
BOUNDARY VALUE PROBLEMS OF PARTIAL DIFFERENTIAL EQUATIONS									12
Finite differences solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.									
Total Periods:									60
The students may be practiced to solve the problems using Software packages.									
Text Book:									
Veerarajan.T.,“Engineering Mathematics for first year”, Fourth Edition, Tata Mc-Graw – Hill, New Delhi, 2008. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10 th Edition, New Delhi, 2015.									
References:									

1. Greenberg, M.D. “Advanced Engineering Mathematics”, Second Edition, Pearson Education Inc. (First Indian reprint), 2002
2. Kreyszig, E., “Advanced Engineering Mathematics”, 8th edition, John Wiley Sons, 2001.
3. Chapra S.C. and Canale R.P., “Numerical Methods for Engineers”, Tata Mc-Graw Hill, New Delhi, (2007).
4. Gerald C.F., and Wheatley P.O., “Applied Numerical Analysis”, Pearson Education Asia, New Delhi, (2006).

COs	Program Outcomes (POs) 231HS21 PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS											Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2									1	2		
CO2	3	2										2		
CO3	2	3	2									2		
CO4	3	2									1	2		
CO5	2	2	1								1	2		
CO6	3	3	2								2	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BS22		PHYSICS OF MATERIALS			L	T	P	C
					2	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	1	Category:		BSC
Prerequisite:		Engineering Physics						
Aim:	To inculcate the students with fundamentals of materials and its properties for understanding the concepts of Engineering and Technology							
Course Outcomes: The Students will be able to								
CO1:	Understand the importance of electrical properties of materials.							
CO2:	Gain knowledge in semiconductor physics.							
CO3:	Install knowledge on magnetic properties of materials.							
CO4:	Explore Knowledge On di electric properties of materials.							
CO5:	Establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications.							
CO6:	Inculcate idea of significance on Nanostructure, quantum confinement and applications of Nano devices.							
ELECTRICAL PROPERTIES OF MATERIALS								9
Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, Wiedemann-Franz law – Success and failures – Fermi Distribution function – Effect of temperature on Fermi function –Density of energy states–Electron in periodic potential–Energy bands in solids–tight binding approximation –Electron effective mass –concept of hole.								
SEMICONDUCTOR PHYSICS								9
Energy band diagram – Direct and indirect band gap semiconductors – Intrinsic Semiconductors – Carrier concentration in intrinsic semiconductors – Extrinsic semiconductors – Carrier concentration in n-type & p-typesemiconductors–Variationofcarrierconcentrationwithtemperature–Variation of Fermi level with temperature and impurity concentration–Hall effect-Determination of Hall Coefficient.								
MAGNETIC AND DIELECTRIC MATERIALS								9
Magnetic materials: Origin of magnetic moment–Bohrmagneton–Dia and Para magnetism–Ferromagnetism– Domain theory– Hysteresis–Soft and hard magnetic materials–Anti-ferromagnetic materials–Ferrites–applications. Dielectric Materials: Polarization-Electronic, Ionic, Orientation and Space charge polarization–Frequency and temperature dependence of polarization–Dielectric loss–Dielectric breakdown–uses of dielectric Materials (capacitor and transformer) –Ferro electricity and applications.								
OPTICAL PROPERTIES OF MATERIALS								9
Classification of optical materials–Carrier generation and recombination processes–Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) – Photocurrent in a P-N diode –solar cell-LED– Organic LED–Laser diodes– Optical data storage techniques.								
NANODEVICES								9
Quantum confinement – Quantum structures – Density of states for quantum wells, wires and dots – Band gap of nanomaterials –Tunneling – Single electron phenomena – Single electron Transistor. Carbon nano tubes: Properties and applications.								

		Total Periods:	60
Text Book:			
1. Jasprit Singh, “Semiconductor Devices: Basic Principles”, Wiley (Indian Edition), 2007. 2. S.O. Kasap. Opto electronics and Photonics-Principles and practices, Dorling Kindersley Pvt. (Indian Edition), 2009. 3. B. Rogers, J. Adams and S. Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014.			
References:			
1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019. 2. V.V. Mitin, V.A. Kochelap and M.A. Strosio, Introduction to Nano electronics, Cambridge Univ. Press, 2008. 3. B. Rogers, J. Adams and S. Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014. 4. Y.B. Band and Y. Avishai, Quantum Mechanics with Applications to Nano technology and Information Science, Academic Press, 2013			

COs	Program Outcomes (POs) 231BS22 PHYSICS OF MATERIALS											Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	3	-	-	1	1		1	1	1	1
CO2	3	1	1	1	3	2	2	1	-		1	2	2	1
CO3	3	3	2	3	3	-	-	-	-		3	2	2	2
CO4	3	3	2	1	3	-	-	-	-		1	1	1	2
CO5	3	2	2	1	3	2	-	1	1		-	1	1	2
CO6	3	1	2	1	3	2	2	-	-		1	1	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BS24		ENVIRONMENTAL SCIENCE			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	1	Category:		BSC
Prerequisite:		Basic Knowledge in Chemistry at School level.						
Aim:	To create and disseminate knowledge to the students about environmental problems at local, regional and global scale.							
Course Outcomes: The Students will be able to								
CO1:	Understand the basic concepts of environment and energy resources.							
CO2:	Get knowledge about the ecosystem.							
CO3:	Get thorough knowledge about biodiversity and its values.							
CO4:	Identify and analyze causes, effects and control measures of various types of pollution.							
CO5:	Get the knowledge about types of disaster and mitigation measures.							
CO6:	Understand the impact of social issues and climate change.							
ENVIRONMENTAL STUDIES AND ENERGY RESOURCES								9
Environment- definition, scope and importance – Need for public awareness – Forest resources- deforestation - dams and their effects on forests and tribal people –Energy resources: Growing energy needs, renewable (solar energy and wind energy) and non renewable energy sources- Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generation (block diagram only), Petroleum processing and fractions.								
ECOSYSTEM AND BIODIVERSITY								9
ECOSYSTEM: Concept of an ecosystem – Structure and function of an ecosystem: Producers, Consumers and Decomposers-Nitrogen cycle, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the Forest ecosystem and Aquatic ecosystems (lake and rivers). BIODIVERSITY: Introduction to Biodiversity – Definition– Value of biodiversity.								
ENVIRONMENTAL POLLUTION								9
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution (e) Nuclear hazards (f) Fireworks: Current environmental issues - Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution – Pollution case studies.								
DISASTER AND ITS IMPACTS								9
Definition of Disaster, Hazard, Vulnerability, Risk – Types – Natural disasters (earthquake, landslides, flood, cyclones, tsunami and drought) – Man-made disasters (Chemical, nuclear and biological) – Disaster impacts (environmental, physical, social, ecological and economical) – Case studies.								
SOCIAL ISSUES AND THE ENVIRONMENT								9
Population-variation among Nation-Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rainwater harvesting– climate change, global warming, acid rain, Ozone layer depletion-Goal of Green chemistry.								
Total Periods:								60
Text Book:								

1. A. Ravikrishnan, “Environmental Science”, Sri Krishna Hitech Publishing Company Private Limited, 2023.
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, 2017.

References:

1. Anubha Kaushik, C.P. Kaushik, “Environmental Science and Engineering”, New Age International Publishers, 2016.
2. Raman Sivakumar, Introduction to Environmental Science and Engineering, Tata McGraw Hill Education Private Limited, New Del, 2016.
3. Erach Bharucha, Textbook for Environmental Studies, New Delhi, 2019.
4. G.Tyler Miller and Scott E. Spoolman,” Environmental Science ”, Cengage Learning India PVT, LTD, Delhi, 2014.

COs	Program Outcomes (POs) 231BS24 ENVIRONMENTAL SCIENCE											Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	1	1	2									1	2	1
CO2	1													
CO3	1	1												
CO4	1	1	2	2								1	1	1
CO5	2	2		2			1							1
CO6	2	2	2				2							

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231ESF2		ENGINEERING DRAWING			L	T	P	C
					1	0	4	3
Programme:	B.E. Computer Science and Engineering			Sem:	1	Category:		ES
Prerequisite:	Nil.							
Aim:	To develop basic graphic skills in students to understand the drawing in Engineering fields.							
Course Outcomes: The Students will be able to								
CO1:	Trace the plane curves and draw its tangent and normal							
CO2:	Construct the orthographic projections of points, lines and planes.							
CO3:	Draw the projections of simple solids.							
CO4:	Visualize the sectional views of solids.							
CO5:	Develop the surfaces of solids.							
CO6:	Practice isometric and orthographic projections.							
Concepts and conventions (Not for Examination)								
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.								
PLANE CURVES								12
Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.								
PROJECTION OF POINTS, LINES AND PLANE SURFACES								12
Projection of Points in all four quadrants - Projection of straight lines located in the first quadrant – inclined to both planes – Determination of true lengths and true inclinations – Projection of regular polygonal and circular lamina inclined to both reference planes.								
PROJECTION OF SOLIDS								12
Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to one reference plane.								
SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES								12
Sectioning of above solids in simple vertical position by cutting planes inclined to HP and perpendicular to VP – Obtaining true shape of section; Development of lateral surfaces of truncated solids – Prisms, Pyramids, Cylinder and Cone.								
ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS								12
Principles of isometric projection – isometric scale – isometric projections of truncated Prisms, Pyramids, Cylinder and Cone; Conversion of Isometric Views to Orthographic Views and Vice-versa.								
Total Periods:								60
Text Book:								
1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, (2022).								
References:								
1. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited (2022).								
2. Shah M.B. and Rana B.C., “Engineering Drawing”, Pearson Education (2022).								

3. John K.C., “*Engineering Graphics for degree*” PHI Learning Pvt. Ltd., New Delhi, (2022).
4. Kumar M.S., “*Engineering Graphics*”, D.D. Publications, (2022).

COs	Program Outcomes (POs) 231ESF2 ENGINEERING DRAWING											Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3			1	2	1					1			
CO2	3	2	1		2	1					1			
CO3	3			1	2	1					1			
CO4	3	2		1	2	1					1			
CO5	3	2	1		2	1					1			
CO6	3	2	1		2	1					1			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS21		PROGRAMMING IN C				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering	Sem :	1	Category:		ESC		
Prerequisite:		Nil							
Aim:	To understand the constructs of C programming language.								
Course Outcomes: The Students will be able to									
CO1	Demonstrate knowledge on C Programming constructs.								
CO2	Develop simple applications in C using basic constructs.								
CO3	Design and implement applications using arrays and strings.								
CO4	Develop and implement modular applications in C using functions.								
CO5	Develop applications in C using structures and pointers.								
CO6	Design applications using sequential and random access file processing.								
BASICS OF C PROGRAMMING									9
Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions – Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process									
ARRAYS AND STRINGS									9
Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.									
FUNCTIONS AND POINTERS									9
Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.									
STRUCTURES AND UNION									9
Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.									
FILE PROCESSING									9
Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments.									
Total Periods:									45
Text Book:									
1. Reema Thareja, “Programming in C”, Oxford University Press, 2/e, 2016. 2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, 2/e, Pearson Education, 2015.									
References:									

1. Paul Deitel and Harvey Deitel, “*C How to Program with an Introduction to C++*”, 8/e, Pearson Education, 2018.
2. Yashwant Kanetkar, “*Let us C*”, 17/e, BPB Publications, 2020.
3. Byron S. Gottfried, “*Schaum’s Outline of Theory and Problems of Programming with C*”, McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, “*Computer Fundamentals and Programming in C*”, 2/e, Oxford University Press, 2013.
5. Anita Goel and Ajay Mittal, “*Computer Fundamentals and Programming in C*”, 1/e, Pearson Education, 2013.

Course Outcomes	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1		1								1	1	
CO2	2	3	2	2								3	3	3
CO3	2	3	3	2								3	1	
CO4	2	3	2	2								3	3	3
CO5	2	3	2	2								3	3	3
CO6	2	2	3	2								3	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231ESF8		ENGINEERING PRACTICES LABORATORY				L	T	P	C
						0	0	3	1.5
Programme:		B.E. Computer Science and Engineering			Sem:	1	Category:		ES
Prerequisite:		Nil							
Aim:	To provide hands-on experience to the students in handling the basic Mechanical and Electrical tools and equipment.								
Course Outcomes: The Students will be able to									
CO1:	Develop simple wooden joints using woodworking tools.								
CO2:	Understand the concepts of plumbing and handling the various components of plumbing.								
CO3:	Make simple welds of lap and butt joints and fabricate a few models.								
CO4:	Demonstrate the concept of wiring circuits.								
CO5:	Explain the measurement of Electrical quantities and the principles of diodes.								
CO6:	Classify the functions of basic gates.								
PART – A – MECHANICAL WORKSHOP (23 hrs)									
CARPENTRY									
Study of the joints in roofs, doors, windows, and furniture; Hands-on-exercise: Dismantling & Assembling of various wooden furniture; Preparation of T Joint, dovetail joint									
PLUMBING									
Study of pipeline joints, their location, and functions: valves, taps, couplings, unions, reducers, elbows in household fittings; Hands-on-exercise - basic pipe connections – Mixed pipe material connection – Connections with different joining components									
WELDING AND SHEET METAL FORMING									
Preparation of arc welding of butt joints and lap joints - Preparation of tray and funnel									
PART – B – ELECTRICAL WORKSHOP (22 hrs)									
NAME OF THE EXPERIMENT									
1. Practice on Simple wiring connections.									
2. Practice on wiring for Staircase setup.									
3. Practice on wiring Fluorescent lamp.									
4. Measurement of electrical quantities – current, voltage, power, and energy.									
5. Characteristics of semiconductor diode.									
6. Verifying the truth tables of Logic gates.									
Total Periods: 45									

COs	Program Outcomes (POs) 231ESF8 ENGINEERING PRACTICE LABORATORY											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1		1	1			3	2	2			
CO2	2	1	1		1	1			3	2	2			
CO3	2	1	1		1	1			3	2	2			
CO4	2	1	1		1	1			3	2	2	3	2	2
CO5	2	1	1		1	1			3	2	2	3	2	
CO6	2	1	1		1	1			3	2	2	3	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS27	PROGRAMMING IN C LABORATORY				L	T	P	C
					0	0	3	1.5
Programme:	B.E. Computer Science and Engineering			Sem:	2	Category:		ESC
Prerequisite:	Nil							
Aim:	To provide a familiarization to C Programming.							
Course Outcomes: The Students will be able to								
CO1:	Demonstrate knowledge on C programming constructs.							
CO2:	Develop programs in C using basic constructs.							
CO3:	Develop programs in C using arrays.							
CO4:	Develop applications in C using strings, pointers, functions.							
CO5:	Develop applications in C using structures							
CO6:	Develop applications in C using file processing.							
LIST OF EXPERIMENTS:								
Note: The lab instructor is expected to design problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.								
1. I/O statements, operators, expressions								
2. decision-making constructs: if-else, goto, switch-case, break-continue								
3. Loops: for, while, do-while								
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal								
5. Strings: operations								
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.								
7. Recursion								
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers								
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.								
10. Files: reading and writing, File pointers, file operations, random access, processor directives.								
Total Periods:								60

Course Outcomes	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2									3	1	1
CO2	3	2	2						2			3	2	2
CO3	3	2	3						2			3	3	2
CO4	2	3	2						2			3	2	2
CO5	3		2						2			3	2	1
CO6	2		2									2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231HS27	ENGLISH COMMUNICATION LABORATORY -II				L	T	P	C
					3	0	0	1
Programme:	B.E. Computer Science and Engineering			Sem:	2	Category:		HS
Prerequisite:	Basic Proficiency in English							
Aim:	To provide students with a digital learning platform to practice their language skills useful for their career.							
Course Outcomes: The Students will be able to								
CO1:	Learn accurate pronunciation through stress on word accent, intonation and rhythm.							
CO2:	Improve technical language skills.							
CO3:	Effectively participate in situational conversations like JAM sessions.							
CO4:	Understand the importance of academic writing.							
CO5:	Inculcate necessary writing skills to face certification exams.							
CO6:	Manage stress, emotion and time in order to be amicable in the workplace.							
LIST OF EXPERIMENTS:								
Note: The lab instructor is expected to design problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.								
1. I/O statements, operators, expressions								
2. decision-making constructs: if-else, goto, switch-case, break-continue								
3. Loops: for, while, do-while								
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal								
5. Strings: operations								
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.								
7. Recursion								
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers								
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.								
10. Files: reading and writing, File pointers, file operations, random access, processor directives.								
Total Periods:								60

Course Outcomes	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1					2				2	3	2			1
CO2					2				2	3	2			1
CO3					2				2	3	2			1
CO4					2				2	3	2			1
CO5					2				2	3	2			1
CO6					2			2	2	3	2			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BS31		TRANSFORMS AND COMPLEX ANALYSIS			L	T	P	C
					2	1	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	1	Category:		BS
Prerequisite:		Matrices and Calculus						
Aim:	To impart the concepts of various transforms and their applications and to handle analytic functions on complex plane and to perform complex integration.							
Course Outcomes: The Students will be able to								
CO1	Apply Laplace transform for relevant applications.							
CO2	Use Z - transform techniques for solving equations.							
CO3	Apply the Fourier transform for applications.							
CO4	Analyse the functions of Complex Variables.							
CO5	Apply the techniques regarding conformal mappings to various fields.							
CO6	Apply complex integration in engineering problems.							
LAPLACE TRANSFORM								9
Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem - solving ODEs by Laplace Transform method.								
Z - TRANSFORM								9
Z-transform - Elementary properties - Inverse Z - transform - Convolution theorem – Formation of difference equations - Solution of difference equations using Z - transform.								
FOURIER TRANSFORM								9
Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity.								
ANALYTIC FUNCTIONS								9
Functions of a complex variable – Analytic functions – Necessary and sufficient conditions (excluding proof) – Cauchy– Riemann equations (Statement only) – Properties of analytic function (Statement only) – Harmonic function – Construction of analytic function – Conformal mapping: $w = z + a$, az , $1/z$ – Bilinear transformation.								
COMPLEX INTEGRATION								9
Line integral – Cauchy’s theorem and 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 semi-circular contour with no pole on real axis.								
Total Periods:								45
Text Book:								
1. Grewal B.S., “ <i>Higher Engineering Mathematics</i> ”, 44 th Edition, Khanna Publishers, New Delhi, 2018.								
2. Veerarajan,T., “ <i>Engineering Mathematics</i> ” (For Semester I and II), Tata McGraw-Hill publishing New Delhi, 2013.								
References:								

1. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2018.
2. G.B. Thomas and R.L. Finney, "Calculus and Analytic Geometry" 9th Edition, Pearson, Reprint, 2002.
3. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publication Reprint, 2008.
4. Ramana B V, "Higher Engineering Mathematics", 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.

Course Outcomes	Program Outcomes (POs) TRANSFORMS AND COMPLEX ANALYSIS											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO3
CO1	3	2	2	1	1						2			
CO2	3	2	2	1	1						2			
CO3	3	3	2	1	1						2			
CO4	3	2	1	1	1						1			
CO5	3	3	1	1	1						1			
CO6	3	2	1	1	1						1			

231CS31		COMPUTER ORGANIZATION AND ARCHITECTURE				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	3	Category:		PC	
Pre-/Co-requisite:		191EC35 – Digital Electronics and Microprocessors							
Aim:	To understand the organization of a computer, hardware-software interface, and to discuss the basic structure of a digital computer.								
Course Outcomes: The Students will be able to									
CO1:	Outline the fundamental organization of a computer system.								
CO2:	Explain the fundamentals concepts of pipeline processing.								
CO3:	Identify the role of the control unit in instruction execution								
CO4:	Compare the performance of various memory systems.								
CO5:	Illustrate the various types of I/O devices and interfaces.								
CO6:	Summarize about the multi-core architectures and processors.								
BASIC STRUCTURE OF COMPUTERS									9
Functional units -Basic operational concepts - Bus structures - Performance and metrics – Instruction Set Architecture - Addressing modes - RISC - CISC. Fixed point and floating point operations.									
PROCESSOR AND CONTROL UNIT									9
Execution of a complete instruction - Multiple bus organization - Hardwired control – Micro-programmed control - Nano programming. Pipelining – Basic concepts - Hazards - Types - Influence on instruction sets – Data path and control considerations - Performance considerations - Exception handling.									
MEMORY SYSTEMS									9
Basic concepts - Semiconductor RAM - ROM - Speed - Size and cost - Cache Memories – Improving cache performance - Virtual memory - Memory management requirements - Associative memories – Performance Considerations.									
I/O SYSTEMS									9
Accessing I/O devices - Programmed Input/output - Interrupts – Direct Memory Access - Buses – Interface circuits - Standard I/O Interfaces (PCI, SCSI, USB).									
MULTI-CORE ARCHITECTURES									9
Introduction to Multithreading – Software and hardware multithreading – SMT and CMP architectures – Design issues – Case study – Intel Core i7. Heterogeneous multi-core processors – Case study: IBM Cell Processor.									
Total Periods:									45
Text Book:									
1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, 6/e, McGraw-Hill Inc, 2012. 2. John L. Hennessey and David A. Patterson, “Computer Architecture – A quantitative approach”, Morgan Kaufmann / Elsevier Publishers, 5/e, 2011.									

References:	
1. David A. Patterson and John L. Hennessy, “ <i>Computer Organization and Design: The Hardware / Software interface</i> ”, 5/e, Elsevier, 2013. 2. William Stallings, “ <i>Computer Organization and Architecture – Designing for Performance</i> ”, 8/e, Pearson Education, 2010. 3. John P.Hayes, “ <i>Computer Architecture and Organization</i> ”, Indian/e, Tata McGraw Hill, 2017. 4. V.P. Heuring, H.F. Jordan, “ <i>Computer Systems Design and Architecture</i> ”, 2/e, Pearson Education,	

2004.

5. David E. Culler, Jaswinder Pal Singh, “*Parallel computing architecture: A hardware/software approach*”, Morgan Kaufmann /Elsevier Publishers, 1999.
6. <https://archive.nptel.ac.in/courses/106/105/106105163/>

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K2	2	3	2	2								1	3	
CO2	K2	2	3	2	2								1	3	
CO3	K3	3	3	3	3								1	3	
CO4	K2	2	3	2	2								1	3	
CO5	K2	2	3	2	2								1	3	
CO6	K3	3	3	3	3								1	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS32		DATA STRUCTURES			L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering				Sem:	3	Category:	PC
Prerequisites:	231CS21 – Programming in C							
Aim:	To study how the operations on data structure and various algorithms are performed.							
Course Outcomes: The Students will be able to								
CO1:	Outline the basic data structures concepts.							
CO2:	Rephrase basic data structures such as linked lists, stacks and queues.							
CO3:	Apply algorithms for solving problems in sorting and searching.							
CO4:	Summarize the pros and cons of hashing techniques.							
CO5:	Explain the implementations and applications of non-linear data structures.							
CO6:	Illustrate the representation of graphs and its various algorithms.							
INTRODUCTION TO DATA STRUCTURES								9
Data Structures: Definition – Types – Need for Data Structures-Applications of Data Structures – Basic Terminologies: Elementary data organizations – Data structures operations.								
LINEAR DATA STRUCTURES								9
Abstract Data Types (ADTs) - List ADT - array-based implementation - linked list implementation - singly linked lists - circularly linked lists - doubly-linked lists -Stack ADT - Queue ADT - circular queue implementation - Double ended Queues - applications of queues.								
SORTING, SEARCHING AND HASH TECHNIQUES								9
Sorting algorithms: Insertion sort - Selection sort - Bubble Sort - Shell sort - Quick sort - Merge sort - Radix sort. Searching: Linear search - Binary Search. Hashing: Hash Functions.								
NON-LINEAR DATA STRUCTURES								9
Binary Tree – Binary Search Tree -AVL trees - Red-Black trees - Heaps - Applications of Non-Linear Data Structures.								
GRAPHS								9
Representation of Graphs - Breadth-first search - Depth-first search - Minimum Spanning Trees - Kruskal and Prim algorithm - Shortest path algorithm - Dijkstra’s algorithm - Bellman-Ford algorithm - Floyd-Warshall algorithm.								
Total Periods:								45
Text Book:								
1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education, 4/e, 2014. 2. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw Hill Company Ltd., 7/e, 2017.								
References:								
1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, C lifford Stein, “Introduction to Algorithms”, McGraw Hill, 4/e, 2022. 2. Reema Thareja, “Data Structures Using C”, Oxford University Press, 3/e, 2023. 3. Aho, Hopcroft and Ullman, “Data Structures and Algorithms”, Pearson Education, 1983. 4. Michael T Goodrich, Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, Wiley Publishers, 7/e, 2004. 5. https://archive.nptel.ac.in/courses/106/102/106102064/								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K2	2	3	2	2								1	3	2
CO3	K3	3	3	3	3								1	3	3
CO4	K2	2	3	2	2								1	3	2
CO5	K2	2	3	2	2								1	3	2
CO6	K2	2	3	2	2								1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS33		PROGRAMMING FOR DATA SCIENCE			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	3	Category:		PC
Pre-/Co-requisite:		NIL						
Aim:	To provide necessary knowledge on data manipulation and to perform analysis on real time problems using statistical and machine learning approach.							
Course Outcomes: The Students will be able to								
CO1:	Recall the basic knowledge in data science.							
CO2:	Organize real time data into suitable form for analysis.							
CO3:	Apply encoding techniques based on project objectives.							
CO4:	Summarize various classification algorithm in machine learning techniques.							
CO5:	Summarize various clustering algorithm in machine learning techniques.							
CO6:	Identify necessary requirement for data visualization to plot graphs using R.							
INTRODUCTION								9
Data Science: Introduction to Data Science – Digital Universe – Sources of Data – Information Commons – Data Science Project Life Cycle.								
DATA PREPROCESSING								9
Introduction to Data Preprocessing – Reading, Selecting, Filtering Data – Filtering Missing Values– Manipulating, Sorting, Grouping, Rearranging, Ranking Data.								
ESSENTIALS OF R								9
R Basics - data types and objects - control structures – data frame -Feature Engineering - scaling, Label Encoding and One Hot Encoding, Reduction.								
MODEL FIT USING R								9
Regression Models - Linear and Logistic Model, Classification Models – Decision Tree, Naive Bayes, SVM and Random Forest, Clustering Models – K Means and Hierarchical clustering								
VISUALIZATION								9
Data visualization: Box plot, histogram, scatter plot, heat map – Working with Tableau – Outlier detection - Data Balancing								
Total Periods:								45
Text Book(s)								
1. Ethem Alpaydin, “Introduction to Machine Learning”, 4/e, MIT Press, 2020. 2. Hadley Wickham, Garrett Grolemund, “R for data science: Import, Tidy, Transform, Visualize, And Model Data Paperback”, 2017.								
References:								
1. Han, J., Kamber, M., Pei, J. “Data mining concepts and techniques”, Morgan Kaufmann, 2011. 2. Carl Shan, Henry Wang, William Chen, Max Song. “The Data Science Handbook: Advice and Insight from 25 Amazing Data Scientists. The Data Science Bookshelf”, 2016. 3. James, G., Witten, D., T., Tibshirani, “R. An Introduction to statistical learning with applications in R”, Springer. 2013. 4. https://onlinecourses.nptel.ac.in/noc21_cs69/preview .								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	2	3	2	2								1	3	2
CO2	K3	3	3	3	3								1	3	3
CO3	K3	3	3	3	3								1	3	3
CO4	K3	3	3	3	3								1	3	3
CO5	K3	3	3	3	3	2							1	3	3
CO6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS34		OBJECT ORIENTED PROGRAMMING USING C++			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	3	Category:		PC
Prerequisites:		231CS21 – Programming in C						
Aim:	To enable the students to tackle complex programming problems, making good use of the object-oriented programming paradigm to simplify the design and implementation process.							
Course Outcomes: The Students will be able to								
CO1:	Classify object oriented programming and procedural programming.							
CO2:	Apply C++ features such as composition of objects, operator overloads, dynamic memory allocation.							
CO3:	Make use of inheritance and polymorphism concept in developing a C++ projects.							
CO4:	Identify the exceptions and its handling techniques.							
CO5:	Demonstrate the concept of templates and generic functions.							
CO6:	Apply the concept of standard template library.							
BASIC CONCEPTS								9
Object oriented programming concepts – Introduction to C++ - Classes and objects: classes - structures and classes - unions and classes - friend functions – friend classes - inline functions -static class members- scope resolution operator - nested classes - local classes -passing objects to functions - returning objects – object assignment. Arrays, Pointers, References and Dynamic Allocation Operators.								
FUNCTION OVERLOADING AND CONSTRUCTORS								9
Function Overloading – Overloading Constructors – Copy Constructors– Destructors Operator overloading: Creating a member Operator Function – Operator Overloading Using Friend Function – Overloading New and Delete – Overloading Special Operators – Overloading Comma Operator.								
INHERITANCE AND POLYMORPHISM								9
Inheritance: Base-Class Access Control – Inheritance and Protected Members – Inheriting Multiple Base Classes –Virtual Base Classes. Polymorphism: Virtual Functions — Pure Virtual Functions – Using Virtual Functions – Early vs. Late Binding. Run-Time Type ID and Casting Operators: RTTI – Casting Operators –Dynamic Cast.								
TEMPLATES AND EXCEPTION HANDLING								9
Templates: Generic Functions – Applying Generic Functions – Generic Classes – Type name and Export Keywords – Power of Templates. Exception Handling: Fundamentals –Handling Derived Class Exceptions – Exception Handling Options – Understanding terminate() and unexpected() – uncaught exception() Function – Exception and bad exception Classes – Applying Exception Handling.								
I/O STREAMS STANDARD TEMPLATE LIBRARY								9
File I/O-<fstream> and the File Classes-Opening and Closing a File-Reading and Writing Text Files-Unformatted and Binary I/O. Standard Template Library: Overview – Container Classes – General Theory of Operation –Vectors- Lists-Maps – String Class								
Total Periods								45
Text Books:								
1. Robert Lafore, “Object Oriented Programming in C++”, Tech media Publication, 4/e, 2008. 2. E. Balagurusamy, “Object oriented Programming with C++”, Tata McGraw-Hill, 6/e, 2013. 3. Herbert shield, “The complete reference C++”, McGraw Hill Publication, 4/e, 2017.								

References:	
1. Joyce Farrell , “<i>Object-Oriented Programming Using C++</i>”, 2009, Cengage Learning products are represented in Canada by Nelson Education, Ltd. 4/e. 2. Ashok N Kamthane, “ <i>Programming in C++</i> ”, Pearson India, 2/e, 2013 3. B. Trivedi, “<i>Programming with ANSI C++</i>”, Oxford University Press, 2012. 4. K.R Venugopal and Rajkumar Buyya, “<i>Mastering C++</i>”, Tata McGraw Hill, 2/e, 2013. 5. https://onlinecourses.nptel.ac.in/noc24_cs44/preview	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K3	3	3	3	3								1	3	3
CO3	K3	3	3	3	3								1	3	3
CO4	K3	3	3	3	3								1	3	3
CO5	K2	2	3	2	2								1	3	2
CO6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS35		DIGITAL ELECTRONICS AND MICROPROCESSORS (Theory–cum–Practical)		L	T	P	C
				3	0	2	3
Programme:		B.E. Computer Science and Engineering		Sem:	3	Category:	PC
Prerequisites:		231ESF1 – Basic Electrical and Electronics Engineering					
Aim:	To focus on the study of Electronic Circuits and Microprocessor and Microcontroller.						
Course Outcomes: The students will be able to							
CO1:	Apply various laws of Boolean algebra and expressions.						
CO2:	Demonstrate digital circuits using basic gates and flip-flops.						
CO3:	Construct the functional blocks of the 8085 and 8086 microprocessors.						
CO4:	Explain the architecture, Instruction formats and features of i3 and i5 microprocessors.						
CO5:	Outline the Peripheral Interface devices and Microprocessors.						
CO6:	Experiment with the Communication and Interrupt handling devices.						
BOOLEAN ALGEBRA							9
Basic logic circuits: Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR and their truth tables), Universal Gates, Laws of Boolean algebra, De-Morgan's theorem, Min term, Max term, POS, SOP, K-Map, Simplification by Boolean theorems.							
COMBINATIONAL LOGIC, FLIP FLOP AND TIMING CIRCUIT							9
The Half adder, the full adder, subtractor circuit. Multiplexer de-multiplexer, decoder, BCD to seven segment Decoder, encoders. Flip flop : D-flip-flop, R-S flip-flop, J-K Flip-flop, Master slave Flip flop, , T flip-flop.							
8085 AND 8086 MICROPROCESSOR							9
Introduction to 8085 Architecture, Timing Diagram, Addressing Modes, Instruction Formats, Instruction Set. Introduction to 8086 Architecture, Features, Signals, I/O & Memory Interfacing, Addressing Modes, Instruction Formats, Instruction Set, Assembler Directives, Interrupts, Assembly Language Programming.							
CORE i3 & i5 MICROPROCESSOR							9
Introduction to Core i3 Architecture, Instruction Formats, Features of Core i3,Advantages of core i3, Introduction to Core i5 Architecture, Instruction Formats, Features of Core i5,Advantages of core i5.							
PERIPHERAL DEVICES							9
Parallel Peripheral Interface (8255), A/D & D/A Interface, Timer / Counter (8253), Keyboard and Display Controller (8279), USART (8251), Interrupt Controller (8259), DMA Controller (8237).							
Total Periods:							45
COMPONENT LAB – LIST OF EXPERIMENTS:							
1. Design and implementation of 4-bit binary adder / subtractor & parity generator / checker using basic gates and MSI devices.							
2. Design and implementation of magnitude comparator.							
3. Design and implementation of application using multiplexers/ De-multiplexers.							
4. Design and implementation of Shift registers.							
5. Design and implementation of Synchronous and Asynchronous counters.							
Total Periods:							15
Cumulative Total:							60
Text Book:							
1. Morris Mano, “Digital Design”, Pearson Education, 6/e, 2018.							
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085” Penram International Publishing 6/e, 2013.							
3. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson education, 2/e, 2011.							
References:							

1. Douglas V. Hall, "Microprocessors and Interfacing, Programming and Hardware, TMH, 2012.
2. Floyd, Jain, "Digital Fundamentals", Pearsons Publications, 2005.
3. Charles H. Roth, Larry L. Kinney, Raghunandan G. H., "Fundamentals of Logic Design", Cengage Learning India Pvt. Ltd.; 1/e, 2019
4. <https://www.intel.com/content/dam/www/public/us/en/documents/white-papers/ia-introduction-basics-paper.pdf>
5. https://onlinecourses.swayam2.ac.in/cec21_cs16/preview

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K3	3	3	3	3								1	3	3
CO2	K2	2	3	2	2								1	3	2
CO3	K3	3	3	3	3	2							1	3	3
CO4	K2	2	3	2	2	2							1	3	2
CO5	K2	2	3	2	2	2							1	3	2
CO6	K3	3	3	3	3	2							1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS37		DATA STRUCTURES LABORATORY			L	T	P	C
					0	0	2	1.5
Programme:		B.E. Computer Science and Engineering		Sem:	3	Category:		PC
Prerequisite:		231CS27 – Programming in C Laboratory						
Aim:	To develop proficiency in C++ programming for designing and implementing data structures.							
Course Outcomes: The Students will be able to								
CO1:	Analyze the importance and basic usability of structure and ADT in different applications.							
CO2:	Examine the use of linear data structures in solving diverse computational problems.							
CO3:	Estimate the various searching and sorting techniques.							
CO4:	Evaluate the performance of hashing techniques in terms of collision resolution.							
CO5:	Justify the need of tree traversal techniques to process and retrieve data from tree structures.							
CO6:	Develop graph algorithms for minimum spanning tree and shortest path.							
LIST OF EXPERIMENTS:								
Implementation in the following topics:								
1. Representation of records using Structures in C – Creation of Linked List – Manipulation of Records in a Linked List.								
2. Operations on a Stack and Queue								
a. Infix to Postfix								
b. Simple expression evaluation using stacks								
c. Linked Stack Implementation.								
d. Linked Queue Implementation.								
3. Applications of Stack and Queue.								
4. Implementation of Sorting algorithm.								
5. Implementation of Linear Search and Binary Search.								
6. Implementation of Hashing Techniques.								
7. Implementation of Binary Search Tree.								
8. Implementation of Tree Traversal Techniques.								
9. Implementation of Minimum Spanning Trees.								
10. Implementation of Shortest Path Algorithms.								
Total Periods:								45
LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:								
Standalone desktops with C compiler 30 Nos. (or)								
Server with C compiler supporting 30 terminals or more.								

Course Outcomes		Program Outcomes (POs) 231CS37 DATA STRUCTURES LABORATORY											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K6	K6	K3								K6	K6	K3
CO1	K4	3	1	1	3								1	1	3
CO2	K4	3	1	1	3								1	1	3
CO3	K4	3	1	1	3								1	1	3
CO4	K4	3	1	1	3								1	1	3
CO5	K5	3	2	2	3								2	2	3
CO6	K6	3	3	3	3								3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS38	C++ PROGRAMMING LABORATORY			L	T	P	C
				0	0	2	1.5
Programme:	B.E. Computer Science and Engineering	Sem:	3	Category:		PC	
Prerequisite:	191CSF7 – C Programming Laboratory						
Aim:	This lab course will enable the students to implement the Object Oriented Programming concepts using C++ and data structures.						
Course Outcomes: The Students will be able to							
CO1:	Construct the basics of simple programs in C++ using Control structures.						
CO2:	Determine the concepts of Arrays, Pointers, and Functions and perform Modular Programming.						
CO3:	Analyze knowledge on Object Oriented Programming Concepts and design programs using Constructors, friend functions.						
CO4:	Develop C++ Programs using the Inheritance concepts.						
CO5:	Examine the principles of virtual functions and polymorphism.						
CO6:	Create Object Oriented Programs using templates and exceptional handling Concepts.						
LIST OF EXPERIMENTS							
1. Write a C++ Program to display Names, Roll No., and grade of 3 students who have appeared in the examination. Declare the class of name, roll no., and grade. Create an array of class objects. Read and display the contents of the array.							
2. Given that EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary, and print data members. Write a C++ program to read the data of N employee and compute the net salary of each employee (DA=52% of basic and IT=30% of gross salary).							
3. Write a C++ Program to allocate memory using new operator.							
4. Write a C++ Program to demonstrate the use of dynamic constructor.							
5. Write a C++ Program to demonstrate the overloading of increment and decrement operators.							
6. Write a C++ Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.							
7. Write C++ Programs that illustrate how the following forms of inheritance are supported: a) Single inheritance b) Multiple inheritance c) Multi level inheritance d) Hierarchical inheritance							
8. Write a C++ Program to Demonstrate Friend Function and Friend Class.							
9. Write a C++ Template Based Program to Sort the Given List of Elements.							
10. Write a C++ Program to implement Class Templates.							
11. Write a C++ program that uses function templates to find the largest and smallest number in a list of integers and to sort a list of numbers in ascending order.							
12. Write a C++ program to implement Virtual Functions.							
13. Write a C++ Program Containing a Possible Exception. Use a Try Block to Throw it and a Catch Block to Handle it Properly.							
14. Write a C++ Program to Demonstrate the Catching of All Exceptions							
Total Periods:							45

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C/C++ compiler 30 Nos.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K6	K6	K3								K6	K6	K3
CO1	K4	3	1	1	3								1	1	3
CO2	K4	3	1	1	3								1	1	3
CO3	K4	3	1	1	3								1	1	3
CO4	K4	3	1	1	3								1	1	3
CO5	K5	3	2	2	3								2	2	3
CO6	K6	3	3	3	3								3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231MC01		DESIGN THINKING			L	T	P	C
					2	0	0	0
Programme:	B.E., / B. Tech		Sem:	-	Category:			MC
Prerequisites:	NIL							
Aim:	To impart knowledge on design thinking process for understanding complex designs and to provide design skills to analyze design thinking issues and apply the tools and techniques of design.							
Course Outcomes: Students will be able to								
CO1:	Demonstrate knowledge of design thinking process							
CO2:	Recall design thinking techniques to design relevant products/services							
CO3:	Apply human centered design (HCD) methodology for product or service design.							
CO4:	Utilize ideation techniques for developing innovative products or services							
CO5:	Identify the causes for the problems in the design of products or services							
CO6:	Interpret the steps to gain practical knowledge of prototyping, testing and validation.							
OVERVIEW OF DESIGN THINKING PROCESS								6
Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking, Problem solving, understanding design thinking and its process model, Design thinking tools. Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyze, Solve and Test.								
EMPATHIZE								6
Design thinking phases, How to empathize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user personas, customer journey mapping, How might we questions								
SOLVE / IDEATE								6
Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications								
ANALYZE / DEFINE								6
Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling.								
TEST (PROTOTYPING AND VALIDATION)								6
Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.								
Total Periods								30
References								
1. Dr. Bala Ramadurai, "Karmic Design Thinking", TRIZ Innovation India, 1/e, 2020. 2. Karl T. Ulrich, “Design Creation of Artifacts in Society”, Trustees of the University of Pennsylvania Publisher, USA, 2011 3. Alma R. Hoffmann, “Sketching as Design Thinking”, Taylor & Francis, UK, 2019 4. Michael Lewrick, Patrick Link and Larry Leifer, “The Design Thinking Playbook”, Wiley, USA, 2018.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K1	1	2	1	1									2	1
CO3	K3	3	3	3	3								1	3	3
CO4	K3	3	3	3	3	2	3	2					1	3	3
CO5	K3	3	3	3	3								1	3	3
CO6	K2	2	3	2	2								1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS41		DATABASE MANAGEMENT SYSTEMS				L	T	P	C
						3	0	0	3
Programme:	B.E. Computer Science and Engineering				Sem:	4	Category:		PC
Prerequisite:	-								
Aim:	To provide a strong foundation in database technology and current trends in this field.								
Course Outcomes: The Students will be able to.									
CO1:	Identify the basic concepts of database systems.								
CO2:	Outline the basics of SQL and methods to enhance queries.								
CO3:	Apply the normalization rules for optimizing the database.								
CO4:	Illustrate the transactions using T-SQL.								
CO5:	Summarize the fundamental concepts of transaction, concurrency and recovery processing.								
CO6:	Classify the various advanced Database technologies and database security.								
INTRODUCTION									9
Purpose of Database System - Views of data - Data Models - Architecture -Entity - Relationship (E-R) model -Extended E-R Features - Design of E-R database schema - Structure of Relational data model - Fundamentals of relational algebra operations									
STRUCTURED QUERY LANGUAGE									9
SQL: Basic structure - Query Processing Overview -Set operations - Aggregate functions - Null Values – Nested sub queries -Data Base Languages- Keys - Embedded SQL -Dynamic SQL. Domain Constraints - Assertions - Triggers - Views.									
DATABASE DESIGN									9
Functional Dependencies –Non-loss Decomposition- Normalization-First, Second, Third Normal Forms, -Boyce/Code Normal Form - Multi-valued Dependencies and Fourth Normal Form - Join Dependencies and Fifth Normal Form.									
TRANSACTIONS PROCESSING AND CONCURRENCY CONTROL									9
Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm.									
ADVANCED DATABASE SECURITY AND No-SQL									9
Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – No-SQL MongoDB- Basic Structure – Commands – Data Base Connectivity- Database Security: Security issues –Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures.									
Total Periods:									45
Text Books:									
1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, 7 th /e, Tata McGraw Hill, 2021. 2. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 7 th /e, Pearson, 2017. 3. Itzik Ben-Gan,“Microsoft SQL Server 2012 T-SQL Fundamentals”, Microsoft Press 2 nd /e, 2012.									
References:									
1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Pearson Education, 8/e, 2006. 2. Raghu Ramakrishnan, “Database Management Systems”, McGrawHill, 4/e, 2010. 3. G.K.Gupta, “Database Management Systems”, Tata McGraw Hill, 2011.									

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K2	2	3	2	2								1	3	2
CO3	K3	3	3	3	3								1	3	3
CO4	K2	2	3	2	2								1	3	2
CO5	K2	2	3	2	2								1	3	2
CO6	K2	2	3	2	2								1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS42		DESIGN AND ANALYSIS ALGORITHMS		L	T	P	C
				3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	4	Category:	PC
Prerequisites:	231CS32-Data Structures						
Aim:	To learn about algorithm analysis for the run time complexities and the space requirements. And acquire knowledge of algorithms for implementing various computing system						
Course Outcomes: The Students will be able to							
CO1:	Identify the time and space complexities of different algorithms.						
CO2:	Solve problems using the divide and conquer paradigms.						
CO3:	Utilize the greedy method to solve basic optimization problems.						
CO4:	Develop algorithms that apply dynamic programming to solve various problems.						
CO5:	Identify how backtracking and branch-and-bound are applied to deliver optimal solutions to various real-world problems.						
CO6:	Apply theoretical knowledge of NP problems and advanced algorithms to solve real-world computational challenges.						
INTRODUCTION TO ALGORITHMS							9
Role of algorithm in computing - Time and Space Complexity - Rate of Growth – Asymptotic Analysis - Recurrence Relations - The substitution method for solving recurrences.							
DIVIDE AND CONQUER							9
Merge sort - Quick sort - Finding Maximum and Minimum Elements - Strassen’s Matrix Multiplication - Tiling Problem - Closest Pair Problems.							
GREEDY METHOD AND DYNAMIC PROGRAMMING							9
Greedy Method: Coin change problem - Scheduling Problems - Knapsack Problem - Minimum Spanning Trees - Huffman coding. Dynamic Programming: Multistage Graph Problem - Floyd-Warshall Algorithm - Bellman-Ford Algorithm							
BACKTRACKING AND BRANCH-AND-BOUND							9
Backtracking: N Queen Problem - Sum of Subsets - Vertex Colouring Problem - Hamiltonian Circuit Problem. Branch and bound – Knapsack problem – Travelling salesman problem.							
NP PROBLEMS AND ADVANCED ALGORITHMS							9
NP-completeness - Cook’s Theorem - Theory of reducibility - Circuit satisfiability - NP hard Graph Problem - Clique Decision Problem - Vertex Cover Problem - Introduction to approximation algorithms - Randomization algorithms - Parallel algorithms - Parallel Searching and Parallel Sorting.							
					Total Periods:		45
Text Book:							
1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3/e, Pearson Education,2012.							
References:							

1. S. Sridhar, “*Design and Analysis of Algorithms*”, Oxford university press, 2014.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “*Introduction to Algorithms*”, 3/e, PHI Learning Private Limited, 2012.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “*Data Structures and Algorithms*”, Pearson Education, Reprint 2006.
4. Harsh Bhasin, “*Algorithms Design and Analysis*”, Oxford university press, 2016.
5. https://onlinecourses.nptel.ac.in/noc25_cs23/preview

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	3	3	3	2								3	2	
CO2	K2	3	3	3	2							2	3	2	
CO3	K2	3	3	3	2							2	3	2	
CO4	K3	3	3	3	2							2	3	2	
CO5	K3	3	3	3	2							2	3	2	
CO6	K3	3	3	3	2								3	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS43		PROGRAMMING WITH JAVA				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	4	Category:		PC	
Aim:	To understand object oriented programming concepts, and apply them in problem solving.								
Course Outcomes: The Students will be able to									
CO1:	Apply the basic concepts of Object Oriented Programming concepts to solve simple programs.								
CO2:	Recall the concepts of inheritance, packages and the need of interfaces in Java.								
CO3:	Make use of exception handling and multi-threaded programming.								
CO4:	Construct Java program using generics, collections and string classes.								
CO5:	Demonstrate user interfaces for java application and applets using GUI.								
CO6:	Build real time applications with JDBC, RMI and servlets.								
INTRODUCTION									9
OOP concepts, classes and objects, History and Evolution of Java –An overview of java-Data types ,variables, and arrays-operators - control statements–Classes and methods –constructors- comments – Simple Java Programs									
INHERITANCE ,PACKAGES AND INTERFACES									9
Overloading Methods-Recursion-understanding static and final –Nested and inner classes-Inheritance basics- types of inheritance –using super- method Overriding-Dynamic method dispatch, abstract classes and methods, Object class-Packages–packages and member access-importing packages, Interfaces - implementing interfaces-default interface methods.									
EXCEPTIONS,MULTITHREADING AND GENERICS									9
Exception handling fundamentals - exception types - throwing and catching exceptions- built in exceptions-user defined exceptions, Multithreaded programming –Java thread model-creating and executing threads –Thread priorities- thread synchronization –Enumerations-Auto boxing-annotations, Generic classes - Generic methods.									
JAVA LIBRARIES AND GUI PROGRAMMING									9
String handling-functions-the collection Framework-Overview- collection Interfaces-Collection classes-Files-The byte streams –The character Streams-Event Handling -The delegation event Model-Event Classes -Event Listener, Interfaces –Adapter classes-AWT Class-Window Fundamentals-Working with frame windows-colors-fonts, Introducing Graphics- AWT controls -Layout Managers-Menus.									
JDBC & RMI									9
Connecting to Database -JDBC Type 1 to 4 drives, connecting to a database, querying a database and processing the results, updating data with JDBC - Example program. RMI -Architecture –A simple client/server application using RMI, Introduction to Servlets, Life cycle-servlet development option - simple servlet									
Total Periods:									45
Text Book:									
1. Java the Complete Reference, Herbert Schildt Eleventh Edition, TMH 2019.									
References :									
1. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, Eighth Edition, Sun Microsystems Press, 2008.									
2. Java for Programmers, P.J. Deitel and H.M. Deitel, Pearson education (OR) Java: How to Program P.J. Deitel and H.M. Deitel, PHI 8 th Edition.									

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K3	3	3	3	3								1	3	3
CO2	K1	1	2	1	1									2	1
CO3	K3	3	3	3	3								1	3	3
CO4	K3	3	3	3	3	1							1	3	3
CO5	K2	2	3	2	2	2							1	3	2
CO6	K3	3	3	3	3	2			2		2	2	1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS44		THEORY OF COMPUTATION				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	4	Category:		PC	
Pre-/Co-requisite:									
Aim:	To understand all basic concepts in theoretical computer science								
Course Outcomes: The Students will be able to									
CO1:	Recall basic concepts of formal languages of finite automata techniques								
CO2:	Organize Finite Automata’s for different Regular Expressions and Languages								
CO3:	Construct context free grammar for various languages								
CO4:	Apply the working of Turing machine and its different categories.								
CO5:	Outline the Characteristics of P, NP and NP Complete problems								
CO6:	Solve the Computational problems regarding their computability and complexity.								
FINITE AUTOMATA (FA)									9
Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epszlon transitions, Minimization of Deterministic Finite Automata.									
REGULAR LANGUAGES									9
Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA’s to Regular Expressions, Converting Regular Expressions to Automata, Applications of Regular Expressions, Proving languages to be non-regular -Pumping lemma and applications, Closure properties of regular languages.									
CONTEXT FREE GRAMMER (CFG)									9
Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG’s, Minimization of CFG’s, CNF, GNF, Pumping Lemma for CFL’s, Definition of Push down automata with example- Equivalence of Pushdown automata and CFL									
TURING MACHINES (TM)									9
Formal definition and behaviour, Languages of a TM, Computable languages and functions – Techniques for Turing machine construction – Multi head and Multi tape Turing Machines - The Halting problem – Partial Solvability – Problems about Turing machine									
UNSOLVABLE PROBLEMS AND COMPUTABLE FUNCTIONS									9
Unsolvable Problems and Computable Functions – Primitive recursive functions – Recursive and recursively enumerable languages – Universal Turing machine. MEASURING AND CLASSIFYING COMPLEXITY: Tractable and Intractable problems- Tractable and possibly intractable problems - P and NP completeness - Polynomial time reductions.									
Total Periods:									45
Text Book:									
1. Hopcroft J.E., Motwani R. and Ullman J.D, “Introduction to Automata Theory, Languages and Computations”, Second Edition, Pearson Education, 2008. (UNIT 1,2,3) 2. John C Martin, “Introduction to Languages and the Theory of Computation”, Third Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007. (UNIT 4,5)									
References:									

1. Mishra K L P and Chandrasekaran N, “Theory of Computer Science - Automata, Languages and Computation”, Third Edition, Prentice Hall of India, 2004.
2. Harry R Lewis and Christos H Papadimitriou, “Elements of the Theory of Computation”, Second Edition, Prentice Hall of India, Pearson Education, New Delhi, 2003.
3. Peter Linz, “An Introduction to Formal Language and Automata”, Third Edition, Narosa Publishers, New Delhi, 2002.
4. Kamala Krithivasan and Rama. R, “Introduction to Formal Languages, Automata Theory and Computation”, Pearson Education 2009

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	1	2	1	1									2	1
CO2	K3	3	3	3	3								1	3	3
CO3	K3	3	3	3	3								1	3	3
CO4	K3	3	3	3	3								1	3	3
CO5	K2	2	3	2	2								1	3	2
CO6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS45	OPERATING SYSTEMS				L	T	P	C
					3	0	2	4
Programme:	B.E. Computer Science and Engineering			Sem:	4	Category:	PC	
Prerequisites:	191CS41 – Computer Organization and Architecture							
Aim:	To introduce the basic principles and concepts of operating systems.							
Course Outcomes: The Students will be able to								
CO1:	Explain the structure and functions of Operating system.							
CO2:	Utilize the techniques and algorithms for process management and synchronization.							
CO3:	Demonstrate various memory management schemes.							
CO4:	Identify the various Process Scheduling algorithms and Page Replacement algorithms.							
CO5:	Summarize various Disk scheduling algorithms, Concepts of files and I/O							
CO6:	Apply administrative tasks on Linux Servers and Compare iOS and Android							
Operating System and Services								9
Computer System Introduction-Operating system overview-structures and Operations-Types-System calls and System Programs-System Booting-Process-Concept-States-Scheduling Types-Inter Process Communication- Threads-Types and Models-Examples.								
Process Management								9
Process scheduling algorithms-examples-thread scheduling- examples-process synchronization-critical sections-hardware and software solutions-semaphores- classical problems in synchronization - producer consumer problem- readers writer problem- dining philosophers problem-deadlocks-detection and avoidance algorithms-deadlock prevention techniques.								
Memory Management								9
Main memory and Types-Registers and Types-Cache memory and Types-Memory allocation-Paging and Segmentation-32 Bits and 64 Bits memory Systems-Virtual Memory-Demand Paging-Page Fault-Page Replacement-Allocating Kernel memory. Examples.								
File and I/O Management								9
Mass Storage-Disk Structure and Scheduling-File-File System-Directory Structure-File Allocation Methods-Free Space Management-I/O System and Components-Services.								
Case Studies and Tools								9
Linux Operating System and Services-Windows Server 2016 and Services – Memory and Process management for Intel i5 and i7 cores-Mobile OS -iOS and Android -Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System								
Total Periods:								45
COMPONENT LAB – LIST OF EXPERIMENTS:								
1. Implement Process Management System Calls								
2. Implement Shared memory and IPC.								
3. Implement Threading Applications.								
4. Implement Synchronization Applications using Semaphores.								
5. Process Scheduling Algorithms (FCFS, SJF, Round Robin and Priority).								
6. Page Replacement Algorithms (FIFO and LRU)								
Text Book:								
1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “Operating System Concepts”, John Wiley and Sons Inc., 9/e, 2012.								
References:								

1. William Stallings, “Operating Systems – Internals and Design Principles”, Prentice Hall, 7/e, 2011.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, Addison Wesley, 2/e, 2001.
3. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata McGraw Hill, 1996.
4. D.M.Dhamdhare, “Operating Systems: A Concept-Based Approach”, Tata McGraw Hill, 2/e, 2007

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K3	3	3	3	3								1	3	3
CO3	K2	3	3	3	3								1	3	3
CO4	K2	3	3	3	3								1	3	3
CO5	K2	2	3	2	2								1	3	2
CO6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS46		COMPUTER NETWORKS			L	T	P	C
					3	0	2	4
Programme:	B.E. Computer Science and Engineering			Sem:	4	Category:		PC
Pre-/Co-requisite:								
Aim:	To understand the concepts of computer networks, protocols and data communication.							
Course Outcomes: The Students will be able to								
CO1:	Identify the components required to build different types of networks.							
CO2:	Classify the Media Access Control Protocols and different Internetworking.							
CO3:	Demonstrate the various types of routing techniques							
CO4:	Outline the mechanisms involved in transport layer							
CO5:	Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.							
CO6:	Construct a networking system and justify the appropriate protocols.							
FUNDAMENTALS & LINK LAYER								9
Building a network – Requirements - Layering and protocols - Internet Architecture – Network software – Performance ; Link layer Services - Framing - Error Detection - Flow control								
MEDIA ACCESS & INTERNETWORKING								9
Media access control - Ethernet (802.3) - Wireless LANs – 802.11 – Bluetooth - Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)								
ROUTING								9
Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)								
TRANSPORT LAYER								9
Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management - Flow control - Retransmission – TCP Congestion control - Congestion avoidance (DECbit, RED) – QoS – Application requirements								
APPLICATION LAYER								9
Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP								
Total Periods:								45
LIST OF EXPERIMENTS:								
1. Implementation of Stop and Wait Protocol and Sliding Window Protocol.								
2. Study of Socket Programming and Client – Server model								
3. Write a code simulating ARP /RARP protocols.								
4. Write a code simulating PING and TRACEROUTE commands								
5. Create a socket for HTTP for web page upload and download.								
6. Write a program to implement RPC (Remote Procedure Call)								
7. Implementation of Subnetting.								
8. Applications using TCP Sockets like								
a. Echo client and echo server								
b. Chat								
c. File Transfer								
9. Applications using TCP and UDP Sockets like								
i. DNS								
ii. SNMP								
iii. File Transfer								
10. Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS 12.								
11. Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer.								
i. Link State routing								

ii. Flooding iii. Distance vector 12. Construct a WAN using Cisco Packet Tracer Tool	
Text Book:	
1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.	
References:	
1. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Fifth Edition, Pearson Education, 2009. 2. Nader. F. Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2010. 3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, Mc Graw Hill Publisher, 2011. 4. Behrouz A. Forouzan, “Data communication and Networking”, Fourth Edition, Tata McGraw – Hill, 2011.	

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K3	3	3	3	3								1	3	3
CO3	K2	3	3	3	3								1	3	3
CO4	K2	3	3	3	3								1	3	3
CO5	K2	2	3	2	2								1	3	2
CO6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS47		DATABASE MANAGEMENT SYSTEMS LABORATORY				L	T	P	C
						0	0	2	1.5
Programme:		B.E. Computer Science and Engineering			Sem:	4	Category:		PC
Prerequisites:		191CS38 – Python Laboratory							
Aim:	To study and implement DDL, DML commands & basics of PL/SQL functions, cursors, triggers etc.								
Course Outcomes: The Students will be able to									
CO1:	Categorize the structured query language (SQL) for database definition and database manipulation.								
CO2:	Recommend with Join and Nested Queries to perform Various Database operations.								
CO3:	Analyze the PL/SQL blocks using Cursors and Triggers.								
CO4:	Evaluate the normalization forms using SQL queries.								
CO5:	Design the Transactions processing using T-SQL.								
CO6:	Analyze the various advanced technology of Databases and No-SQL.								
LIST OF EXPERIMENTS:									
MICROSOFT SQL SERVER									
1. Practice of Database Languages using SQL Query 2. Create a database table, add constraints (primary key, unique, check, Not null), insert rows, update and delete rows using SQL DDL and DML commands 3. Set operators and Join queries and nested queries 4. PL/SQL–(Cursors, Stored procedures, stored function, Triggers) 5. Front end Connectivity 6. Normalization (1NF, 2NF and 3NF) 7. Auto Rollback - IF ELSE statement-SQL Transaction in TRY CATCH using T-SQL.									
MONGODB									
1. No-SQL commands 2. Recursion 3. Java Database Connectivity									
Mini project :									
a) Inventory Control System. b) Hospital Management System. c) Railway Reservation System. d) Personal Information System. e) Web Based User Identification System. f) Timetable Management System. g) Hotel Management System h) Education Management System i) Airline Reservation System j) Online Voting System k) Goods and Service Tax(GST) Management System l) Aadhaar Management System									
								Total Periods:	45
LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:									
Standalone desktops 30 Nos. (or) Server supporting 30 terminals or more.									

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K6	K6	K3								K6	K6	K3
CO1	K4	3	1	1	3								1	1	3
CO2	K5	3	2	2	3								2	2	3
CO3	K4	3	1	1	3								1	1	3
CO4	K5	3	2	2	3								2	2	3
CO5	K6	3	3	3	3								3	3	3
CO6	K4	3	1	1	3								1	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS48		JAVA LABORATORY				L	T	P	C
						0	0	2	1.5
Programme:		B.E. Computer Science and Engineering			Sem:	4	Category:		PC
Prerequisites:		231CS38 – Python Laboratory							
Aim:	To introduce java compiler and eclipse platform or netbeans and to impart hand on experience with java programming.								
Course Outcomes: The Students will be able to									
CO1:	Analyze OOPs concepts to solve the problems using Java programs.								
CO2:	Create the Java program using Inheritance, Polymorphism and exception handling.								
CO3:	Examine programming skills to implement multi-threaded concept.								
CO4:	Estimate the use of GUI components (Console and GUI based).								
CO5:	Design coding methods and able to implement event handling mechanisms.								
CO6:	Develop interactive applications, which communicate with database.								
LIST OF EXPERIMENTS:									
1. Develop the java application to implement basic concepts of OOPs 2. Implement the java application using Inheritance,Polymorphism 3. Create the java application that handle the different types of Exceptions. 4. Write the java program to implement multi-threading. 5. Write the program to perform file operations. 6. Develop the java applications using AWT controls, layouts and menus 7. Write a Java application to implement event handling mechanisms 8. Develop the applications to demonstrate the features of generics classes 9. Design the java applications that connects to a database using JDBC and does add, deletes, modify and retrieve operations									
Total Period									60
Software Required:									
JDK and NetBeans / Eclipse IDE									

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K6	K6	K3								K6	K6	K3
CO1	K4	3	1	1	3								1	1	3
CO2	K6	3	3	3	3								3	3	3
CO3	K4	3	1	1	3								1	1	3
CO4	K5	3	2	2	3								2	2	3
CO5	K6	3	3	3	3						2		3	3	3
CO6	K6	3	3	3	3						2	2	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS51		ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:	5	Category:	PC
Prerequisite:		231CS42- Design and Analysis of Algorithms						
Aim:	To introduce basic artificial intelligence techniques and basic concepts of Machine Learning and techniques.							
Course Outcomes: The Students will be able to								
CO1:	Outline the intelligent agents and problem solving techniques in artificial intelligence.							
CO2:	Develop the knowledge representation through various planning techniques.							
CO3:	Recall the basic concepts of machine learning.							
CO4:	Develop and implement supervised machine learning algorithms.							
CO5:	Apply and evaluate various unsupervised machine learning algorithms.							
CO6:	Summarize various reinforcement algorithms to solve real world applications							
INTRODUCTION- SEARCHING PROBLEMS								9
Introduction to Artificial Intelligence - History of Artificial Intelligence – Agents and Environments - Artificial Intelligence Agents: Types – Structure .Breadth first Search – Depth first Search – Heuristics Search – Iterative Deepening – Hill Climbing – Simulated annealing - Best first search, A* algorithm, AO* algorithm, Constraint satisfaction								
KNOWLEDGE REPRESENTATION- PLANNING- LEARNING								9
Knowledge Representation -Logical Representation: Boolean Logic – Inference in Boolean Logic, First Order Predicate Logic –Inference in FOL – Unification – Forward Chaining-Backward Chaining Representation for planning, Partial order planning algorithm. Learning from Observations - Inductive Learning - Learning Decision Trees.								
MACHINE LEARNING INTRODUCTION - SUPERVISED LEARNING								9
Definition and Need for Machine Learning – Types of Machine Learning algorithms – Machine Learning process —Understanding Data Regression – Types —Linear regression— Logistic regression – Regularizations: Ridge – Lasso— Classification algorithms: K-Nearest Neighbour – Decision Trees – Naïve Bayes algorithm— Support Vector Machine								
UNSUPERVISED LEARNING								9
Clustering algorithms –Partitioning methods: K-Means – K-Medoids – DBSCAN – Hierarchical clustering – Spectral Clustering– Case study on various clustering applications								
REINFORCEMENT LEARNING								9
Markov Decision process model –Multi-arm Bandit problem —Model based Learning —Planning algorithms —policy iteration – Model free methods—Q-Learning – SARSA – Case study on various reinforcement applications.								
Total Periods:								45
Text Book:								

1. Russell and Norvig, “*Artificial Intelligence, A Modern Approach*”, 3rd edition, Pearson Prentice Hall, 2009.
2. S.Sridhar, M.Vijayalakshmi, “*Machine Learning*”, Oxford University Press, 2021

References:

1. Deepak Khemani, “*A First Course in Artificial Intelligence*”, Tata Mc Graw Hill Education 2013
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “*Artificial Intelligence*”, 3rd edition, Tata McGraw Hill, 2009.
3. Jiawei Han, Micheline Kamber and Jian Pei, “*Data Mining: Concepts and Techniques*”, Morgan Kaufmann, 2011
4. Saikat Dutt, Subramanian Chandramouli, Amit kumar Das, “*Machine Learning*”, Pearson, 2018

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K6	K6	K3								K5	K3	K2
CO1	K2	2	1	1	1	2							1	2	1
CO2	K3	1	2	1	1	1							1	2	2
CO3	K1	2	2	1	2	1							2	1	1
CO4	K3	1	2	1	1								1	2	2
CO5	K3	1	1	2	1	2							1	1	2
CO6	K2	1	1	2	1	2							2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS52		WEB TECHNOLOGY			L	T	P	C
					3	0	0	3
Programme:		B.E : Computer Science and Engineering		Sem:	V	Category:		PC
Prerequisite:		NIL						
Aim:	To provide web based interface for the applications to access the application from anywhere, anytime, anyone using HTML, CSS and XHTML including JavaScript, server side scripting							
Course Outcomes: After Successful completion of the course, students will be able to								
CO1:	Explain the basic concepts of the Internet, protocols, HTTP transactions, and web communication models.							
CO2:	Design aesthetically appealing web pages using Cascading Style Sheets (CSS) and its styling properties.							
CO3:	Understand and apply basic JavaScript syntax and constructs.							
CO4:	Implement JavaScript arrays, objects, and their methods.							
CO5:	Illustrate web services to develop interactive web applications							
CO6:	Design and implement web services using JAX-RPC, WSDL, XML Schema, and SOAP for interoperable web applications.							
UNIT I WEB ESSENTIALS:HTML								9
Introduction to HTML-HTML Document Structure-Basic HTML Tags-Creating Links-Inserting Images-Lists-Basic Text Formatting-Saving and Viewing HTML Files-HTML5 Semantic Elements-Forms and Input Types-Multimedia Elements-Data Tables.								
UNIT II STYLE SHEETS:CSS								9
Introduction to CSS-CSS Selectors-Box Model-Text and Font Styling-Colors and Backgrounds-Layout Techniques-Responsive Design-Advanced Styling.								
UNIT III JAVASCRIPT FUNDAMENTALS								9
Introduction to Java Script- Setting up the environment- Variables- Data Types- Operators- Conditional Statements- Loops- Functions- Basic DOM Introduction.								
UNIT IV INTERMEDIATE JAVASCRIPT & THE DOM								9
Arrays and Array Methods- Objects and Object Methods- Destructuring and Spread/Rest syntax- Template Literals- Scope and Closures- Selecting/manipulating elements- Event Handling- Forms and validation- Basic JavaScript debugging- JSON and localStorage/sessionStorage								
UNIT V WEB SERVICES: JAX-RPC								9
Web Services: JAX-RPC-Concepts-Writing a Java Web Service-Writing a Java Web Service Client Describing Web Services: WSDL- Representing Data Types: XML Schema-Communicating Object Data: SOAP Related Technologies								
Total Periods:								45
Text Book:								
1. Jeffrey C. Jackson, “Web Technologies-A Computer Science Perspective”, Pearson Education, 2012. 2. David Flanagan, ‘JavaScript: The Definitive Guide’, 7th Edition 2020. 3. Angular for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing								
References:								
1. Ralph Moseley and M. T. Savaliya, “Developing Web Applications”, Wiley-India, 2011								

2. Harwani,, “*Developing Web Applications in PHP and AJAX*”, McGrawHill, 2010.
3. Robert. W. Sebesta, "*Programming the World Wide Web*", Fourth Edition, Pearson Education, 2007.
4. Deitel, Deitel, Goldberg, "*Internet & World Wide Web How To Program*", Third Edition, Pearson Education, 2006.
5. Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, 1st edition, O'Reilly

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K6	K6	K3								K6	K6	K3
CO1	K2	2	3									3		3	2
CO2	K3	3		3		2				2		2	3	2	3
CO3	K3	3	2		3	2						2		2	3
CO4	K4	3	3		3	2						3	2	3	3
CO5	K3	3	2			3						2	3	2	3
CO6	K3	3		3		3				2	2	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS58		WEB TECHNOLOGY LABORATORY			L	T	P	C
					3	0	2	1.5
Programme:		B.E : Computer Science And Engineering		Sem:	V	Category:		PC
Prerequisite:								
Aim	To design and develop full-stack web applications using front-end, back-end, and database technologies.							
Course Outcomes: The Students will be able to								
CO1:	Develop a static web pages using HTML and CSS for creating user-friendly interfaces.							
CO2:	Apply JavaScript for client-side validation and interactivity to enhance user experience in web applications.							
CO3:	Demonstrate the use of Servlets for dynamic web content generation and server-side validations.							
CO4:	Develop web applications integrated with databases using Servlets and JSP for data-driven functionalities.							
CO5:	Construct interactive web applications using AJAX and XML technologies for asynchronous communication and structured data representation.							
CO6:	Create a multiple web technologies to build and deploy a functional mini-project showcasing the full-stack development lifecycle.							
LIST OF EXPERIMENTS:								
1. Design the following static web pages required for an online bookstore website. a. HOME PAGE b. LOGIN PAGE c. CATOLOGUE PAGE d. REGISTRATION PAGE								
2. Write JavaScript to validate the following fields of the Registration page. (First Name, Password, E-mail id, Mobile Number, Last Name and Address)								
3. To create a simple personal portfolio webpage using HTML and CSS that includes text, images, links, forms, and basic styling.								
4. To create a simple JavaScript program that interacts with the user by asking for their name and then displaying a personalized greeting message on the webpage.								
5. To create an interactive To-Do List web app where users can add, mark as completed, and delete tasks dynamically using JavaScript DOM manipulation.								
6. Implement the web applications with Database using (a) Servlets and (b) JSP								
7. Write a program to design a simple calculator using (a) JavaScript (b) Servlet and (c) JSP.								
8. Write HTML Programs using AJAX.								
9. Write an XML file which will display the Book information which includes the following: Title of the book, Author Name, ISBN number, Publisher name, Edition and Price. Validate the above document using DTD and XML Schema.								
10. Mini Project								
Total Periods:								60

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
		K3	K2	K3	K3					K2	K2	k3	K2	K2	K3
CO1	K3	3	2	3	3					2	2	3	2	2	3
CO2	K3	3	2	3	3					2	2	3	2	2	3
CO3	K2	2	3	2	2							2	3	3	2
CO4	K3	3	2	3	3							3	2	2	3
CO5	K4	3	3	3	3					3	3	3	3	3	3
CO6	K6	3	3	3	3							3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS53		CLOUD COMPUTING TECHNIQUES				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:	5	Category:		PC
Prerequisite:		Computer Networks							
Aim:	To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.								
Course Outcomes: The Students will be able to									
CO1:	Recall the fundamental concepts, types, and Illustrate the architecture and infrastructure of cloud computing.								
CO2:	Apply virtualization techniques, including CPU, memory, and I/O virtualization, and evaluate their impact on load balancing, scalability, and elasticity in cloud environments.								
CO3:	Analyze various cloud infrastructure services such as compute, storage, databases, content delivery, analytics, and deployment services, and apply them in real-world								
CO4:	Design and develop cloud-native applications using reference architectures, design methodologies, and Python-based development frameworks for use cases such as image								
CO5:	Assess cloud security challenges and apply techniques for authentication, authorization, identity and access management, and data protection in cloud environments.								
CO6:	Apply cloud computing solutions to real-world industry case studies in healthcare, energy, transportation, manufacturing, and education sectors.								
INTRODUCTION TO CLOUD COMPUTING									9
Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Characteristics of Cloud Computing-Cloud deployment models – Cloud service models- Cloud services and Applications; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds									
VIRTUALIZATION BASICS									9
Virtualization- Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices, Load balancing-Scalability&Elasticity-Deployment-Replication-Monitoring-Software Defined Networking-Network Function Virtualization –Hadoop & Map Reduce									
CLOUD SERVICES & PLATFORMS									9
Compute services-Storage services-Database services-Application services-Content delivery services- Analytics services-Deployment& Management services, Identify and Access Management-Open Source Private Cloud Software: Cloud Stack-Eucalyptus-Open stack-Google Cloud Platform.									
DEVELOPING FOR CLOUD									9
Cloud application design consideration-Cloud application reference architectures-Design methodologies-Data Storage Approaches-Cloud application development in Python-Design approaches-Image processing App, Document storage App, Map Reduce App									
CLOUD SECURITY									9
Cloud Security challenges –Authentication-Authorization-identify& Access Management-Data Security-Cloud for Industry ,Healthcare and Education case study: Health Care, Energy Systems, Transportation Systems, Manufacturing Industry, Education.									

Total Periods:											45
LIST OF EXPERIMENTS:											
1. Use Eucalyptus or Open Nebula or Open Stack or equivalent to set up the cloud and demonstrate 2. Find procedure to run the virtual machine of different configuration Check how many virtual machines can be utilized at particular time. 3. Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine 4. Install C compiler in the virtual machine and execute a sample program. 5. Show the virtual machine migration based on the certain condition from one node to the other. 6. Show auto scaling on Amazon Cloud 7. Show load balancing on cloud (Amazon, Google Cloud, Windows Azure)											
Text Book:											
1 .Cloud Computing: “A Hands-On Approach” Arshdeep Bahga and Vijay K. Madiseti, published 2013. 2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012											
References:											
1. Barrie Sosinsky, “Cloud Computing Bible” John Wiley & Sons, Wiley publishing, Inc. 2011 2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy Enterprise Perspective on Risks and Compliance”, O'Reilly 2009											

Course Outcome s	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
	K3	K2	K3	K3								K5	K3	K2
CO1	1	1	1	1	1							1	2	1
CO2	2	1	2	2	1							3	2	2
CO3	2	2	1	2	2							2	2	1
CO4	2	2	2	1	1							3	2	1
CO5	3	3	2	2	1							1	1	2
CO6	3	3	1	2	3							1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS57		MACHINE LEARNING PRACTICES LABORATORY			L	T	P	C
					0	0	0	1.5
Programme:		B.E. Computer Science and Engineering		Sem:	5	Category:		PC
Prerequisite:		231CS42- Design and Analysis of Algorithms						
Aim:	To develop knowledge in using suitable supervised, semi-supervised, or unsupervised learning algorithms for solving problems in real life.							
Course Outcomes: The Students will be able to								
CO1:	Construct algorithms to implement Linear regression.							
CO2:	Illustrate the implementation of logistic regression.							
CO3:	Describe and design classification methods							
CO4:	Outline the implementation of support vector machines							
CO5:	Discuss the Clustering algorithms							
CO6:	Illustrate the implementation of Hierarchical clustering							
To implement Machine Learning Algorithms using difference application tools								
List of Experiments:								
Exercises to solve the real-world problems using the following machine learning methods:								
1. Build Linear regression models								
2. Build Logistic regression models								
3. Implement classification algorithms: (KNN, Decision Tree)								
4. Build Support Vector Machine models								
5. Implement Clustering algorithms (K-Means)								
6. Construct Hierarchical clustering – Spectral Clustering								
							Total Periods:	60
Web References:								
1. https://machinelearningmastery.com/linear-regression-for-machine-learning/								
2. https://ml-cheatsheet.readthedocs.io/en/latest/logistic_regression.html								
3. https://machinelearningmastery.com/support-vector-machines-for-machine-learning/								

Course Outcomes	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	K3	K2	K3	K3	K3							K5	K2	K3
CO1	2	1	1	1	1							1		
CO2	1		1		1								2	1
CO3	2	2	1	2	1							1		1
CO4	1	2	1	1	1								1	2
CO5	1	1	2		1							1	1	
CO6	2	1	2		1							2	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS58		WEB TECHNOLOGY LABORATORY			L	T	P	C
					3	0	2	1.5
Programme:		B.E : Computer Science And Engineering		Sem:	V	Category:		PC
Prerequisite:								
Aim	To design and develop full-stack web applications using front-end, back-end, and database technologies.							
Course Outcomes: The Students will be able to								
CO1:	Develop a static web pages using HTML and CSS for creating user-friendly interfaces.							
CO2:	Apply JavaScript for client-side validation and interactivity to enhance user experience in web applications.							
CO3:	Demonstrate the use of Servlets for dynamic web content generation and server-side validations.							
CO4:	Develop web applications integrated with databases using Servlets and JSP for data-driven functionalities.							
CO5:	Construct interactive web applications using AJAX and XML technologies for asynchronous communication and structured data representation.							
CO6:	Create a multiple web technologies to build and deploy a functional mini-project showcasing the full-stack development lifecycle.							
LIST OF EXPERIMENTS:								
11. Design the following static web pages required for an online bookstore website. a. HOME PAGE b. LOGIN PAGE c. CATOLOGUE PAGE d. REGISTRATION PAGE								
12. Write JavaScript to validate the following fields of the Registration page. (First Name, Password, E-mail id, Mobile Number, Last Name and Address)								
13. Develop and demonstrate the usage of inline, internal and external style sheet using CSS								
14. Write a Servlet application to print the current date and time.								
15. Design an application to validate age are less than 18 or more than 18 using SERVLET.								
16. Implement the web applications with Database using (a) Servlets and (b) JSP								
17. Write a program to design a simple calculator using (a) JavaScript (b) Servlet and (c) JSP.								
18. Write HTML Programs using AJAX.								
19. Write an XML file which will display the Book information which includes the following: Title of the book, Author Name, ISBN number, Publisher name, Edition and Price. Validate the above document using DTD and XML Schema.								
20. Mini Project								
Total Periods:								60

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
		K3	K2	K3	K3					K2	K2	k3	K2	K2	K3
CO1	K3	3	2	3	3					2	2	3	2	2	3
CO2	K3	3	2	3	3					2	2	3	2	2	3
CO3	K2	2	3	2	2							2	3	3	2
CO4	K3	3	2	3	3							3	2	2	3
CO5	K4	3	3	3	3					3	3	3	3	3	3
CO6	K6	3	3	3	3							3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS61	OBJECT ORIENTED SOFTWARE ENGINEERING				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering Curriculum and Syllabi (UG Regulations – 2023)			Sem:	6	Category:		PC
Prerequisite:	Basic knowledge of programming in an object-oriented language and fundamentals of Software Engineering							
Aim:	To develop high-end programming environments, tools and architectures.							
Course Outcomes: The Students will be able to								
CO1:	Understand object-oriented software engineering concepts, Agile principles.							
CO2:	Apply object-oriented analysis techniques and develop UML models for real-world systems.							
CO3:	Analyze object-oriented architectures using OO principles, design patterns, and best practices.							
CO4:	Implement object-oriented testing techniques, TDD, refactoring, and maintenance strategies.							
CO5:	Use Scrum practices and Agile project management techniques to plan and track software projects.							
CO6:	Demonstrate the ability to apply modern software engineering trends, tools in OOSE projects.							
UNIT 1 OBJECT ORIENTED SOFTWARE ENGINEERING & AGILE FOUNDATIONS								9
Overview of Software Engineering-Object Oriented Software Engineering: Concepts & Importance-Plan driven vs Object Oriented approaches-Software Process Models: Waterfall, Incremental, Spiral, Iterative-Agile Software Development, Agile Manifesto & Principles, Agile Mindset vs Traditional Mindset-Evolution of Agile Methods-Extreme Programming (XP) – Practices & Values								
UNIT II OBJECT ORIENTED REQUIREMENTS & UML ANALYSIS								9
Requirements Engineering Overview-Functional vs Non-Functional Requirements-User Stories and Acceptance Criteria-SRS for OO Systems-Object Oriented Analysis- Identifying Classes, Objects, Responsibilities-Object Relationships: Association, Aggregation, Composition- UML Models for Analysis: Use Case Diagram, Class Diagram, Sequence Diagram, Activity Diagram, State Machine Diagram-Domain Modeling Case Study: Payment failure, Order cancellation flow								
UNIT III OBJECT ORIENTED DESIGN, ARCHITECTURE & PATTERNS								9
Object Oriented Design Overview-Principles of Good OO Design: Abstraction, Encapsulation, Cohesion & Coupling, Modularity-Architectural Styles: Layered Architecture, Client–Server, Component-Based Architecture- Object Oriented Design Principles: SOLID Principles, GRASP Patterns- Design Patterns Overview: Creational, Structural, Behavioral-Mapping Models to Implementation								
UNIT IV OBJECT ORIENTED TESTING, REFACTORING & MAINTENANCE								9
Introduction to Software Testing: Black-box & White-box Testing-Object Oriented Testing Techniques: Class Testing, Integration Testing-Unit testing-Testing for Non-Functional Requirements-Test-Driven Development: Red–Green–Refactor Cycle- Code Smells & Refactoring Concepts-Software Maintenance: Types of Maintenance, Legacy System Evolution- Reverse Engineering & Software Reengineering-Maintenance Patterns								
UNIT V PROJECT MANAGEMENT& SCRUM								9
Software Configuration Management: CI/CD pipeline-Agile Project Management: Agile Project Planning, Iterative and Incremental Delivery, Effort Estimation-Agile Metrics: Velocity & Burndown-Scrum: Basics-Roles-Artifacts-Events-User Stories & Backlog Management-Estimation & Planning- Agile Metrics & Charts- Scrum in Real-Time Projects- Scrum vs Other Agile Frameworks- Tools Used in Industry								
Total Periods:								45
Text Book:								
1. B. Bruegge and A. H. Dutoit, Object-Oriented Software Engineering: Using UML, Patterns, and Java,3 rd ed.Pearson,2010. ➤ https://www.pearson.com/en-us/subject-catalog/p/Bruegge-Object-Oriented-Software-Engineering-Using-UML-Patterns-and-Java-3rd-Edition/P200000003319 2. Somerville,Ian Software Engineering, 10th Edition, Pearson Education. Available at: Software Engineering by Ian Sommerville (Pearson publication)								

3. K. S. Rubin, *Essential Scrum: A Practical Guide to the Most Popular Agile Process*. Addison-Wesley, 2013.

➤ <https://www.informit.com/store/essential-scrum-a-practical-guide-to-the-most-popular-9780137043293>

References:

1. **Schwaber, K., & Sutherland, J.** (2020). *The Scrum Guide: The definitive guide to Scrum — the rules of the game*. Available online: <https://scrumguides.org/download.html>
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, *Fundamentals of Software Engineering*, 2nd edition, PHI Learning Pvt. Ltd., 2010
3. Stephen Schach, *Object-Oriented and Classical Software Engineering*, 8th ed, McGraw-Hill, 2010
4. Rajib Mall, *Fundamentals of Software Engineering*, 3rd edition, PHI Learning Pvt. Ltd., 2009.
5. Craig Larman, *Applying UML and Patterns*, 3rd ed, Pearson Education, 2005.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3							K2	K5	K2	K3
CO1	K2	3	2	2	2							2	1	3	2
CO2	K3	3	2	2	2							2	1	3	2
CO3	K3	3	2	2	2							2	1	3	2
CO4	K3	3	2	2	2							2	1	3	2
CO5	K3	3	2	2	2							2	1	3	2
CO6	K3	3	2	2	2	2						2	1	3	3

231CS62		MOBILE APPLICATION DEVELOPMENT				L	T	P	C
						3	0	2	4
Programme:		B.E. Computer Science and Engineering			Sem:	6	Category:		PC
Prerequisite:									
Aim:	To develop mobile applications using android SDK, incorporating multimedia, data storage, sensors, and advanced technologies through hands-on projects.								
Course Outcomes: The Students will be able to									
CO1:	Infer the Features and Architecture of Android SDK with Sample Application								
CO2:	Extend the various Android Applications using layout and menus.								
CO3:	Demonstrate the audio, video and animation application.								
CO4:	Explain the fundamentals concepts of Saving data with Internal and External database.								
CO5:	Develop various types of sensors in Android.								
CO6:	Design and Develop the mobile application with Advanced Technology (Mini Project).								
ANDROID OVERVIEW									9
Overview of Android platform- Android SDK features - setting up the mobile app development environment along with an emulator- Android Application Development Architecture - creating an applications and activities -Application manifest									
INTERFACE TOOLS									9
Creating user interface - Views - creating views - Layouts - Drawable resources - resolution and density independence - Menus - Intents - Adapters - Internet resources - Audio, Video Using the Camera									
FILES AND DATABASES									9
Saving Simple Application Data - creating and saving preferences - preferences activity -saving activity state - loading files - file management tools-sending emails through application - Introducing Android databases -SQLite - Web Database- Firebase									
SMALL COMPUTING TECNOLOGY AND SENSORS									9
Telephony And SMS - Bluetooth Networks - Managing network connectivity - WI-FI - Sensors -Sensors and the Sensor Manager - Interpreting sensor values-Using the compass, Accelerometer and Orientation sensor.									
ADVANCED TECHNOLOGY									9
Paranoid Android - Using Wake Locks - AIDL to Support IPC for Services -General API's- Payment-gateway, Android jetpack-Technology II-IOS-Introduction to Objective C-IOS features.									
Total Periods:									45
LIST OF EXPERIMENTS:									
Implementation in the following topics:									
1. Develop an application that uses layouts and menus.									
2. Implement audio, video and animation									
3. Develop Web data base application.									
4. Implement location provider.									
5. Implement an application that creates notification upon receiving a message.									
6. Write a Mobile Application for chatting.									

7. Mini Project	
Text Book:	
1. Jeff Mc Wherter and Scott Gowell, “ <i>Professional Mobile Application Development</i> ” Wrox, 2012 2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson “ <i>Beginning ios 6 Development: Exploring the iOS SDK</i> ”, Apress, 2013 3. “ <i>Teach Yourself Android Application Development in 24 Hours</i> ”, SAMS publication, 3/e, 2013	
References:	
1. Anubhav Pradhan, Anil V. Deshpande, “ <i>Composing Mobile Apps: Learn. Explore. Apply. Using Android</i> ”, Wiley publication, 2014. 2. Barry Burd, “ <i>Android Application Development All in one for Dummies</i> ”, John Wiley & Sons publication, 2011. 3. http://developer.android.com/develop/index.htm 4. https://www.tutorialspoint.com/android 5. http://www.androidhive.info/ 6. https://www.codeschool.com/learn/ios	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3							K2	K5	K2	K3
CO1	K2	3				2						2		2	1
CO2	K2	3										2			
CO3	K2	3			2		2					2	3	2	
CO4	K2	3	2	2								2			3
CO5	K2	3	2		2	2	3					2	2	3	1
CO6	K3	3		2			2					3	3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CS63	INTERNET OF THINGS				L	T	P	C
					3	0	2	4
Programme:	B.E. Computer Science and Engineering	Sem:	6	Category:	PC			
Prerequisite:	231CS35 – Digital Electronics and Microprocessors							
Aim:	To learn the concepts of IoT and implement own smart network							
Course Outcomes: The Students will be able to								
CO1	Relate new concepts of IoT with the basics of networking.							
CO2	Understand IoT networking Components and various networking topologies.							
CO3	Infer the requirements associated with various connectivity protocols.							
CO4	Identify virtualization, different cloud models and service level agreements (SLAs).							
CO5	Utilize the applicability of IoT in real sceneries.							
CO6	Assess the various evolving aspects and paradigms of IoT.							
FUNDAMENTALS OF NETWORKING AND IoT								9
Basics of Networking: Types, Models, Addressing, Basics of Network Security: Security, Cryptography, Message Integrity and Authenticity, Key Management, Internet Security, Firewall, Predecessors of IoT: Wireless Sensor Networks, Machine-to-Machine Communications, Cyber Physical Systems.								
EVOLUTION OF IoT								9
Emergence of IoT: Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT, IoT Sensing and Actuation: Sensors, Sensing types, Considerations, Actuators, types, Characteristics, IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, Processing Offloading.								
TECHNOLOGIES OF IoT								9
IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth, IoT Communication Technologies, Infrastructure Protocols: IPv6, 6LoWPAN, QUIC, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols, IoT Interoperability: Standards, Frameworks.								
ASSOCIATED IoT TECHNOLOGIES								9
Cloud Computing: Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service, Fog Computing and Its Applications: Introduction, View of a Fog Computing Architecture, Fog Computing in IoT, Selected Applications of Fog Computing.								
IOT CASE STUDIES AND FUTURE TRENDS								9
Agricultural IoT, Vehicular IoT, Healthcare IoT, Paradigms, Challenges, and the Future: IoBT, IoV, IoUT, IoD, IoSpace, IoS, IoP, IoNT, IoE, Challenges Associated with IoT, Emerging Pillars of IoT.								
Total Periods:								45
COMPONENT LAB – LIST OF EXPERIMENTS:								
1. DHT Sensor interface with Arduino								
2. Ultrasonic sensor interface with Arduino								

3. Obstacle detection using Arduino 4. Servo motor interface with Arduino 5. Pulse sensor interface with Arduino 6. Pi Camera interface with Raspberry Pi	
Text Book:	
1. Sudip Misra, Anandarup Mukherjee and Arijit Roy, “ <i>Introduction to IoT</i> ”, Cambridge University Press, 2021.	
References:	
1. HonboZhou,” <i>The Internet of Things in the Cloud: A Middleware Perspective</i> ”, CRC Press, 2012. 2. Dieter Uckelmann, Mark Harrison, “ <i>Architecting the Internet of Things</i> ”, Springer, 2011. 3. Arshdeep Bahga, Vijay Madisetti, “ <i>Internet of Things (A Hands-On-Approach)</i> ”, VPT, 2014.	

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	1	2	1	1								2	1	
CO2	K2	2	3	2	2							1	3	2	
CO3	K2	2	3	2	2							1	3	2	
CO4	K3	3	3	3	3							2	3	3	
CO5	K3	3	3	3	3							2	3	3	
CO6	K3	3	3	3	3						2	2	3	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231OE1A		BASICS OF JAVA PROGRAMMING				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:		Category:		OE
Prerequisite:		Nil							
Aim:		Develop skills to build robust, reusable, and interactive applications.							
Course Outcomes: The Students will be able to									
CO1:		Illustrate the fundamental concepts of Object-Oriented Programming and apply them in Java programming.							
CO2:		Develop Java programs using classes, methods, interfaces, and string handling techniques.							
CO3:		Apply inheritance, polymorphism, abstract classes, and exception handling mechanisms for building robust and reusable Java applications.							
CO4:		Demonstrate multi-threaded programming concepts for concurrent application development.							
CO5:		Explain file handling operation using byte streams and character streams.							
CO6:		Develop interactive graphical programs using Applets and event handling.							
OBJECT ORIENTED PROGRAMMING									9
Object Oriented Programming – objects and classes – Abstraction – Encapsulation - Inheritance – Polymorphism. OOPs in Java – Characteristics, Advantages of Java – Java Virtual Machine – Java Source File Structure – Compilation, Fundamental Programming Structures in Java. Data Types, Variables, Operators, Control Statements, Loops, Arrays and functions.									
INTRODUCTION TO JAVA PROGRAMMING									9
Objects and classes in Java - defining classes - methods - access specifiers - static members - constructors - Interface, Defining an Interface, implementing interface, differences between classes and interfaces–Strings - String Buffer - String Tokenizer									
INHERITANCE AND EXCEPTION HANDLING									9
Inheritance - class hierarchy - final keyword - polymorphism - dynamic binding - abstract classes - inner classes- Exceptions - exception hierarchy - throwing and catching exceptions - Try-with Catch Block Handling Multiple Exceptions.									
MULTITHREADING									9
Multi-threaded programming - thread states - thread life cycle - thread properties - thread synchronization – Inter thread Communication - Suspending, Resuming, and Stopping Threads. Introduction to Applet - Applet Life Cycle - Event handling in Applets.									
FILES AND APPLETS									9
File -The Byte Streams -The Character Streams – File operations - Introduction to Applet - Applet Life Cycle - Event handling in Applets.									
Total Periods:									45
Text Book:									
3. E.Bala Gurusamy, “Programming with java A Primer”, Tata McGraw Hill Education, 4/e, 2009									
References:									
1. J.Deitel & H.M.Deitel, “Java: How to Program Java 2”, Prentice Hall, 7/e, 2011. 2. Herbert Schildt, “Java The Complete Reference”, Tata McGraw Hill, 8/e, 2011. 3. Y.Daniel Liang “Introduction to Java Programming”, 7/e, Pearson Education, 2013.									

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2									3	2
CO2	K3	3	3	3	3								1	3	3
CO3	K3	3	3	3	3								1	3	3
CO4	K2	2	3	2	2									3	2
CO5	K2	2	3	2	2									3	2
CO6	K3	3	3	3	3	2							1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231OE1B		C PROGRAMMING FOR ALL				L	T	P	C
						3	0	0	3
Programme:		B.E./B.Tech. Common to all Branches			Sem:		Category:		OE
Prerequisite:		Nil							
Aim:		To provide an awareness to Computing and Programming.							
Course Outcomes: The Students will be able to									
CO1:		Apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and logical problems							
CO2:		Recall the fundamentals concepts for constructing a C program.							
CO3:		Outline the various types of arrays and functions for string handling.							
CO4:		Summarize the essence of functions and pointers in a C program.							
CO5:		Illustrate the requirements of structures and unions.							
CO6:		Make use of different file handling, and perform operations on text and binary files..							
INTRODUCTION									9
Overview of programming: Problem Solving in Everyday Life, Types of Problem, Computer-based problem solving, Algorithms - Building blocks of algorithms (statements, control flow, functions) - Notation (pseudo code, flow chart) – Problem solving aspect – Top down design – Implementation of algorithms – Program Verification – Efficiency of algorithms – Analysis of algorithm.									
C PROGRAMMING BASICS									9
Introduction to Unix Operating System - Introduction to ‘C’ programming - fundamentals - structure of a ‘C’ program - compilation and linking processes - Constants, Variables - Data Types - Keywords - Expressions using operators in ‘C’ - Decision Making and Branching – Looping statements.									
ARRAYS AND STRINGS									9
Arrays: Initialization - One dimensional, Two dimensional, and Multi-dimensional arrays - String: String operations, Manipulating Strings - Passing arrays and strings as arguments - Command Line Arguments									
FUNCTIONS AND POINTERS									9
Function - Definition of function - Declaration of function - Pass by value - Pass by reference - Recursion - Pointers: Definition - Initialization - Pointers arithmetic - Array of Pointers, Pointer to Pointer, Pointer to an array.									
STRUCTURES AND FILES									9
Introduction - need for structure data type - structure definition - Structure declaration - Structure within astructure - Bit fields in Structure - Union - File Manipulation - Random access in file- Working with Text Files and Binary Files									
Total Periods:									45
Text Book:									
1. Pradip Dey, Manas Ghosh, “Programming in C”, AICTE Edition, Oxford University Press, 2018 2. Yashavant P. Kanetkar, “Let Us C : Authentic guide to C programming language”, Eighteenth Edition, BPB Publications, 2021.									
References:									

1. Paul Deitel, Harvey Deitel, “C How to Program”, Ninth Edition, Pearson, 2021.
2. Brian.W.Kernighan and Dennis.M.Ritchie, “C Programming language”, Second Edition, Independently Published, 2021
3. Byron S Gottfried, “Programming with C”, Fourth Edition, Schaum’s Outlines, McGraw Hill Education, 2018
4. Ashok N. Kamthane, Amit A.Kamthane, “Programming in C”, Third Edition, Pearson Education, 2015.
5. Behrouz A. Forouzan, Richard F.Gilberg, P.Golda Jeyasheeli, G.Priyanka,S.T.Veena “Problem solving Using C A Structured Programming Approach” Volume I & II.First Edition, Cengage Publication, 2022

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	1	2	1	1									2	1
CO2	K2	2	3	2	2								1	3	2
CO3	K3	3	3	3	3								2	3	3
CO4	K2	2	3	2	2								1	3	2
CO5	K3	3	3	3	3								2	3	3
CO6	K3	3	3	3	3								2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231OE1C	INTRODUCTION TO ARTIFICIAL INTELLIGENCE				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:		Category:		OE
Prerequisite:	Nil							
Aim:	To introduce basic of artificial intelligence Learning methods and techniques.							
Course Outcomes:	The Students will be able to							
CO1:	Outline the intelligent agents and structures							
CO2:	Develop the knowledge representation through various searching techniques.							
CO3:	Recall the basic concepts of logical agents and their syntax.							
CO4:	Implement inference in FOL and their representations.							
CO5:	Apply and evaluate various planning algorithms.							
CO6:	Summarize acting in nondeterministic domain for real world applications.							
INTRODUCTION								9
The Foundations of Artificial Intelligence - The History of Artificial Intelligence- The State of the Art- Risks and Benefits of AI- Agents and Environments- Good Behavior: The Concept of Rationality- The Nature of Environments- The Structure of Agents.								
Problem-solving								9
Solving Problems by Searching- Problem-Solving Agents- Example Problems- Search Algorithms- Uninformed Search Strategies- Informed (Heuristic) Search Strategies- Heuristic Functions- Constraint Satisfaction Problems.								
Logical Agents								9
Knowledge-Based Agents- The Wumpus World- Logic- Propositional Logic: A Very Simple Logic- Agents Based on Propositional Logic- First-Order Logic- Representation Revisited- Syntax and Semantics of First-Order Logic- Using First-Order Logic- Knowledge Engineering in First-Order Logic								
Inference in First-Order Logic								9
Propositional vs. First-Order Inference- Unification and First-Order Inference- Forward Chaining- Backward Chaining- Resolution- Knowledge Representation- Ontological Engineering- Categories and Objects- Mental Objects and Modal Logic.								
Planning								9
Classical Planning- Algorithms for Classical Planning- Partial order Planning- Heuristics for Planning- Hierarchical Planning- Planning and Acting in Nondeterministic Domains- Time, Schedules, and Resources- Uncertain knowledge and reasoning- Acting under Uncertainty- Basic Probability Notation- Bayes’ Rule and Its Use.								
Total Periods:								45
Text Book:								
1. Russell and Norvig, “Artificial Intelligence, A Modern Approach”, 4 th global edition, Pearson Prentice Hall, 2021.								
References:								
1. Deepak Khemani, “A First Course in Artificial Intelligence”, Tata Mc Graw Hill Education 2013								
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, 3/e, Tata McGraw Hill, 2009.								

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3	K3							K5	K2	K2
CO1	K2	2	1	1	1	2							1	2	1
CO2	K3	1	2	1	1	1							1	2	2
CO3	K2	2	2	1	2	1							2	1	1
CO4	K3	1	2	1	1								1	2	2
CO5	K3	1	1	2	1	2							1	1	2
CO6	K2	1	1	2	1	2							2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231OE1D		FUNDAMENTALS OF SCRIPTING LANGUAGES				L	T	P	C
						3	0	0	3
Programme:		B.E./B.Tech. Common to all Branches			Sem:		Category:		OE
Prerequisite:		Nil							
Aim:	To introduce students to the core concepts and practical applications of scripting languages, enabling them to write efficient, reusable, and maintainable scripts for automating tasks, manipulating data, and enhancing software development productivity across various platforms.								
Course Outcomes: The Students will be able to									
CO1:	Construct a basic website using HTML and Cascading Style Sheets								
CO2:	Understand and apply basic JavaScript syntax and constructs.								
CO3:	Implement JavaScript arrays, objects, and their methods.								
CO4:	Develop dynamic, single-page web applications using AngularJS by implementing data binding, dependency injection, controllers, and directives to create responsive and maintainable user interfaces.								
CO5:	Create interactive and component-based user interfaces using React by effectively managing state, props, and lifecycle methods or hooks.								
CO6:	Build modular React applications integrated with REST APIs and routing for modern web development.								
WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0									9
Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap Framework									
JAVASCRIPT FUNDAMENTALS									9
Introduction to Java Script- Setting up the environment- Variables- Data Types- Operators- Conditional Statements- Loops- Functions- Basic DOM Introduction.									
INTERMEDIATE JAVASCRIPT & THE DOM									9
Arrays and Array Methods- Objects and Object Methods- Destructuring and Spread/Rest syntax- Template Literals- Scope and Closures- Selecting/manipulating elements- Event Handling- Forms and validation- Basic JavaScript debugging- JSON and localStorage/sessionStorage									
ANGULAR JS									9
Introduction to AngularJS, AngularJS Architecture, Working with Directives, Data Binding, Controllers and Scope, Forms and Validation.									
REACT									9
MERN stack overview- Basic React applications, React components and state, Express REST APIs, Modularization and Webpack. Routing with React Router.									
Total Periods:									45
Text Book:									
1. Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5 th Edition, 2011. 2. David Flanagan, ‘JavaScript: The Definitive Guide’, 7th Edition 2020. 3. Vasan Subramanian, Pro MERN Stack: Full Stack Web App Development with Mongo,									

Express, React, and Node, Apress, 2nd Edition, 2019.	
References:	
1. Brown, Ethan. Web Development with Node and Express. O'Reilly Media, 2019. 2. Choi, David. Full-Stack React, TypeScript, and Node. O'Reilly Media, 2020. 3. Casciaro, Mario. Node.js Design Patterns. Packt Publishing, 2014. 4. Mead, Andrew. Learning Node.js Development. O'Reilly Media, 2017.	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	1	2	1	1									2	1
CO2	K3	2	3	2	2								1	3	2
CO3	K3	3	3	3	3								2	3	3
CO4	K3	2	3	2	2								1	3	2
CO5	K6	3	3	3	3								2	3	3
CO6	K3	1	2	3	2								3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231OE1E		DATA STRUCTURES USING PYTHON				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		OE	
Prerequisite:		231ESF1 – Problem Solving and Python Programming							
Aim:	To introduce data structures and algorithms, including their design, analysis, and implementation in Python.								
Course Outcomes: The Students will be able to									
CO1:	Recall the principles of object-oriented programming using Python.								
CO2:	Apply Python-specific data structures like lists, tuples, sets, and dictionaries to solve real-world problems.								
CO3:	Implement searching and sorting algorithms.								
CO4:	Distinguish between lists and arrays.								
CO5:	Summarize the concepts and applications of linked lists, stacks, queues.								
CO6:	Implement various tree structures and graph algorithms.								
OBJECT-ORIENTED PROGRAMMING CONCEPTS IN PYTHON									9
OOPs Concepts: class, object, constructors, types of variables, types of methods. Inheritance: single, multiple, multi-level, hierarchical, hybrid, Polymorphism: with functions and objects, with class methods, with inheritance, Abstraction: abstract classes.									
FUNDAMENTAL DATA STRUCTURES IN PYTHON									9
Data Structures: Definition, Linear Data Structures, Non-Linear Data Structures Python Specific Data Structures: List, Tuples, Set, Dictionaries, Comprehensions and its Types, Strings, Slicing.									
ARRAYS, SEARCHING, AND SORTING TECHNIQUES									9
Arrays: Overview, Types of Arrays, Operations on Arrays, Arrays vs List. Searching -Linear Search and Binary Search. Sorting - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort.									
LINKED LISTS, STACKS, AND QUEUES									9
Linked Lists: Implementation of Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists. Stacks: Overview of Stack, Implementation of Stack (List & Linked list), Applications of Stack Queues: Overview of Queue, Implementation of Queue(List & Linked list), Applications of Queues, Priority Queues.									
TREES AND GRAPHS									9
Trees: Overview of Trees, Tree Terminology, Binary Trees: Introduction, Implementation, Applications. Tree Traversals, Binary Search Trees: Introduction, Implementation, AVL Trees: Introduction, Rotations, Implementation. Graphs: Introduction, Directed vs Undirected Graphs, Weighted vs Unweighted Graphs, Representations, Breadth First Search, Depth First Search.									
Total Periods:									45
Text Books:									
1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data structures and algorithms in Python”, Wiley, 1/e, 2013. 2. Narasimha Karumanchi, “Data Structures and Algorithmic Thinking with Python”, CareerMonk Publicaions, 2020.									
References:									

1. Dr. Basant Agarwal, Benjamin Baka, “*Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7*”, Packt Publishing Ltd., 2/e, 2018.
2. Kent D. Lee, Steve Hubbard, “*Data Structures and Algorithms with Python*”, Springer, 2024.
3. Bradley N Miller, David L. Ranum., “*Problem Solving with Algorithms and Data Structures using Python*”, Franklin, Beedle & Associates Inc, 2006.
4. R. Nageswara Rao, “*Core Python Programming*”, Dreamtech Press, 2/e, 2018.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K2	K2	K3							K5	K2	
CO1	K1	3	2	2	1	2					1		2	2	
CO2	K3	3	3	2	2	3				1	1		3	3	
CO3	K3	2	3	2	2	3					1		3	3	
CO4	K2	2	2	3	3	3				1	1	1	3	3	
CO5	K2	2	3	3	2	3					1		3	3	
CO6	K3	3	3	3	3	3	1	1	1	1	2	1	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231OE1F		FUNDAMENTALS OF DATABASE			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	1	Category:		ESC
Prerequisite:		Nil						
Aim:	To provide an awareness to Computing and Programming							
Course Outcomes: The Students will be able to								
CO1:	Recall the fundamental concepts of database systems, data models, database architecture, and Entity-Relationship modeling for effective database design.							
CO2:	Construct Entity-Relationship (E-R) diagrams and apply design principles to represent real-world data effectively.							
CO3:	Develop and execute SQL queries using DDL, DML, and DCL statements, including advanced features such as subqueries, joins, views, and PL/SQL constructs.							
CO4:	Apply normalization techniques to design an optimized and consistent database schema.							
CO5:	Examine transaction management, concurrency control, and recovery mechanisms to maintain data consistency and integrity in multi-user environments.							
CO6:	Build traditional RDBMS from NoSQL databases and demonstrate the use of MongoDB or Cassandra for scalable, real-time data storage and processing.							
DATABASE FUNDAMENTALS								9
Purpose of Database System — Views of data — Data Models — Database System Architecture — Introduction to relational databases — Relational Model — Keys — Relational Algebra — SQL fundamentals — Advanced SQL features — Embedded SQL– Dynamic SQL								
DATABASE DESIGN								9
Entity-Relationship model — E-R Diagrams — Enhanced-ER Model — ER-to-Relational Mapping — Functional Dependencies — Non-loss Decomposition — First, Second, Third Normal Forms, Dependency Preservation — Boyce/Codd Normal Form — Multi-valued Dependencies and Fourth Normal Form — Join Dependencies and Fifth Normal Form								
TRANSACTIONS								9
Transaction Concepts — ACID Properties — Schedules — Serializability — Concurrency Control — Need for Concurrency — Locking Protocols — Two Phase Locking — Deadlock — Transaction Recovery — Save Points — Isolation Levels — SQL Facilities for Concurrency and Recovery.								
INTRODUCTION TO NOSQL DATABASES								9
Introduction to NoSQL - Difference between SQL and NoSQL Databases - Characteristics of NoSQL Databases (Schema-free, Scalable, Flexible) - CAP Theorem – Consistency, Availability, and Partition Tolerance - BASE Properties of NoSQL Systems								
DATA MANAGEMENT AND APPLICATION								9
Types of NoSQL databases: Key-Value, Document, Column-Family, Graph- CAP Theorem and BASE properties - MongoDB – Document-oriented database for real-time applications - Storing JSON Data in NoSQL Databases - Cassandra – Column-family store for distributed and scalable data.								
Total Periods:								45
Text Book:								
4. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, McGraw Hill, 7/e, 2020. 5. H.A. Taha, “Operations Research”, Pearson Education, Asia, 8/e, 2016.								
References:								

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Pearson Education/Addison Wesley, 6/e, 2010.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Pearson Education, 5/e, 2009.
3. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Pearson Education, 8/e, 2006.
4. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, 3/e, 2004.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	3	3								1	3	
CO2	K2	2	3	3	3								1	3	
CO3	K3	3	3	3	3								1	3	
CO4	K3	3	3	3	3								1	3	
CO5	K2	2	3	3	3							1	1	3	
CO6	K2	2	3	3	3							2	1	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

P.S.R. ENGINEERING COLLEGE, SIVAKASI – 626140.

*An Autonomous Institution, Affiliated to Anna University, Chennai,
Accredited by NAAC with A+ and listed under 2(f) &12(B) of the UGC Act, 1956
An ISO 9001:2015 Certified Institution*

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

**UG REGULATION – 2023
CHOICE BASED CREDIT SYSTEM**

CURRICULUM [V – VIII SEMESTERS and VERTICALS FULL-TIME]
(Candidates admitted from 2023–2024 onwards)

Total Credits: 164

VERTICAL I - CYBER SECURITY AND DATA PRIVACY

S. No.	Course Code and Course Title	Category	Vertical Coordinator	Course Designer
1.	231CSV11 – Cryptography and network Security	PE	Dr.V.Selvakumar	Mrs.S.Sujitha
2.	231CSV12 – Data Security	PE		Mrs.M.ThangaAruna
3.	231CSV13 – Ethical Hacking	PE		Mrs.R.Anitha
4.	231CSV14 – Crypto currency and Blockchain Technologies	PE		Mrs.R.Anitha
5.	231CSV15 – Cyber Laws and Digital Forensics	PE		Dr.V.Selvakumar
6.	231CSV16 – Multimedia Security	PE		Mrs.C.Sakthi Lakshmi Priya
7.	231CSV17 – Malware Analysis	PE		Mrs.R.Anitha
8.	231CSV18 – Firewall and IDS	PE		Mrs.M.ThangaAruna

231CSV11		CRYPTOGRAPHY AND NETWORK SECURITY				L	T	P	C
						3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:		PE	
Prerequisite:	231CS46 – Computer Networks								
Aim:	To provide deeper understanding into cryptography, its application to network security, threats/vulnerabilities to networks and countermeasures.								
Course Outcomes: the students will be able to									
CO1:	Understand the fundamentals of cryptography and network security, security architecture, threats and vulnerabilities .								
CO2:	Apply the different cryptographic operations of symmetric cryptographic algorithms.								
CO3:	Solve the different cryptographic problems by using public key cryptography.								
CO4:	Develop various Authentication schemes to simulate different applications.								
CO5:	Understand various Security practices and System security standards.								
CO6:	Elaborate the current issues towards information security.								
INTRODUCTION									9
Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks - Model of network security - OSI security architecture - Types of Security attacks, Security services, Security Mechanisms – A model for Network Security- Classical encryption techniques: substitution techniques, transposition techniques, steganography- key range and key size, possible types of attacks.									
SYMMETRIC KEY CRYPTOGRAPHY									9
Algebraic structures – Modular arithmetic-Euclid’s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: DES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4. Key distribution.									
PUBLIC KEY CRYPTOGRAPHY									9
ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler’s totient function, Fermat’s and Euler’s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -ElGamal cryptosystem – Elliptic curve arithmetic- Elliptic curve cryptography.									
MESSAGE AUTHENTICATION AND INTEGRITY									9
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509.									
SECURITY PRACTICE AND SYSTEM SECURITY									9
ELECTRONIC MAIL SECURITY – Pretty Good Privacy, S/MIME – IP Security: IP Security overview -Encapsulating security payload, Combining security associations, Internet Key Exchange – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.									
Total Periods:									45
Text Book:									
1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 7 th Edition, 2016.									

References:	
1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd. 2. Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw Hill 2007. 3. Charlie Kaufman, Radia Perlman, and Mike Speciner, “Network Security: PRIVATE Communication in a PUBLIC World”, Prentice Hall, ISBN 0-13-046019-2	

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K2	K2	K3	K3							K2	K2	K3	K3
CO1	K2	2	2	1	1							1		2	
CO2	K3	3	3	2	2							2	2	3	2
CO3	K3	2	3	3	3							3	1	3	2
CO4	K3	2	3	2	2							2	3	3	2
CO5	K2	3	3	2	3							3	2	3	3
CO6	K2	3	2	3	3							3	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV12		DATA SECURITY			L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:	PE	
Prerequisite:	Nil							
Aim:	To understand the basics of Data Security and to know the legal, ethical and professional issues in implementing Information Security.							
Course Outcomes: At the end of the course, the students will be able to								
CO1:	Understand the essential concepts and need for information security.							
CO2:	Outline the law, ethics, policy and standards in information security.							
CO3:	Demonstrate various risks and use of technologies .							
CO4:	Explore the foundations of modern cryptosystems.							
CO5:	Illustrate the implementation of physical security.							
CO6:	Demonstrate the security implementation and maintenance.							
INTRODUCTION TO INFORMATION SECURITY								9
History of Information Security - CNSS Security Model - Components of an Information System - Balancing Information Security and Access - Security in the Systems Development Life Cycle - Threats and Attack - Human Error or Failure - Software Attacks – Hardware and Software Failures								
ISSUES IN INFORMATION SECURITY AND PLANNING FOR SECURITY								9
Law and Ethics in Information Security - International Laws and Legal Bodies - Ethics and Information Security - Information Security Planning and Governance - Policy, Standards, and Practices - Information Security Blueprint								
RISK MANAGEMENT AND SECURITY TECHNOLOGY								9
Risk Identification - Risk Assessment - Risk Control - Access Control – Firewalls - Intrusion Detection and Prevention System – Honeypots - Scanning and Analysis Tools								
CRYPTOGRAPHY AND PHYSICAL SECURITY								9
Foundations of Cryptology - Cipher Methods - Cryptographic Algorithms - Cryptographic Tools - Protocols for Secure Communications - Physical Access Controls - Fire Security and Safety - Failure of Supporting Utilities and Structural Collapse - Securing Mobile and Portable Systems								
IMPLEMENTING SECURITY AND SECURITY MAINTENANCE								9
Information Security Project Management - Technical Aspects of Implementation - Nontechnical Aspects of Implementation - Certification and Accreditation - Security Management Maintenance Models - Digital Forensics								
Total Periods:								45
Text Book:								
1. Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, Sixth Edition, 2017.								
References:								
1. Micki Krause, Harold F. Tipton, “ Handbook of Information Security Management”, Vol 1-3 CRC Press LLC, 2004.								
2. Stuart Mc Clure, Joel Scrambray, George Kurtz, “Hacking Exposed”, Tata McGraw-Hill, 2003.								
3. Matt Bishop, “Computer Security Art and Science”, Pearson/PHI, 2002.MoralHazar,								

YanruZhang,NguyenH. Tran, DusitNiyato,andZhu Han,. “Multidimensional payment Plan in Fog Computing”with IEEE, Universityof Melbourne 2016.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K2
CO1	K2	2	3	2	2									2	2
CO2	K2	2	3	2	2			2						2	2
CO3	K2	2	3	2	2		2							2	2
CO4	K2	2	3	2	2									2	2
CO5	K2	2	3	2	2									2	2
CO6	K2	2	3	2	2									2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV13		ETHICAL HACKING			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:		NIL						
Aim:		To evaluate the security and identify the vulnerabilities in target systems and networks.						
Course Outcomes: The Students will be able to								
CO1:		Recall the Fundamentals of Hacking.						
CO2:		Understand the various tools to gather information.						
CO3:		Identify the vulnerabilities across the system.						
CO4:		Examine the various prediction methods.						
CO5:		Outline various attacks (Exploitation) to protect the system.						
CO6:		Explore the different kinds of tools for hacking and security measures in the wireless networks.						
INTRODUCTION TO HACKING								9
Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement -Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests.								
INFORMATION GATHERING TECHNIQUES								9
Information Gathering Techniques and its types– Sources of Information Gathering – Tracing the Location – Traceroute – ICMP Traceroute – TCP Traceroute – Usage – UDP Traceroute – Enumerating and Fingerprinting the Web servers – Google Hacking – DNS Enumeration – Interacting with DNS servers – DIG – Forward DNS Lookup – Forward DNS Lookup with Fierce – Enumerating SNMP – SMTP Enumeration.								
VULNERABILITY ASSESSMENT AND NETWORK SNIFFING								9
Vulnerability scanners types, pros and cons,Vulnerability Assessment with Nmap,Updating the Database, Nessus Vulnerability Scanner - Adding a User – Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – Promiscuous versus Non promiscuous Mode – MITM Attacks – ARP Attacks – Denial of Service Attacks –Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic – DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing .								
EXPLOITATION								9
Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication – Client Side Exploitation Methods – Creating a PDF Document with a Launch Action – Post exploitation, Acquiring Situation Awareness – Escalating Privileges – Data Mining.								
WIRELESS HACKING AND WEB HACKING								9
Wireless Hacking – Introducing Aircrack– Speeding Up the Process - Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircracking – Attack Scenario – Causing Denial of Service on the Original AP –Web Hacking – Attacking the Authentication – Types of Authentication – Brute Force Attack – Log-In Protection Mechanisms – Captcha Validation Flaw – Captcha RESET Flaw– Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability – honeypots								

Total Periods: 45

Text Book:

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014

References:

1. JKevin Beaver, “*Ethical Hacking for Dummies*”, Sixth Edition, Wiley, 2018.
2. Jon Erickson , “*Hacking: The Art of Exploitation*”, Second Edition, Rogunix, 2007.
3. AnkitFadia “*Ethical Hacking*” Second Edition, Macmillan India Ltd, 2006
4. Kenneth C.Brancik “*Insider Computer Fraud*” Auerbach Publications Taylor & amp; Francis Group–2008.

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K2
CO1	K2	2	3	2	2			2					2	2	
CO2	K2	2	3	2	2								2	2	
CO3	K2	2	3	2	2								2	2	
CO4	K2	2	3	2	2								2	2	
CO5	K3	3	3	3	3							1	3	3	
CO6	K3	3	3	3	3		2					1	3	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV14	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES			L	T	P	C
				3	0	0	3
Programme:	B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:	Nil						
Aim:	To understand the concept of cryptocurrency and blockchain technologies						
Course Outcomes: At the end of the course, the students will be able to							
CO1:	Recall the basic concepts of cryptocurrencies and block chains.						
CO2:	Understand the details of Bitcoin and its different components.						
CO3:	Illustrate the basics of Hyper ledger and Web3.						
CO4:	Explore the position of Web 3 and Hyper ledger with different aspects of block chain technologies.						
CO5:	Outline alternate block chains and their advantages in application areas.						
CO6:	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.						
INTRODUCTION							9
Cryptographic hash functions – hash pointers – digital signatures – public keys as identities – an example cryptocurrency. Bitcoin, history of blockchain and Bitcoin – Types of Blockchain – Consensus – Decentralization							
BITCOIN							9
Bitcoin – Digital Keys and Addresses – Transactions, life cycle, data structure, types – Structure of the blockchain – Mining – Bitcoin Networks and Payments – Wallets – Alternative coins – Smart Contracts – Definition – Recardian contracts.							
WEB3 AND HYPER LEDGER							9
Web 3 Contract development – POST requests – Frontend – Development framework – Hyper ledger Projects – Protocol – Reference architecture – Hyper ledger Fabric – Corda.							
ALTERNATIVE BLOCKCHAINS AND APPLICATIONS							9
Alternative blockchains – Applications, Internet of Things, Government, Health, Finance – Scalability – Privacy.							
ETHEREUM							9
Setting up Ethereum development tools – Solidity language. – Ethereum accounts, key pairs, working with Externally Owned Accounts (EOA), contract accounts – Smart contracts, structure, setting up and interaction, examples – Decentralized applications, implementation, case studies – Whisper protocol – Swarm architecture and concepts.							
Total Periods:							45
Text Books:							
1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018. 2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016.							
References:							

1. Arshdeep Bahga and Vijay Madisetti, “*Blockchain Applications : A Hands-On Approach*”, 2017.
2. Andreas Antonopoulos, Satoshi Nakamoto, “*Mastering Bitcoin*”, O’Reilly Publishing, 2014.
3. Roger Wattenhofer, “*The Science of the Blockchain*” Create Space Independent Publishing Platform, 2016.
4. Alex Leverington, “*Ethereum Programming*” Packt Publishing Limited, 2017.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2									2	2
CO2	K2	2	3	2	2									2	2
CO3	K2	2	3	2	2									2	2
CO4	K3	3	3	3	3							2	1	3	3
CO5	K2	3	3	2	2							2		2	
CO6	K2	3	3	2	2	2						2		2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV15	CYBER LAWS AND DIGITAL FORENSICS				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering		Sem:		Category:		PE	
Prerequisite:	Nil							
Aim:	To understand the evolution and jurisprudence of cyber law in India, including the IT Acts.							
Course Outcomes: At the end of the course, the students will be able to								
CO1:	Identify the offenses and penalties under the Information Technology Act (ITA) 2000.							
CO2:	Explore the challenges faced by India in enforcing cyber laws and the cybercrime scenario in the country.							
CO3:	Examine the challenges faced by Indian cyber law and assess its effectiveness in combating cybercrime and ensuring digital security							
CO4:	Outline the basics of digital forensics, digital crime and criminal law.							
CO5:	Apply the methods for collecting and doing the investigation and digital crime							
CO6:	Understand the digital forensic readiness.							
IT ACT, OFFENSES AND PENALTIES								9
Offences under the Information and Technology Act 2000 - Penalty and adjudication - Punishments for contraventions under the Information Technology Act 2000 (Case Laws, Rules and recent judicial pronouncements to be discussed) - Limitations of Cyber Law								
CYBERCRIMES AND CYBER SECURITY: THE LEGAL PERSPECTIVES								9
Cybercrimes and the legal Landscape around the world, why do we need cyber laws: The Indian context, The Indian IT ACT: Admissibility of Electronic records, Amendments made in Indian ITA 2000, Positive Aspects and weak areas of ITA 2000, Challenges to Indian law and cybercrime scenario in India, Digital signatures and the Indian ITA act, Cybercrime and punishment, Cyber law Technology and students: Indian Scenario								
INTRODUCTION TO DIGITAL FORENSICS								9
Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase – Challenges in Digital Forensics								
INVESTIGATION OF DIGITAL CRIME								9
Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence								
DIGITAL FORENSIC READINESS								9
Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness								
Total Periods:								45
Text Books:								
1. Textbook on “Cyber Law”, second edition, Pavan Duggal, Universal Law Publishing. 2. Textbook on “Indian Cyber law on Cybercrimes”, Pavan Duggal 3. Andre Arnes, –Digital Forensics, Wiley, 2018.								

4. Chuck Easttom, —An In-depth Guide to Mobile Device Forensics, First Edition, CRC Press, 2022

References:

1. The Cybersecurity to English Dictionary” by Raef Meeuwisse.
2. Internet Security: A Beginners Guide” by Vikram Singh.Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, CharlesRiver Media, 2005, ISBN: 1-58450-389.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2		2					2		2	2
CO2	K2	2	3	2	2		2					2		2	2
CO3	K2	2	3	2	2		2					2		2	2
CO4	K2	2	3	2	2		2					2		2	2
CO5	K2	2	3	2	2		2					2		2	2
CO6	K2	2	3	2	2		2					2		2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV16		MULTIMEDIA SECURITY				L	T	P	C
						3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:		PE	
Prerequisite:	NIL								
Aim:	To explores the principles and techniques of securing multimedia data, including images, audio, and video								
Course Outcomes: At the end of the course, the students will be able to									
CO1:	Examine the fundamental concepts, types, and challenges of multimedia security and the role of cryptography.								
CO2:	Classify cryptographic techniques into symmetric and asymmetric methods, including AES and RSA, for securing images and videos.								
CO3:	Recall the steganography and digital watermarking methods used for securing multimedia content.								
CO4:	Apply hash functions, digital signatures, and forensic techniques to ensure multimedia authenticity and integrity.								
CO5:	Construct the real-time multimedia security challenges and assess techniques like SRTP, block chain, and AI for protection.								
CO6:	Explore emerging technologies and trends and construct strategies to enhance multimedia security.								
INTRODUCTION TO MULTIMEDIA SECURITY									9
Overview of multimedia (images, audio, video)- Importance of Multimedia Security-Key Challenges in Multimedia Security content-Types of Multimedia Content, Security threats and challenges, The role of cryptography in multimedia security.									
BASIC CRYPTOGRAPHIC TECHNIQUES									9
Fundamentals of encryption and decryption, Symmetric vs. asymmetric cryptography in multimedia, Introduction to AES and RSA, Image and Video Encryption Techniques- Selective encryption techniques for images and videos- Compression standards and their impact on encryption.									
PRINCIPLES OF STEGANOGRAPHY AND DIGITAL WATERMARKING									9
Principles of Steganography- Steganography fundamentals and applications- Spatial vs. frequency domain techniques, Fundamentals of Digital Watermarking- Basics and importance of watermarking- Types: visible, invisible, fragile, robust- Watermarking Techniques for Videos and Audio- Temporal and spatial watermarking in videos.-Watermarking techniques for audio signals									
MULTIMEDIA AUTHENTICATION AND INTEGRITY									9
Techniques for ensuring multimedia authenticity - Hash functions and digital signatures.- Exercise: Implementing HMAC for multimedia authentication, Multimedia Forensics- Fundamentals of forensic analysis for multimedia- Forgery detection and tampering analysis- Case Study: Deepfake detection techniques.									
REAL-TIME MULTIMEDIA SECURITY CHALLENGES									9
Challenges in securing live multimedia streams- Secure RTP (SRTP) and its applications.- Case Study: Securing VoIP communications, Blockchain applications for DRM- AI and machine learning for securing multimedia- Using machine learning for anomaly detection in multimedia									
Total Periods:									45
Text Book:									
1. “Multimedia Security: Watermarking, Steganography”, and Forensics by Frank Y. Shih (CRC Press)									

2. Nematollahi, Mohammad Ali, Vorakulpipat, Chalee, Rosales, Hamurabi Gamboa (2017). *Digital Watermarking: Techniques and Trends*, Springer, Signals and Communication.
3. Pande, Amit, Zambreno, Joseph (2013). *Embedded Multimedia Security Systems*, Springer, Image Processing.
4. Singh, Amit Kumar, Mohan, Anand (2019). *Handbook of Multimedia Information Security: Techniques and Applications*, Springer, Security and Cryptology.

References:

1. Cox, I., Miller, M., Bloom, J., Fridrich, J., Kalker, T. (2007). *Digital watermarking and steganography*. Morgan Kaufmann.
2. Yi, Xun, Paulet, Russell, Bertino, Elisa (2014). *Homomorphic Encryption and Applications*, Springer, Security and Cryptology

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2		2					2		2	2
CO2	K3	3	3	3	3							2	1	3	3
CO3	K2	2	3	2	2		2					2		2	2
CO4	K3	3	3	3	3							2	1	3	3
CO5	K2	2	3	2	2		2					2		2	2
CO6	K2	2	3	2	2		2					2		2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV17	MALWARE ANALYSIS				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:		PE
Prerequisite:	231CSV22– Information Security							
Aim:	To deal with detection, analysis, understanding of malware							
Course Outcomes: At the end of the course, the students will be able to								
CO1:	Recall the various concepts of malware analysis and their technologies.							
CO2:	Identify the skills necessary to carry out independent analysis of modern malware samples using static analysis techniques							
CO3:	Understand the concept of dynamic analysis techniques.							
CO4:	Explore the methods and techniques used by professional malware analysts							
CO5:	Understand malware analysis to safely analyze, debug, and disassemble any malicious software.							
CO6:	Demonstrate the concept of Android malware analysis their architecture, and App development							
INTRODUCTION								9
Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots.								
ADVANCED STATIC ANALYSIS								9
The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism.								
ADVANCED DYNAMIC ANALYSIS								9
Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, api calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching.								
MALWARE FUNCTIONALITY								9
Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection								
ANDROID MALWARE ANALYSIS								9
Android Malware Analysis: Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis, Case studies								
Total Periods:								45
Text Book:								
1. Michael Sikorski and Andrew Honig, “Practical Malware Analysis” by No Starch Press,								

2012,ISBN: 9781593272906.

2. Bill Blunden, “*The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System*”, Second Edition, Jones & Bartlett Publishers, 2009.

References:

1. Jamie Butler and Greg Hoglund, “*Rootkits: Subverting the Windows Kernel*” by 2005, Addison-Wesley Professional.
2. Bruce Dang, Alexandre Gazet, Elias Bachaalany, Sébastien Josse, “*Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation*”, 2014.
3. Victor Marak, “*Windows Malware Analysis Essentials*” Packt Publishing, O’Reilly, 2015.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K1	3	1	1	1								2	1	1
CO2	K2	2	3	2	2									2	2
CO3	K2	2	3	2	2									2	2
CO4	K2	2	3	2	2									2	2
CO5	K3	3	3	3	3							2	1	2	3
CO6	K2	2	3	2	2							2		2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV18		FIREWALL AND IDS				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE	
Prerequisite:		NIL							
Aim:	To know the fundamental knowledge of Firewalls and it types and to understand Intrusion Detection Systems, model for intrusion analysis and IDS tool.								
Course Outcomes: At the end of the course, the students will be able to									
CO1:	Understand the basics of firewall								
CO2:	Recall the knowledge of Firewalls, Interpreting firewall logs, alerts, Intrusion and Detection								
CO3:	Explore the essential concepts and types of IDS.								
CO4:	Categorize the various components, architecture and capabilities of the IDS.								
CO5:	Identify the steps in intrusion analysis and its types.								
CO6:	Outline the implementation and working of snort IDS tool.								
INTRODUCTION TO FIREWALL									9
Introduction - Types of Firewalls - Ingress and Egress Filtering - Types of Filtering - Network Address Translation (NAT) - Application Proxy - Circuit Proxy - Content Filtering - Software versus Hardware Firewalls - IPv4 versus IPv6 Firewalls - Dual-Homed and Triple-Homed Firewalls - Placement of Firewalls.									
EXPLORING THE DEPTHS OF FIREWALLS									9
Firewall Rules - Authentication and Authorization - Monitoring and Logging - Understanding and Interpreting Firewall Logs and Alerts - Intrusion Detection - Limitations of Firewalls - Downside of Encryption with Firewalls - Firewall Enhancements and Management Interfaces.									
INTRODUCTION TO IDS									9
History of Intrusion detection - Audit, Concept and definition - Internal and external threats today, attacks - Need and types of IDS - Information sources Host based information sources - Network based information sources									
IDS TECHNOLOGIES									9
Components & Architecture - Typical components, Network Architectures - Security capabilities - Information gathering capabilities, logging capabilities, detection & prevention capabilities - Intrusion Prevention Systems - Network protocol based IDS, Hybrid IDS - Analysis schemes, thinking about intrusion - A model for intrusion analysis, techniques, Responses, requirement of responses - types of responses, mapping responses to policy, Vulnerability analysis, credential analysis, non credential analysis									
IDS TOOL : SNORT IDS									9
Introduction to Snort, Working with Snort Rules, Snort configuration, Snort with MySQL, Running Snort on Multiple Network Interfaces, Snort Modes Snort Alert Modes, Snarf with Snort, Agent development for intrusion detection, Architecture models of IDS and IPS.									
Total Periods:									45
Text Book:									
1. J. Michael Stewart and Denise Kinsey "Network Security, Firewalls, and VPNs", 3rd Edition, Jones & Bartlett Learning, October 2020, ISBN: 9781284183696 2. Carl Endorf, Eugene Schultz and Jim Mellander "Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2006									

References:	
1. RafeeqRehman “ <i>Intrusion Detection with SNORT, Apache,MySQL, PHP and ACID,</i>” 1stEdition, Prentice Hall , 2003 2. Christopher Kruegel, Fredrik Valeur, Giovanni Vigna “<i>Intrusion Detection and Correlation Challenges and Solutions</i>”, 1st Edition, Springer, 2005 3. Karen Scarfone, Peter Mell, " <i>Guide to Intrusion Detection and Prevention Systems (IDPS)</i>", NIST special publication, 2007 4. Kerry J Cox , Christopher Gerg," <i>Managing Security with Snort and IDS Tools</i>", O'Reilly, 2007 5. Stephen Northcutt, Judy Novak “<i>Network Intrusion Detection</i>”, 3rd Edition, New Riders Publishing, 2002	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	1	2	1	2	1								2	1
CO2	K2	2	3	2	2									2	2
CO3	K2	2	3	2	2									2	2
CO4	K2	2	3	2	2									2	2
CO5	K2	2	3	2	2									2	2
CO6	K2	2	3	2	2	2								2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

P.S.R. ENGINEERING COLLEGE, SIVAKASI – 626140.

*An Autonomous Institution, Affiliated to Anna University, Chennai,
Accredited by NAAC with A+ and listed under 2(f) &12(B) of the UGC Act, 1956
An ISO 9001:2015 Certified Institution*

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

UG REGULATION – 2023
CHOICE BASED CREDIT SYSTEM
CURRICULUM [V – VIII SEMESTERS and VERTICALS FULL-TIME] <i>(Candidates admitted from 2023–2024 onwards)</i>
Total Credits: 164

Vertical II – CLOUD TECHNOLOGIES AND DATA MANAGEMENT

S. No	Course Code and Course Title	Category	Vertical Coordinator	Course Designer
1.	231CSV21 – Software Defined Networks	PE	Dr.R.Arun Dr.P.Kavitha	Dr.R.Arun
2.	231CSV22 – Cloud Architecture	PE		Dr.P.Kavitha
3.	231CSV23 – Virtualization and Cloud Deployment	PE		Dr.R.K Soundaryaa
4.	231CSV24 – Cloud Storage and Data Management	PE		Mr.P.Gopalsamy
5.	231CSV25 – Cloud Optimization Techniques	PE		Ms.M.Umarajalakshmi
6.	231CSV26 – DevOps for Cloud Computing	PE		Ms. Rajasathya
7.	231CSV27 – Cloud Services	PE		Ms.T.Blessing Karunya
8.	231CSV28 – Cloud Security	PE		Ms.Malini

231CSV21		SOFTWARE DEFINED NETWORKS				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE	
Prerequisite:									
Aim:	Software-Defined Networking (SDN) is to make networks more flexible, scalable, and easier to manage by separating the control plane from the data plane.								
Course Outcomes: At the end of the course, the students will be able to									
CO1:	Recall the Fundamental concepts of SDN.								
CO2:	Outline the functions of the data plane and control plane.								
CO3:	Infer the network applications using SDN.								
CO4:	Build network services using Network Function Virtualization (NFV)								
CO5:	Demonstrate various use cases of SDN and NFV.								
CO6:	Recap the performance of SDN deployments and propose optimizations to improve performance.								
INTRODUCTION									9
Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane, Control plane and Application Plane									
SDN DATA PLANE AND CONTROL PLANE									9
Data Plane functions and protocols - OpenFlow Protocol - Flow Table - Control Plane Functions Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS Distributed Controllers									
SDN APPLICATIONS									9
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking									
NETWORK FUNCTION VIRTUALIZATION									9
Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture									
NFV FUNCTIONALITY									9
NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV									
Total Periods:									45
Text Book:									
1. William Stallings, “ <i>Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud</i> ”,Pearson Education, 1st Edition, 2015.									
References:									
1. Ken Gray, Thomas D. Nadeau, “ <i>Network Function Virtualization</i> ”, Morgan Kauffman, 2016. 2. Thomas D Nadeau, Ken Gray, “ <i>SDN: Software Defined Networks</i> ”, O’Reilly Media, 2013. 3. Fei Hu, “ <i>Network Innovation through OpenFlow and SDN: Principles and Design</i> ”, 1st Edition,CRC Press, 2014. 4. Paul Goransson, Chuck Black Timothy Culver, “ <i>Software Defined Networks: A Comprehensive Approach</i> ”, 2nd Edition, Morgan Kaufmann Press, 2016. 5. Oswald Coker, SiamakAzodolmolky, “ <i>Software-Defined Networking with OpenFlow</i> ”, 2ndEdition, O’Reilly Media, 2017.									

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O 1	PS O 2	PS O 3
		K 3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K3	2	3	2	2								1	3	2
CO3	K2	3	3	3	3								1	3	3
CO4	K3	3	3	3	3								1	3	3
CO5	K3	2	3	2	2								1	3	2
CO6	K2	2	3	2	2								1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV22		CLOUD ARCHITECTURE				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:		Category:		PE
Prerequisite:									
Aim:	To provide foundational knowledge of cloud computing paradigms, service models, architectures, and technologies and familiarity with major service providers.								
Course Outcomes: At the end of the course, the students will be able to									
CO1:	Recognize different cloud deployment and service models, along with essential technologies supporting cloud computing.								
CO2:	Interpret the relationship between systems of systems, web services, RESTful communication, and virtualization within a distributed environment.								
CO3:	Elaborate the concepts and design principles related to storage systems, cloud infrastructures, and security in virtualized environments.								
CO4:	Expound on the performance, scalability, and resource provisioning mechanisms used in cloud environments.								
CO5:	Apply cloud management tools and technologies to configure compute, storage, and platform resource								
CO6:	Configure cloud-based optimization patterns to enhance scalability, reliability, and performance of distributed applications.								
INTRODUCTION TO CLOUD COMPUTING FUNDAMENTALS									9
Cloud Computing definition - Cloud deployment models - Private, Public, Hybrid, community cloud - Cloud services - IaaS, PaaS, SaaS – Enabling technologies of cloud computing Type - Benefits and challenges of cloud computing - Business Agility - Benefits and challenges to Cloud architecture, Cloud Applications - Application availability. Performance - Security and disaster recovery - Next generation of Cloud Applications. – Virtualization - Types of virtualization in cloud computing - Advantages and Disadvantages.									
SERVICE ORIENTED ARCHITECTURE									9
REST - Systems of Systems - Web Service - Publish-Subscribe Model - Basics of Virtualization-Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structure - Tools and Mechanisms - Virtualization of CPU Memory - I/O Devices- Virtualization Support and Disaster Recovery - Server Virtualization - Parallel Processing - Vector Processing - Symmetric Multiprocessing Systems - Massively Parallel Processing Systems.									
INTRODUCTION TO CLOUD STORAGE INFRASTRUCTURES									9
Concept, planning and Design - Business continuity - Basic concepts of information security - Managing VDC and cloud environments and infrastructures - Securing storage in virtualized and cloud environments - Security auditing and SIEM - Storage Network Design - Architecture of storage, analysis and planning - Storage network design consideration - NAS and FC SANs - Hybrid storage networking technologies - iSCSI, FCIP, FCoE - Design for storage virtualization in cloud computing - host system design considerations - Cloud Applications - Technologies and the processes required when deploying web services.									
MANAGEMENT OF CLOUD SERVICES									9
Reliability, availability and security of services deployed from the cloud - Performance and scalability of services - Tools and technologies used to manage cloud services deployment - Cloud Economics - Cloud Computing infrastructures available for implementing cloud based services - Runtime Support Services - Resource Provisioning and Platform Deployment- Provisioning of Compute Resources (VMs) - Resource Provisioning Methods - NIST Cloud Computing Reference Architecture - Demand-Driven, Event-Driven Resource Provisioning - Popularity-Driven Resource Provisioning - Popularity-Driven Resource Provisioning - Storage-as-a-Service - Advantages of									

Cloud Storage – Global Exchange of Cloud Resources - Application Development - Service creation environments to develop cloud based applications.	
INTRODUCTION TO CLOUD ARCHITECTURE PATTERNS	9
Horizontally Scaling Compute Pattern - Cloud Significance - Queue-Centric Workflow Pattern - Auto-Scaling Pattern - Eventual Consistency Prime - Map Reduce Pattern – Database Sharding Pattern - Node Failure Pattern - Network Latency Prime - CDN Pattern - Multisite Deployment Pattern - Network connectivity optimization evolution: Top of rack (TOR), end of rack (EOR), connectivity - Stand-alone, blades, stateless – Clustering – Scaling - optimization, virtualization - optimization, virtualization - Case studies.	
Total Periods:	45
Text Books:	
1. Rittinghouse, John W., and James F. Ransome, “<i>Cloud Computing: Implementation, Management and Security</i>”, CRC Press, 2017. 2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.	
References:	
1. Greg Schulz, “<i>Cloud and Virtual Data Storage Networking</i>”, Auerbach Publications [ISBN: 978- 1439851739], 2011. 2. Toby Velte, Anthony Velte, Robert Elsenpeter, “<i>Cloud Computing, A Practical Approach</i>” McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	1	2	1	1									2	1
CO2	K2	2	3	2	2								1	3	2
CO3	K3	3	3	3	3								1	3	3
CO4	K3	3	3	3	3								1	3	3
CO5	K2	3	3	3	3								1	3	3
CO6	K3	3	3	3	3	2						2	1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV23		VIRTUALIZATION AND CLOUD DEPLOYMENT			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:								
Aim:	To enable the design, deployment, and secure management of scalable cloud-based solutions using modern technologies.							
Course Outcomes: At the end of the course, the students will be able to								
CO1:	Recognize core network technologies and cloud distribution models relevant to modern cloud infrastructures.							
CO2:	Analyze the key design challenges in cloud infrastructure, including scalability, reliability, security, and cost optimization							
CO3:	Organize virtual cluster managements and resource allocation strategies.							
CO4:	Apply the virtualization levels ,tools and techniques including CPU,I/O devices virtualization in cloud environments							
CO5:	Understand the framework of cloud and Compare open-source cloud platforms like Eucalyptus, Nimbus, OpenNebula, and OpenStack.							
CO6:	Develop cloud environments like defense mechanisms, intrusion detection mechanism and data/software protection techniques knowing the cloud security basics							
INTRODUCTION								9
Technologies for Network-Based System – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture. Cloud Computing and Service Models: - Characteristics – Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Cloud ecosystem and enabling technologies.								
CLOUD INFRASTRUCTURE								9
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.								
VIRTUALIZATION								9
Introduction – Implementation Levels of Virtualization – Virtualization Structures/Tools and Mechanisms – Virtualization of CPU, Memory, and I/O Devices – Virtual Cluster and Resource Management – Virtualization for Data Center Automation.								
CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENTS								9
Hadoop – Hadoop HDFS – Hadoop Map Reduce, Google - Google App Engine-GFS- BigTable - Microsoft Azure - Open Source Eucalyptus and Nimbus - OpenNebula – OpenStack and Appliances.								
SECURITY								9
Security management in Peer-to-Peer networks – Peer trust and Reputation Systems – Trust overlay and DHT implementation – Power Trust – Securing Overlays. Cloud Security and Trust Management – Defense Strategies – Distributed Intrusion Detection – Data and Software Protection Techniques -Reputation Guided Protection of Data Centers.								
Total Periods:								45
Text Book:								

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, “*Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet*”, First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2019.

References:	
1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, <i>Cloud Computing Principles and Paradigms</i> , Wiley, 2011.	
2. Toby Velte, Anthony Velte, Robert Elsenpeter, <i>Cloud Computing, A Practical Approach</i> , McGrawHill, 2010	
3. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, “ <i>Cloud Computing: Concepts, Technology & Architecture</i> ”, Second Edition, Prentice Hall, 2023.	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O 1	PS O 2	PS O 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	1	2	1	1									2	1
CO2	K2	2	3	2	2								1	3	2
CO3	K3	3	3	3	3								1	3	3
CO4	K2	2	3	2	2								1	3	2
CO5	K2	2	3	2	2								1	3	2
CO6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV24		CLOUD STORAGE AND DATA MANAGEMENT				L	T	P	C
						3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:		Category:		PE	
Prerequisite:	Linux Fundamentals, Computer Networks								
Aim:	To introduce cloud computing concepts and explore its various components, technologies, and security standards.								
Course Outcomes: At the end of the course, the students will be able to									
CO1:	Identify major components of cloud infrastructure and their influence on cost and performance..								
CO2:	Illustrate fundamental data storage technologies and management techniques used in cloud environments.								
CO3:	Utilize virtualization platforms to create and manage virtual machines, implement clustering strategies, and automate data-center operations for improved efficiency.								
CO4:	Elaborate the role of databases and web communication platforms in facilitating collaboration through tools such as social media, group-based systems, blogging platforms, and wikis.								
CO5:	Implement security controls and best practices to mitigate common security challenges in cloud computing.								
CO6:	Apply integrated knowledge of cloud computing, storage, virtualization, databases, and security to perform hands-on assessments and validate cloud-based systems.								
INTRODUCTION TO CLOUD COMPUTING									9
Evolution of Cloud Computing -System Models for Distributed and Cloud Computing - NIST Cloud Computing Reference Architecture -IaaS - On-demand Provisioning - Elasticity in Cloud - Examples of IaaS, PaaS & SaaS Providers - Public , Private and Hybrid Clouds – Google App Engine, Amazon AWS - Cloud Software Environments - Eucalyptus, Open Nebula, Open Stack, Nimbus									
DATA STORAGE FUNDAMENTALS									9
Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage.									
VIRTUAL MACHINES AND VIRTUALIZATION OF CLUSTERS AND DATA CENTERS									9
Implementation Levels of Virtualization- Virtualization Structures/Tools and Mechanisms-Virtualization of CPU, Memory, and I/O Devices - Virtual Clusters and Resource Management-Virtualization for Data-Center Automation									
DATABASES AND WEB-BASED COMMUNICATION									9
Definition of Database and its types-Purpose of using a Database- Database System Applications-Working of Databases- Collaborating on Databases- Web-Based Communication- Collaborating via Social Networks and Groupware- Collaborating via Blogs and Wikis									
SECURITY AND STANDARDS IN CLOUD									9
Introduction - Cloud Computing Security - Security Challenges in Cloud Computing - Software-as-a-Service Security, Standards in Cloud Computing - Standards for Application Developers - Standards for Messaging - Standards for Security									
Total Periods:									45
Text Books:									

1. Dr. Tarandeep Kaur “*Cloud Computing*” published by Lovely Professional University, 2023.
2. ArshdeepBahga and Vijay K. Madiseti, “*Cloud Computing: A Hands-On Approach*” published 2013.

References:

3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “*Distributed and Cloud Computing, From Parallel Processing to the Internet of Things*”, Morgan Kaufmann Publishers, 2012.
4. John W.Rittinghouse and James F.Ransome, “*Cloud Computing: Implementation, Management, and Security*”, CRC Press, 2010.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	PO 11	PS O 1	PS O 2	PS O 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2						2	3	1	3	2
CO2	K2	2	3	2	2							2	1	3	2
CO3	K2	2	3	2	2	2					3	1	1	3	2
CO4	K2	2	3	2	2	2						2	1	3	2
CO5	K2	2	3	2	2						2	2	1	3	2
CO6	K2	2	3	2	2							2	1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV25	CLOUD OPTIMIZATION TECHNIQUES			L	T	P	C
				3	0	0	3
Programme:	B.E. Computer Science and Engineering	Sem:	-	Category:	PE		
Prerequisites:	Cloud Computing						
Aim:	To allows an enterprise to understand and manage the costs and needs associated with its cloud technology						
Course Outcomes: The Students will be able to							
CO1:	Understand cloud cost fundamentals, including pricing models, cost components, ROI, FinOps, and financial governance..						
CO2:	Interpret the impact of tagging and KPI-driven reporting on cloud resource management and cost optimization.						
CO3:	Perform resource optimization by configuring compute and storage services with right-sizing, scaling, and tiring methods.						
CO4:	Manage and reduce network costs while implementing effective multi-cloud and hybrid cloud cost optimization strategies.						
CO5:	Automate cloud cost control and governance using IaC, policy-as-code, tagging automation, and compliance enforcement tools.						
CO6:	Apply real-world cost optimization practices using case studies from AWS, Azure, and GCP across startups and enterprises.						
INTRODUCTION TO CLOUD COST MANAGEMENT							9
Cloud computing overview & cost sensitivity-Cost components: compute, storage, network, data transfer, managed services-Cloud pricing models: On-demand, Reserved Instances, Spot instances, Savings Plans-Cost allocation models (business units, projects, accounts)-Return on Investment (ROI) & Value Realization-FinOps principles, roles, and lifecycle (Inform – Optimize – Operate) - CapEx vs OpEx cloud cost shifts-Cloud budget preparation and financial governance							
COST MONITORING, ANALYSIS & REPORTING							9
Tagging strategies: cost allocation tags, compliance, automation of tagging-Cost transparency & visibility frameworks-Cost modeling tools and methods-Billing architectures: AWS Organizations, Azure Subscriptions, GCP Projects-Cross-cloud cost comparison and abstraction tools-Establishing cost KPIs, SLAs, SLOs related to budget compliance-Chargeback and showback models							
COMPUTE & STORAGE COST OPTIMIZATION							9
Compute Optimization: Right-Sizing Compute (Vm Instance Sizing, Cpu/Memory Optimization)-Autoscaling Strategies (Hpa, Vpa, Dynamic Scaling)-Serverless Cost Optimization (Lambda, Cloud Functions, Azure Functions)-Containerization Vs Vm Cost Comparison. Storage Optimization: Tiered Storage Strategies (Hot, Cool, Archive)-Storage Protocols And Pricing (S3, Blob Storage, Cloud Storage)-Backup And Snapshot Cost Optimization							
NETWORK COST MANAGEMENT & MULTI-CLOUD OPTIMIZATION							9
Data transfer pricing models (inter-region, intra-region, Internet egress)-Reducing cross-region and cross-zone traffic costs-Designing low-cost network architectures-Cost comparison frameworks for AWS, Azure, GCP-Vendor lock-in and cost risks-Hybrid cloud cost strategies-API gateway & service mesh cost considerations-Cost-efficient microservices architecture and service granularity decisions							
TOOLS, AUTOMATION & GOVERNANCE							9

Cost Automation & IaC: Using Terraform, CloudFormation, ARM, Pulumi for cost governance-Tagging automation scripts-Policy-as-Code for budgets (OPA, Sentinel, AWS Config Rules)-Governance & Best Practices: Establishing cloud cost governance models-Automated compliance enforcement-Cost/security balance in architecture decisions-Case Studies: Cost optimization in startups vs enterprises -Real-world examples from AWS, Azure, GCP customer stories

Total Periods: 45

Text Books:

1. J.R. Stormont, Mike Fullercloud Finops: Collaborative, Real-Time Cloud Financial Management O'Reilly Media, 2020.
2. Kevin L. Jackson, Scott Goessling architecting Cloud Computing Solutions Packt Publishing, 2018.
3. Gregor Hohpe Cloud Strategy: A Decision-Based Approach To Successful Cloud Migration O'Reilly Media, 2021.

References:

1. Kamal Kishore, The Financial Times, Guide to Cloud Computing: How to Choose and Implement the Best Cloud Strategy, FT Press, 2011.
2. Jessen McLean, AWS Cost Optimization: Practical Techniques for Reducing Your AWS Bill Amazon Digital Services, 2021.
3. Microsoft Azure Team, Azure Cost Management and Billing: Monitor, Control, and Optimize Azure Spending, Microsoft Press, 2022.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	1	1									1		1
CO2	K3	1	1	1		2				1			1	1	1
CO3	K3	2	2	2	1	2					1		2	2	
CO4	K3	1		1		2							1		1
CO5	K3	1		2		2					1		2		1
CO6	K2	1	1	1							1	1		1	

231CSV26		DEVOPS FOR CLOUD COMPUTING				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:	1	Category :		PC
Prerequisite:		Cloud Computing							
Aim:		To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations							
Course Outcomes: The Students will be able to									
CO1:		Recall the principles of cloud computing and outline the functionalities provided by IaaS, PaaS, and SaaS platforms.							
CO2:		Identify the stages of the DevOps lifecycle and their interdependencies in delivering high-quality software efficiently.							
CO3:		Apply Docker-based containerization techniques to configure, deploy, and manage cloud applications efficiently.							
CO4:		Implement automated build, test, and deployment pipelines to reduce manual intervention and improve software delivery.							
CO5:		Develop containerized applications using Docker/Kubernetes and deploy them in cloud environments.							
CO6:		Configure and manage virtual machines, storage, and network resources by applying appropriate virtualization methods.							
INTRODUCTION TO CLOUD COMPUTING									9
Cloud computing fundamentals – layers and types of clouds -Service Models (IaaS, PaaS, SaaS) – Deployment models – Benefits and challenges – Case studies (AWS, Azure, GCP).									
DevOps FUNDAMENTALS									9
Understanding DevOps- Definition and Goals of DevOps, History and Evolution of DevOps, Key Principles of DevOps, Benefits of DevOps, Develops Technical Challenges, Tools we use in Devops.									
DOCKER									9
Introduction to Docker-Docker Architecture-Docker container- Docker Manipulation Basic- Docker Compose Basics- Docker Security- Docker Troubleshooting and debugging- Docker Images and Repositories.									
AUTOMATION AND CONFIGURATION MANAGEMENT									9
Automation tools: Chef, Puppet, Ansible – Containerization with Docker – Docker files– Orchestration with Kubernetes – Cloud deployment using Terraform.									
VIRTUALIZATION INFRASTRUCTURE									9
Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines.									
Total Periods:									45
Text Book:									

1. Len Bass, Ingo Weber, Liming Zhu, “DevOps: A Software Architect's Perspective”, Addison-Wesley, 2015.
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, “Cloud Computing: Principles and Paradigms”, Wiley, 2011.

References:

1. Kelsey Hightower, Brendan Burns, Joe Beda, “Kubernetes: Up and Running”, O'Reilly, 2022.
2. Gene Kim, Jez Humble, Patrick Debois, John Willis, “The DevOps Handbook”, IT Revolution Press, 2016.
3. Amazon AWS Documentation: <https://docs.aws.amazon.com/>
4. Jenkins CI Documentation: <https://www.jenkins.io/doc/>
5. <https://www.freecodecamp.org/news/the-docker-handbook/>

Course Outcome s		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	PS O 1	PS O 2	PS O 3
		K3	K2	K3	K3								K5	K2	K3
CO 1	K2	2	3	2	2								1	3	2
CO 2	K2	2	3	2	2								1	3	2
CO 3	K3	3	3	3	3								1	3	3
CO 4	K3	3	3	3	3								1	3	3
CO 5	K3	3	3	3	3								1	3	3
CO 6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV27		CLOUD SERVICES				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE	
Prerequisites:		-							
Aim:	Students with a comprehensive understanding of storage technologies and solutions used in modern data centers.								
Course Outcomes: The Students will be able to									
CO1:	Recognize different storage solutions and their role within a modern data center environment..								
CO2:	Identify the physical components of storage infrastructure, including disks, storage arrays, SAN/NAS devices, and network switches.								
CO3:	Implement storage solutions using FC-SAN, NAS, or object-based storage to meet performance, redundancy, and scalability requirements..								
CO4:	Apply storage networking protocols to connect servers, storage devices, and cloud platforms for optimized performance and reliability.								
CO5:	Identify the business continuity solutions along with archive for managing and fixed content.								
CO6:	Illustrate key characteristics, services, deployment models, and infrastructure components.								
STORAGE SYSTEM									9
Introduction to information storage, Virtualization and cloud computing, Key data center elements, Compute, application, and storage virtualization, Disk drive & flash drive components and performance, RAID, Intelligent storage system and storage provisioning (including virtual									
STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION									9
Fibre Channel SAN components, FC protocol and operations, Block level storage virtualization, iSCL and FCIP as an IP-SAN solutions, Converged networking option – FcoE, Network Attached Storage (NAS) – components, protocol and operations, File level storage virtualization, Object based storage and unified storage platform.									
BACKUP, ARCHIVE AND REPLICATION									9
Business continuity terminologies, planning and solutions, Clustering and multi pathing to avoid single points of failure, Backup and recovery – methods, targets and topologies, data deduplication and backup in virtualized environment, fixed content and data archive, Local replication in classic and virtual environments, Remote replication in classic and virtual environments, Three-site remote replication and continuous data protection.									
CLOUD COMPUTING									9
Characteristics and benefits, Services and deployment models, Cloud infrastructure components, Cloud migration considerations.									
SECURING AND MANAGING									9
Storage Infrastructure Security threats, and countermeasures in various domains, Security solutions for FC-SAN, IP-SAN and NAS environments, Security in virtualized and cloud environments, Monitoring and managing various information infrastructure components in classic and virtual environments, Information lifecycle Management (ILM) and storage tiering.									
Total Periods:									45

Text Books:	
1. Information Storage and Management: Storing, Managing and Protecting Digital Information in classic, Virtualized and Cloud Environments, 2nd Edition, EMC Education Services, Wiley, May	

2012.	
References:	
1. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein , "Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE, 2nd Edition, Wiley, July 2009	
2.Information Storage and Management: Storing, Managing, and Protecting Digital Information, EMC Education Services, Wiley, January 2010	

Course Outcome s		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO 1	K2	2	3	2	2								1	3	2
CO 2	K3	3	3	3	3								1	3	3
CO 3	K1	1	2	1	1								1	3	3
CO 4	K3	3	3	3	3								1	3	3
CO 5	K2	2	3	2	2								1	3	2
CO 6	K2	2	3	2	2								1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV28		CLOUD SECURITY				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:		Category:		PE
Prerequisite:		-							
Aim:	To develop the ability to secure cloud environments by applying industry-standard practices in data protection, workload security, compliance, and incident response.								
Course Outcomes: The Students will be able to									
CO1:	Understand the Shared Responsibility Model in the cloud and its implications for security.								
CO2:	Interpret strategies for redundancy, resiliency, and disaster recovery to ensure business continuity in data center operations								
CO3:	Apply data lifecycle management practices to ensure secure creation, storage, usage, and disposal of data.								
CO4:	Implement security measures for serverless functions and containerized applications to prevent unauthorized access and exploitation.								
CO5:	Perform real-time monitoring and response using logging, alerting, and security orchestration tools.								
CO6:	Utilize cloud provider compliance tools to monitor and enforce adherence to regulatory requirements.								
INTRODUCTION TO CLOUD AND DATA CENTER SECURITY									9
Overview of Cloud Computing and Deployment Models (Public, Private, Hybrid),Cloud Service Models: IaaS, PaaS, SaaS, Introduction to Data Center Infrastructure, Shared Responsibility Model in the Cloud, Core Security Concepts: CIA Triad, Risk Management, Zero Trust									
DATA CENTER AND INFRASTRUCTURE SECURITY									9
Physical and Environmental Security in Data Centers, Access Control: Role-Based, Biometric, and Logical Access, Virtualization Security: Hypervisors, Containers, and VMs, Network Security: Firewalls, IDS/IPS, Segmentation, VPNs, Redundancy, Resiliency, and Disaster Recovery in Data Centers									
CLOUD DATA AND IDENTITY SECURITY									9
Data Protection Techniques (Encryption, Tokenization), Data Lifecycle Management (Creation to Disposal), Data Loss Prevention (DLP) and Media Sanitization, Identity and Access Management (IAM) RBAC, Least Privilege, MFA, Identity Federation, Key and Certificate Management in the Cloud									
APPLICATION SECURITY AND THREAT MANAGEMENT									9
Securing Web Applications and APIs (OWASP Top 10), Serverless and Container Security, Threat Modeling and Risk Analysis, Common Threats: DoS, Malware, Insider Threats, Misconfigurations, Logging, Monitoring, and Incident Response, Security Audits and Vulnerability Assessments									
COMPLIANCE, GOVERNANCE, AND SECURITY AWARENESS									9
Industry Standards and Compliance Frameworks :ISO 27001, NIST, HIPAA, PCI DSS, SOC 2, Cloud Provider Compliance Tools (AWS, Azure, GCP), Governance and Policy Management, Security Best Practices and User Awareness, Training Programs and Phishing Simulations, Final Review and Capstone/Project Presentation									
Total Periods:									45
Text Book:									

1.” Cloud Computing: Concepts, Technology, Security & Architecture — 2nd Edition”, Thomas Erl and Eric Barceló Monroy, **Publisher:** Pearson **Publication Date:** August 14, 2023 (2nd edition) **ISBN-13:** 9780138052256 (paperback) / 9780138052188 (eTextbook)

2.” Cloud Computing with Security and Scalability: Concepts and Practices”, Naresh Kumar Sehgal, Pramod Chandra P. Bhatt & John M. Acken ,Springer, 2022 (softcover 2023)

References:

1. “*Information Security: Principles and Practice (2nd or 3rd Edition)*”, Mark Stamp, Publisher: Wiley, Publication Year: 2011 (2nd ed.), 2020 (3rd ed.) ISBN: 978-1119026400 (3rd ed.).
2. “*Data Center Handbook*” ,Editor: Hwaiyu Geng, Publisher: Wiley, Publication Year: 2014, ISBN: 978-1118436637.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)				
		P O 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	PSO 3	PSO 4
		K 3	K5	K6	K5	K6	K6							K5	K2	K3	K3
CO1	K1	2	2	3	3							1	2	2	2	2	3
CO2	K2	2	2	3	3							1	2	2	2	2	3
CO3	K2	2	2	3	3							1	2	2	2	2	3
CO4	K3	2	2	3	3							1	2	2	2	2	3
CO5	K3	2	2	3	3							1	2	2	2	2	3
CO6	K3	2	2	3	3							1	2	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)



P.S.R. ENGINEERING COLLEGE, SIVAKASI – 626140.

An Autonomous Institution, Affiliated to Anna University, Chennai,
Accredited by NAAC with A+ and listed under 2(f) & 12(B) of the UGC Act, 1956
An ISO 9001:2015 Certified Institution



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

UG REGULATION – 2023
CHOICE BASED CREDIT SYSTEM
CURRICULUM [V – VIII SEMESTERS and VERTICALS FULL-TIME] <i>(Candidates admitted from 2023–2024 onwards)</i>
Total Credits: 164

S. No.	Course Code and Course Title	Category	Vertical Coordinator	Course Designer
1.	231CSV31 – Distributed Computing	PE	Dr R Palanikumar Dr S Singaravelan	Mr.P.Gopi Kannan
2.	231CSV32 – Fog and Edge Computing	PE		Dr.S.Singaravelan
3.	231CSV33 – Quantum Computing: Algorithms and Limitations	PE		Mrs.R.Velselvi
4.	231CSV34 – High Performance Computing	PE		Mrs.R.Velselvi
5.	231CSV35 – Financial Computing	PE		Mrs.R.Priyanka
6.	231CSV36 – Green Computing	PE		Mr.P.Rama Subramanian
7.	231CSV37 – Pervasive Computing	PE		Ms.S.M.Madhumathi
8.	231CSV38 – Multi Programming	PE		Ms.S.M.Madhumathi

231CSV31	DISTRIBUTED COMPUTING				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering		Sem:	-	Category:		PE	
Prerequisite:	231CS46 – Computer Networks							
Aim:	To provide the knowledge of Distributed computing and its importance.							
Course Outcomes: At the end of the course, the students will be able to								
CO1:	Recall the fundamental concepts in distributed computing.							
CO2:	Explore various layered protocols that simplify the programming interface to computer system.							
CO3:	Apply methods and techniques for distributed query processing and optimization.							
CO4:	Execute the concepts of distributed file systems, name services, and distributed transactions, and explain how they work using real-world examples.							
CO5:	Apply open-source security tools to identify and mitigate vulnerabilities in distributed computing.							
CO6:	Solve problems related to distributed computing, including its services and applications.							
INTRODUCTION								9
Characterization of Distributed Systems - Examples of Distributed Systems - Trends in Distributed Systems - Focus on Resource Sharing – Challenges - Case Study: The World Wide Web. System Models - Physical Models - Architectural Models - Fundamental Models. Networking and Internetworking - Types of Network - Network Principles - Internet Protocols - Case Studies: Ethernet, Wi-Fi and Bluetooth.								
COMMUNICATION IN DISTRIBUTED SYSTEMS								9
Inter process Communication - The API for the Internet protocols - External data representation and marshalling - Multicast communication - Network virtualization: Overlay networks - Case study: MPI. Remote Invocation - Request-reply protocols -Remote procedure call - Remote method invocation - Case study: Java RMI. Indirect Communication - Group communication - Publish-subscribe systems - Message queues - Shared memory approaches. Operating System Concept - Communication and invocation - Operating system architecture - Virtualization at the operating system level.								
DISTRIBUTED MIDDLEWARE								9
Distributed objects - CORBA - From objects to components - Enterprise JavaBeans and Fractal. Web Services - Introduction - Service descriptions and IDL for web services - A directory service for use with web services - xml security - coordination of web services - applications of web services. Peer-to Peer systems - Introduction - Napster and its legacy - Peer-to-peer middleware - Routing overlays - Overlay case studies: Pastry, Tapestry - Application case studies: Squirrel, Ocean Store, Ivy								
DISTRIBUTED SYSTEM SERVICES AND SHARED DATA								9
Distributed File Systems - File service architecture - Case study: Sun Network File System, The Andrew File System - Enhancements and further developments. Name Services - Introduction - Name services and the Domain Name System - Directory services - Case study: The Global Name Service, The X.500 Directory Service. Distributed Transactions -Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions - Distributed deadlocks - Transaction recovery.								
NEW CHALLENGES AND CASE STUDY								9

Mobile and Ubiquitous Computing - Introduction - Association - Interoperation - Sensing and context awareness - Security and privacy - Adaptation -Case study: Cooltown. Distributed Multimedia Systems - Characteristics of multimedia data - Quality of service management - Resource management - Stream adaptation - Case studies: Tiger, BitTorrent and End System Multicast. Designing Distributed Systems: Google Case Study - Overall architecture and design philosophy - Underlying communication paradigms - Data storage and coordination services - Distributed computation services.

Total Periods: 45

Text Book:

1. G Coulouris, J. Dollimore, T. Kindberg, Gordon Blair, "Distributed System Concepts and Design", Addison Wesley, 5/e, 2012.

References:

1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed System Principles and Paradigms", Pearson Education, 2002.
2. HagitAttiya and Jennifer Welch, "Distributed Computing: Fundamentals, Simulations and Advanced Topics", Wiley, 2004.
3. A.S.Tanenbaum, M.Van Steen, "Distributed Systems", Pearson Education, 2004.
4. M.L.Liu, "Distributed Computing Principles and Applications", Pearson Addison Wesley, 2004.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K2	2	3	2	2								1	3	2
CO3	K3	3	3	3	3								2	3	3
CO4	K2	2	3	2	2								1	3	2
CO5	K3	3	3	3	3								2	3	3
CO6	K3	3	3	3	3								2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV32		EDGE - FOG COMPUTING			L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:	PE	
Prerequisite:	Nil							
Aim:	To provide a comprehensive understanding of Edge and Fog Computing, its architecture, protocols, integration with IoT, and data management strategies.							
Course Outcomes: The Students will be able to								
CO1:	Recall the different system paradigms and frameworks used in edge computing architectures							
CO2:	Relate the Integrated Modelling and the resources							
CO3:	Apply the fundamental concepts, characteristics, and application scenarios of Fog Computing and its integration with the Internet of Things (IoT).							
CO4:	Infer Fog Computing with Cloud and Edge Computing in terms of architecture, benefits, and performance.							
CO5:	Utilize the architecture, working procedures, and modeling aspects of different protocols.							
CO6:	Build real-world case studies involving Fog Computing, the Security and privacy issues of Edge computing.							
INTRODUCTION TO EDGE COMPUTING								9
Fundamentals of Edge Computing: Introduction-Key Techniques-Benefits-Systems-Paradigms of Edge computing- Edge Computing Frameworks-Value Scenarios for Edge Computing- system architectures-Edge platforms-Edge vs Fog Computing- Communication Models - Edge, Fog and M2M.								
CHALLENGES IN FEDERATING EDGE RESOURCES								9
Introduction – Methodology-Integrated Modelling C2F2T Literature by Modelling technique-Integrated C2F2T Literature by Use Case Scenarios- Integrated C2F2T Literature by Metrics – Resources- deployment of edge nodes-Modelling-Mobility modelling-Network resource Modelling								
INTRODUCTION TO FOG COMPUTING:								9
Fog Computing-Definition-Characteristics-Application Scenarios – Issues – Fog Computing and Internet of Things – Pros and Cons – Myths of Fog Computing – Need and Reasons for Fog Computing Fog Computing and Edge Computing-IoT, FOG, Cloud Benefits.								
ARCHITECTURE & PROTOCOLS :								9
Working Procedure -Performance Evaluation Components- Software Systems – Architecture-Modeling and Simulation –Challenges Fog Kit - Proximity Detection Protocols - DDS/RTPS computing protocols								
CASE STUDY & ISSUES								
Case Study: Wind Farm - Smart Traffic Light System, Wearable Sensing. Devices, Wearable Event Device, Wearable System, Demonstrations, Post Application Example. Event Applications Example. Edge Security, privacy, policy and compliance- Edge federation, interoperability and standards.								
Total Periods:								45
Text Book:								
1. Assad Abbas, Samee U. Khan “Fog Computing: Theory and Practice” Wiley India, May 2020. 2. Buvya Raj Kumar and Satish Narayana Srirama eds “Fog and Edge Computing: Principles and Paradigms”, 1/e, John Wiley & Sons, 2019.								

3. Bilay Peter Gutsche, Mandy Krimmel, Volker Stiehl, "SAP Cloud Platform Integration: The Comprehensive Guide", 2/e, Rheinweg Publishing Edition 2019

References:

1. Stojan Kitanov (Mother Teresa University, Macedonia), "Introduction to Fog Computing" IGI Global Publication.
2. Moral Hazar, Yanru Zhang, Nguyen H. Tran, Dusit Niyato, and Zhu Han, "Multidimensional payment Plan in Fog Computing" with IEEE, University of Melbourne 2016.
3. Jie Cao, Quan Zhang, Weisong Shi, "Edge Computing: A Primer", Springer International Publishing, 2018.
4. Shi, W., Zhang, L., Liu, Y., Hou, Y, "Edge Computing: Models, Technologies, and Applications", Institution of Engineering and Technology, 2020.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K2	2	3	2	2								1	3	2
CO3	K2	2	3	2	2								1	3	2
CO4	K2	2	3	2	2	2							1	3	2
CO5	K3	3	3	3	3							2	2	3	3
CO6	K3	3	3	3	3							2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV33		QUANTUM COMPUTING: ALGORITHMS AND LIMITATIONS			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:								
Aim:	To provide students with a comprehensive understanding of the principles and applications of quantum computing.							
Course Outcomes: At the end of the course, the students will be able to								
CO1:	Recall the fundamental principles of quantum mechanics relevant to computation.							
CO2:	Represent quantum information using qubits, quantum gates, and circuit models.							
CO3:	Analyze and implement basic quantum algorithms such as Deutsch-Jozsa, Grover, and Shor.							
CO4:	Understand and apply techniques in quantum error detection and correction.							
CO5:	Identify the applications and limitations of quantum computing in modern problems.							
CO6:	Develop and simulate quantum programs using tools like Qiskit or Cirq.							
FOUNDATIONS OF QUANTUM MECHANICS								9
Introduction-Postulates of quantum mechanics, Qubits and quantum states (Dirac notation), Superposition and entanglement, Quantum measurement, Bloch sphere representation								
QUANTUM GATES AND CIRCUITS								9
Single-qubit gates, Multi-qubit gates: CNOT, Toffoli, SWAP, Universal gate sets, Quantum circuit diagrams, Reversibility and unitary transformations.								
QUANTUM ALGORITHMS								9
Quantum parallelism and interference, Deutsch-Jozsa algorithm, Grover's search algorithm, Shor's factoring algorithm, Quantum Fourier Transform.								
QUANTUM ERROR CORRECTION AND NOISE								9
Sources of quantum noise (decoherence), No-cloning theorem, Quantum error correction codes (bit-flip, phase-flip, Shor code), Fault-tolerant quantum computation								
APPLICATIONS AND FUTURE OF QUANTUM COMPUTING								9
Quantum supremacy and current quantum hardware, Quantum machine learning, Quantum cryptography, Challenges in scalability and decoherence, Overview of platforms: IBM Q, Google Sycamore, IonQ, etc.								
Total Periods:								45
Text Book:								
1. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information” Cambridge University Press, 10 th Anniversary Edition, 2010.								
References:								
1. Jesse Van Griensven Thé, Roydon Andrew Fraser, and Jose Rosas-Bustos “Quantum Computing and Quantum Machine Learning for Engineers and Developers” ,2025								
2. Rajiv Pandey, Nidhi Srivastava, Neeraj Kumar Singh & Kanishka Tyag, “Quantum Computing: A Shift from Bits to Qubits”,2023.								
3. Anshuman Mishra, “Quantum Computing: Principles Programming and Possibilities”,2025.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1		3	2	-	2	-	-	-	-	-	-	-	3	2	3
CO2		3	2	2	2	2	-	-	-	-	-	-	3	3	3
CO3		2	3	3	3	3	-	-	-	-	-	-	2	3	3
CO4		2	2	2	3	2	-	-	-	-	-	-	2	2	3
CO5		2	3	2	2	2	2	-	1	1	2	1	2	2	3
CO6		2	2	2	3	3	-	-	-	2	2	2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV34		HIGH PERFORMANCE COMPUTING				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:		Category:		PE
Prerequisite:									
Aim:	To provide students with a comprehensive understanding of the principles, architectures, and programming paradigms used in modern high-speed computing systems.								
Course Outcomes: The Students will be able to									
CO1:	Understand the fundamental concepts, classifications, and architectures of High Performance Computing systems.								
CO2:	Analyze and differentiate between various parallel programming models such as MPI, OpenMP, and CUDA.								
CO3:	Evaluate the performance of parallel programs using key metrics like speedup, efficiency, and scalability.								
CO4:	Apply parallel programming techniques to solve computational problems on shared and distributed memory architectures.								
CO5:	Demonstrate the use of HPC tools, software libraries, and resource management systems in real-time environments.								
CO6:	Explore current applications and future trends of HPC in science, engineering, big data, and artificial intelligence.								
INTRODUCTION TO HIGH PERFORMANCE COMPUTING									9
Basics of HPC and its necessity, Evolution of HPC systems, Flynn’s taxonomy – SISD, SIMD, MISD, MIMD, Parallel computing paradigms – shared memory, distributed memory, hybrid, Applications of HPC in science, engineering, and industry									
PARALLEL PROGRAMMING CONCEPTS									9
Parallelism: Data vs. Task parallelism, Amdahl’s Law and Gustafson’s Law, Communication and synchronization, Parallel programming Models-Message Passing Interface (MPI), Open MP, CUDA, Tools and libraries for parallel programming, Programming constructs: fork-join, barriers, critical sections.									
HPC ARCHITECTURES									9
Multicore and multiprocessor systems- Memory hierarchy and cache coherence- NUMA vs. UMA-Interconnection networks: topology, latency, bandwidth -Clusters, Grids, and Cloud-based HPC-GPU architecture and acceleration- Case study: NVIDIA, Intel Xeon, AMD EPYC									
HPC SOFTWARE AND TOOLS									9
Operating systems for HPC-Job scheduling and workload management: SLURM, PBS-Resource management and virtualization- Compilers and performance analysis tools (gprof, valgrind, perf)- Scientific computing libraries: BLAS, LAPACK, ScaLAPACK- Debugging and profiling in parallel environments-Storage systems and file management (Lustre, GPFS)									
APPLICATIONS AND TRENDS IN HPC									9
HPC applications in domains-Weather modelling, Molecular dynamics, Bioinformatics, AI and Machine Learning, Big Data Analytics-Exascale computing-Energy-efficient computing (Green HPC)-Quantum computing (introductory concepts)-Future trends: neuromorphic computing, heterogeneous computing.									
Total Periods:									45

Text Book:	
1. “Introduction to High Performance Computing for Scientists and Engineer”s, Georg Hager, Gerhard Wellein, 1st Edition, 2010 , CRC Press.	
2. Charles Severance “High Performance Computing”, , 2nd Edition, 2013	
References:	
1. “Parallel Programming in C with MPI and OpenMP”, McGraw-Hill Education, 1st Edition, 2003	
2. “CUDA by Example: An Introduction to General-Purpose GPU Programming”, Jason Sanders, Edward Kandrot, 1st Edition, 2010	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	3	2	-	2	2	-						3	2	3
CO2	K2	2	3	2	2	3	-			2			3	3	3
CO3	K2	2	3	2	3	2	-						2	3	3
CO4	K4	3	3	3	3	3	-	-		2			3	3	3
CO5	K3	2	2	3	2	3	-	-		3	2	2	2	3	3
CO6	K3	2	2	2	2	2	2	3		2	2	2	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV35		FINANCIAL COMPUTING			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:		-						
Aim:	To develop advanced computational skills for solving complex financial problems using modern C++ and parallel computing.							
Course Outcomes: The Students will be able to								
CO1:	Recall the proficiency in modern C++ programming techniques relevant to high-performance and parallel computing in financial applications.							
CO2:	Explore parallel simulation frameworks to price complex financial derivatives using Monte Carlo methods.							
CO3:	Build Algorithmic Adjoint Differentiation (AAD) for the efficient computation of sensitivities (Greeks) in financial models.							
CO4:	Develop reusable, professional-grade financial computing libraries for real-time risk assessment and regulatory compliance.							
CO5:	Identify computational methods with financial theory to model, price, and manage the risk of structured financial products and portfolios.							
CO6:	Apply numerical algorithms for robustness, accuracy, and performance in real-world financial contexts.							
FOUNDATIONS OF FINANCIAL COMPUTING								9
Introduction to Computational Finance, High-performance C++ programming, Innovations in Modern C++, Standard Threading Library and concurrency, Concurrent programming with Standard Threading Library, Building and managing thread pools, Design of parallel algorithms for finance, Parallel Monte Carlo simulations, Parallel simulation libraries and applications in derivatives valuation.								
ALGORITHMIC ADJOINT DIFFERENTIATION (AAD)								9
Introduction to AAD and its importance in finance, Operator overloading and taping, Memory management in AAD, Checkpointing and calibration (explicit & implicit),Expression templates for performance acceleration, Application of AAD in simulation libraries and financial derivatives.								
APPLICATIONS IN FINANCIAL RISK MANAGEMENT								9
CVA, DVA, and xVA calculations,Portfolio-level risk aggregation, Differentiation through calibration, Sensitivity analysis using AAD,Efficient computation of multiple risk metrics								
SOFTWARE DEVELOPMENT FOR FINANCIAL ENGINEERING								9
Structuring and scripting financial products,Development of simulation engines and libraries, Exporting financial software functionality to Excel, Integration of C++ libraries with front-end tools.								
CASE STUDIES								9
Regression proxies and model hierarchies, Implementation of Longstaff-Schwartz (LSM) method, Case studies from Danske Bank systems, Real-time risk computation demonstrations.								
Total Periods:								45
Text Book:								
2. Antoine Savine “ <i>Modern Computational Finance</i> ”, Published by John Wiley & Sons, 2019								
References:								
6. Lars Stentoft, “ <i>Computational Finance</i> ”, Printed Edition of the Special Issue Published in								

Journal of Risk and Financial Management

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2							3	1	3	2
CO2	K2	2	3	2	2							3	1	3	2
CO3	K3	3	3	3	3							3	1	3	3
CO4	K3	3	3	3	3							3	1	3	3
CO5	K2	2	3	2	2							3	1	3	2
CO6	K3	3	3	3	3	2						3	1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV36	GREEN COMPUTING				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:		PE
Prerequisite:	Nil							
Aim:	To understand all basic concepts in Green Computing							
Course Outcomes:	At the end of the course, the students will be able to							
CO1:	Recall the basic knowledge of Green computing fundamentals							
CO2:	Illustrate the Architecture , design and development model in green computing							
CO3:	Demonstrate the telecommuting, data center and grid framework							
CO4:	Analyze green compliance Protocols, Standards, and Audits.							
CO5:	Discover with various green computing Case Study Scenarios							
CO6:	Apply green computing concepts in real time							
GREEN COMPUTING FUNDAMENTALS								9
Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.								
GREEN ASSETS AND MODELING								9
Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modelling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.								
GRID FRAMEWORK								9
Virtualization of IT systems – Role of electric utilities, Telecommuting, tele conferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center –Green Grid framework.								
GREEN COMPLIANCE								9
Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future.								
CASE STUDIES								9
The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.								
Total Periods:								45
Text Book:								
2. Bhuvan Unhelkar, “Green IT Strategies and Applications-Using Environmental Intelligence”, CRC Press, June 2014.								
3. Woody Leonhard, Katherine Murray, “Green Home computing for dummies”, August 2012.								
References:								
3. Alin Gales, Michael Schaefer, Mike Ebberts, “Green Data Center: steps for the Journey”, Shroff/IBM rebook, 2011.								
4. John Lamb, “The Greening of IT”, Pearson Education, 2009								
5. Jason Harris, “Green Computing and Green IT- Best Practices on regulations & industry”, Lulu.com, 2008								

6. Carl speshocky, “*Empowering Green Initiatives with IT*”, John Wiley & Sons, 2010.
7. Wu Chun Feng (editor), “*Green computing: Large Scale energy efficiency*”, CRC Press

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3		K4	K3				K3	K5	K2	K3
CO1	K1	1											1		
CO2	K2	2	3		3		2								3
CO3	K2	2		3	3										
CO4	K4	3						2						3	
CO5	K4	3													
CO6	K3	3													

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV37		PERVASIVE COMPUTING			L	T	P	C
					3	0	2	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		
Prerequisites:		Computer Networks, Operating Systems, Basic Programming in C/C++						
Aim	To introduce students to the concepts, design strategies, technologies, and tools that enable computing everywhere, anytime, and by anyone. The course emphasizes context-awareness, embedded systems, wireless networks, and user-centric application development.							
COURSE OUTCOMES:								
CO1	Recall the fundamental concepts and architecture of pervasive computing systems.							
CO2	Explore and demonstrate various pervasive devices and embedded hardware.							
CO3	Develop applications that leverage context-aware and ubiquitous services.							
CO4	Analyze security and privacy concerns in pervasive environments.							
CO5	Build hardware and software for prototyping real-world pervasive applications.							
CO6	Apply pervasive computing principles in designing adaptive, user-centric systems using							
INTRODUCTION TO PERVASIVE COMPUTING								9
Evolution from distributed and mobile computing-Characteristics of pervasive computing-Smart environments and ambient intelligence-Applications: Smart homes, healthcare, wearable systems, smart cities-Enabling technologies: IoT, Cloud, Mobile, AI								
PERVASIVE DEVICES AND EMBEDDED HARDWARE								9
Overview of pervasive hardware: sensors, actuators, smart cards-Wireless technologies: Wi-Fi, Bluetooth, Zigbee, RFID, NFC-Embedded systems overview: Arduino, Raspberry Pi-Interfacing sensors and controlling devices-Case Study: Home automation or health monitoring system								
MIDDLEWARE AND CONTEXT-AWARE COMPUTING								9
Middleware architecture and role in pervasive systems-Service discovery and context-awareness - Context modelling and reasoning-Location-aware computing-Context-aware application design patterns								
HUMAN-COMPUTER INTERACTION IN PERVASIVE ENVIRONMENTS								9
Natural interfaces: touch, voice, gesture, AR/VR-Adaptive interfaces and Personalization-Multimodal Interaction-Usability and accessibility in pervasive systems-Designing for non-traditional interface.								
SECURITY, PRIVACY, AND CASE STUDIES								9
Security challenges: authentication, data protection-Privacy in context-aware systems-Secure communication in wireless environments-Mini-project: Build a pervasive application prototype-Real-world case studies: Retail tracking, Smart agriculture, Mobile healthcare								
Total Periods:								45
Textbooks:								
1. Spyros Panagiotakis & Evangelos K. Markakis — <i>Pervasive Computing in IoT</i> , MDPI Books, 2024. 2. Lin Hui, Ching-Hsien Hsu & Somchoke Ruengittinun — <i>Ubi-Media Computing, Pervasive Systems, Algorithms and Networks (I-SPAN 2025)</i> , Springer, 2025								
References:								
1. Stefan Poslad, <i>Ubiquitous Computing: Smart Devices, Environments and Interactions</i> , Wiley. 2. FreeRTOS Documentation – https://www.freertos.org 3. Raspberry Pi and Arduino Official Guides								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3		K4	K3				K3	K5	K2	K3
CO1	K1	3	2	3									3		
CO2	K2	3	2	3									2	2	
CO3	K2	3	2	3									2		
CO4	K4	3	2	3				3					3	3	
CO5	K4	3	2	3									3		
CO6	K3	3	2	3									3	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV38		MULTI PROGRAMMING			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:		Computer Organization, Basic Programming in C/C++						
Aim:	To introduce students to the principles and practices of multiprogramming at the application level. The course emphasizes concurrency, real-time task handling, and performance optimization in modern systems.							
Course Outcomes: At the end of the course, the students will be able to								
CO1:	Distinguish between single-tasking, multitasking, and multiprogramming environments.							
CO2:	Develop concurrent applications using threading libraries and multiprocessing APIs.							
CO3:	Model and simulate multiprogramming in real-time and embedded systems.							
CO4:	Analyze performance of multi programmed systems with profiling tools.							
CO5:	Implement solutions for concurrency issues like race conditions and starvation at the application level.							
CO6:	Apply multiprogramming techniques to build concurrent applications on real-time and embedded platforms using appropriate tools and frameworks.							
UNIT I: FUNDAMENTALS OF MULTIPROGRAMMING								9
History and evolution of multiprogramming, Differences: Multiprogramming vs Multitasking vs Multiprocessing, Hardware requirements and support overview, Multiprogramming models: Cooperative and Preemptive, concurrency at application level, Basics of thread lifecycle and execution flow								
UNIT II: PROGRAMMING FOR CONCURRENCY								9
Concurrent programming using pthreads in C/C++, Introduction to Open MP for parallel tasks, Task parallelism vs Data parallelism, Language-level concurrency: async/await (JavaScript/C, Goroutines (Go), Coroutines (Python))								
UNIT III: USER-SPACE SYNCHRONIZATION TECHNIQUES								9
Locks, Mutexes, and Condition Variables in user-space, Spinlocks, Barriers, and atomic operations, Reader-writer logic without OS-level primitives, Application-layer deadlock scenarios and solutions, Synchronization patterns and best practices								
UNIT IV: MULTIPROGRAMMING IN EMBEDDED AND REAL-TIME SYSTEMS								9
Deterministic scheduling and task deadlines, Real-time task models: periodic, aperiodic, and sporadic, Resource access protocols: Priority Inheritance, Ceiling Protocol, Introduction to Embedded C, Case: RTOS-based multitasking with real examples (e.g., FreeRTOS)								
UNIT V: TUNING AND PRACTICAL PERFORMANCE APPLICATIONS								9
CPU and memory profiling tools: gprof, Valgrind, etc., Identifying and addressing concurrency bottlenecks, Optimization strategies for performance, Mini-project: Simulation of a multi programmed system, Real-world case studies: Robotics control systems, Game loop concurrency, Media player pipelines, Raspberry Pi/Arduino-based concurrent control								
Total Periods:								45
Text Book:								
1. David R. Butenhof, “ Programming with POSIX Threads ”, Addison-Wesley, 1997. 2. Anthony Williams, “ C++ Concurrency in Action ”, Manning Publications, 2/e., 2019. 3. Maurice Herlihy & Nir Shavit, “ The Art of Multiprocessor Programming ”, Morgan Kaufmann, 2012.								

References:	
1. OpenMP® Application Programming Interface (latest spec) - https://www.openmp.org/specifications/ 2. FreeRTOS Documentation & API Reference – https://www.freertos.org/ 3. gprof User's Guide - GNU Project, https://sourceware.org/binutils/docs/gprof/ 4. Valgrind Manual – https://valgrind.org/docs/manual/	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1		3	2	3									3		
CO2		3	2	3									2	2	
CO3		3	2	3									2		
CO4		3	2	3									3	3	3
CO5		3	2	3									3		
CO6		3	2	3									3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

VERTICAL IV – FULL STACK DEVELOPMENT

S. No.	Category	Course Code	Course Title	Vertical Coordinator	Course Designer
1.	PE	231CSV41	Visual and Interaction Design	K.Manikandan & M.Giridhar	M.Giridhar
2	PE	231CSV42	Web Designing using HTML and CSS		P. Velayutha Perumal
3	PE	231CSV43	Java Scripts		K.Manikandan
4	PE	231CSV44	Modern Java Script for Web Development		M.Giridhar
5	PE	231CSV45	Framework for Microservices		G.Renuga Devi
6	PE	231CSV46	.NET Programming		M.Uma Maheswari
7	PE	231CSV47	Backend Databases		G.Renuga Devi
8	PE	231CSV48	Web Application Security		R.Kesavan

231CSV41		VISUAL AND INTERACTION DESIGN			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE
Prerequisite:		Web Technology						
Aim:	To equip learners with the skills to create intuitive, user-friendly digital interfaces that enhance user experience.							
Course Outcomes: The Students will be able to								
CO1:	Analyze the difference between UI and UX design and explain the core stages of design thinking, including both divergent and convergent thinking techniques.							
CO2:	Apply visual design principles and UI patterns to develop user-friendly interfaces that are consistent with brand identity.							
CO3:	Identify the UX design process and methodologies, and evaluate the importance of aligning user needs with business goals to drive design decisions.							
CO4:	Create wireframes, prototypes, and high-fidelity mockups using industry-standard tools, and assess them through usability testing to ensure effectiveness and user satisfaction.							
CO5:	Apply information architecture principles to design an intuitive and effective user experience.							
CO6:	Develop UI/UX concepts, research, ideation, and design strategies to solve real-world design challenges through an iterative process.							
FOUNDATIONS OF DESIGN								9
UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy.								
FOUNDATIONS OF UI DESIGN								9
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides.								
FOUNDATIONS OF UX DESIGN								9
Introduction to User Experience - Why You Should Care about User Experience – Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.								
WIREFRAMING, PROTOTYPING AND TESTING								9
Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing– CreatingWireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.								
RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE								9
Identifying and Writing Problem Statements - Identifying Appropriate Research Methods – Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams – Flow Mapping - Information Architecture.								
Total Periods:								45
Text Book:								
1.Joel Marsh, “UX for Beginners”, O’Reilly , 2022								

2. Jon Yablonski, “*Laws of UX using Psychology to Design Better Product & Services*” O’Reilly 2021

References:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “*Designing Interface*” 3 rd Edition , O’Reilly 2020
2. Steve Schoger, Adam Wathan “*Refactoring UI*”, 2018.
3. Steve Krug, “*Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile*”, Third Edition, 2015
4. <https://www.nngroup.com/articles/>
5. https://www.interaction-design.org/literature._

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K2	2	3	2	2								1	3	2
CO3	K3	3	3	3	3								1	3	3
CO4	K2	2	3	2	2	2							1	3	2
CO5	K2	2	3	2	2	2						2	1	3	2
CO6	K2	2	3	2	2							2	1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV42		WEB DESIGNING USING HTML AND CSS				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE	
Prerequisite:		Nil							
Aim:	To provide students with the foundational knowledge and practical skills necessary to design and develop visually appealing, user-friendly, and responsive websites using HTML and CSS, thereby enabling them to structure content effectively and apply styling principles in accordance with modern web standards.								
Course Outcomes: The Students will be able to									
CO1:	Construct a basic website using HTML and Cascading Style Sheets								
CO2:	Develop dynamic web pages with validation using JavaScript objects and implement various event handling mechanisms.								
CO3:	Create server-side functionalities using Servlets and JavaServer Pages (JSP).								
CO4:	Build web pages using PHP and structure data using XML format.								
CO5:	Design interactive and responsive web applications focusing on effective UI/UX principles using contemporary development tools and frameworks.								
CO6:	Apply modern web technologies such as AngularJS, Firebase, Docker, Node.js, React, and Django to design and develop responsive web applications.								
WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0									9
Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap Framework									
CLIENT SIDE PROGRAMMING									9
Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation-Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.									
SERVER SIDE PROGRAMMING									9
Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.									
PHP and XML									9
An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL ,									
INTRODUCTION TO ANGULAR and WEB APPLICATIONS FRAMEWORKS									9
Introduction to AngularJS, MVC Architecture, Understanding attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- Django- UI & UX.									
Total Periods:									45
Text Book:									
1. Deitel and Deitel and Nieto, “Internet and World Wide Web - How to Program”, Prentice Hall, 5 th Edition, 2011.									

2. Jeffrey C and Jackson, “Web Technologies A Computer Science Perspective”, Pearson Education, 2011.
3. Angular 6 for Enterprise-Ready Web Applications, DoguhanUluca, 1st edition, Packt Publishing

References:

1. Stephen Wynkoop and John Burke “Running a Perfect Website”, QUE, 2nd Edition, 1999.
2. Chris Bates, “Web Programming – Building Intranet Applications”, 3rd Edition, Wiley Publications, 2009.
3. Gopalan N.P. and Akilandeswari J., “Web Technology”, Prentice Hall of India, 2011.
4. UttamK.Roy, “Web Technologies”, Oxford University Press, 2011.
5. Angular: Up and Running: Learning Angular, Step by Step, ShyamSeshadri, 1st edition, O'Reilly

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K3	3	3	3	3								1	3	3
CO3	K2	3	3	3	3								1	3	3
CO4	K3	3	3	3	3								1	3	3
CO5	K3	3	3	3	3								1	3	3
CO6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV43		JAVA SCRIPTS				L	T	P	C
						3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:		PE	
Prerequisite:	Web Technology								
Aim:	To equip students with a solid understanding of JavaScript programming language fundamentals and modern features, enabling them to develop dynamic, interactive, and responsive web applications.								
Course Outcomes: The Students will be able to									
CO1:	Demonstrate the basic JavaScript syntax, variables, data types, and control structures to write functional code.								
CO2:	Construct JavaScript arrays, objects, and their methods to organize and process data effectively.								
CO3:	Apply object-oriented programming principles using classes and prototypes to design reusable and maintainable code.								
CO4:	Classify asynchronous programming concepts and manage asynchronous tasks with promises, async/await, and callbacks to ensure non-blocking code execution.								
CO5:	Apply modern JavaScript features ES6+ syntax, arrow functions, destructuring to write more concise and efficient code.								
CO6:	Utilize modern development tools such as NPM, bundlers, and task runners to streamline the development process and optimize the performance of applications.								
JAVASCRIPT FUNDAMENTALS									9
Introduction to Java Script- Setting up the environment- Variables- Data Types- Operators- Conditional Statements- Loops- Functions- Basic DOM Introduction.									
INTERMEDIATE JAVASCRIPT & THE DOM									9
Arrays and Array Methods- Objects and Object Methods- Destructuring and Spread/Rest syntax- Template Literals- Scope and Closures- Selecting/manipulating elements- Event Handling- Forms and validation- Basic JavaScript debugging- JSON and localStorage/session Storage									
ADVANCED JAVASCRIPT CONCEPTS									9
Execution Context and Call Stack-Hoisting-Closures-this keyword -Prototypes and Inheritance- ES6+ Classes-Modules-Error Handling-Regular Expressions -Timers									
ASYNCHRONOUS JAVASCRIPT									9
Callbacks and Callback Hell-Promises-async / await-Fetch API and handling responses-Axios (optional)-Error Handling in async code-Chaining Promises-Working with external APIs									
JAVASCRIPT IN PRACTICE & MODERN TOOLS									9
JavaScript Best Practices (clean code, naming, organization)-Project Structure and Modularization- NPM and using packages-. Net programming Webpack / Vite (basic bundling)-ESLint and Prettier-Introduction to TypeScript (optional)-Unit Testing with Jest or Vitest-Building Projects: To-Do List,Weather App,Quiz App,Calculator									
Total Periods:									45
Text Book:									
1. David Flanagan, ‘JavaScript: The Definitive Guide’, 7th Edition 2020. 2. Kyle Simpson, ‘You Don’t Know JS Yet: Scope & Closures’, 1st Edition 2020.									

References:	
1.Stoyan Stefanov, ‘ <i>JavaScript Patterns</i> ’, 1st Edition 2010. 2.Nicholas C. Zakas, ‘ <i>Professional JavaScript for Web Developers</i> ’, 4th Edition 2019. 3. https://www.w3schools.com/js/ 4. https://developer.mozilla.org/en-US/docs/Web/JavaScript	

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	2	3	1							2	2	3	2
CO2	K3	2	2	3	2							2	2	3	3
CO3	K3	3	2	3	2							2	2	3	3
CO4	K2	3	2	2	2							2	3	3	2
CO5	K3	3	2	2	1							2	3	3	3
CO6	K3	3	2	2	1							2	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV44		MODERN JAVASCRIPT FOR WEB DEVELOPMENT			L	T	P	C	
					3	0	0	3	
Programme:		B.E. Computer Science and Engineering			Sem:	-	Category:		PE
Prerequisite:		Web Technology							
Aim:		To develop the ability to design, develop, and deploy modern web applications following best practices and current industry standards.							
Course Outcomes: The Students will be able to									
CO1:		Classify the fundamentals of both front-end and back-end web development, including the roles and technologies involved in building complete web applications.							
CO2:		Build scalable server-side applications using Node.js, integrating RESTful APIs, asynchronous operations, and database connectivity.							
CO3:		Develop dynamic single-page web applications using AngularJS with data binding, dependency injection, and directives for responsive UI design.							
CO4:		Apply Express.js to build robust and scalable web applications with efficient routing, middleware handling, and server-side logic.							
CO5:		Develop and integrate RESTful APIs using Express.js to enable seamless communication between client and server components.							
CO6:		Construct interactive, component-based user interfaces using React, effectively managing state, props, and lifecycle methods or hooks.							
BASICS OF FULL STACK									9
Understanding the basic web development framework, User, browser, webserver, and backend services, MVC architecture. Role of Express, Angular, Node and React.									
NODE.JS									9
Basics of Node.js and installation, working with Node packages using npm. Creating a simple Node.js application, Using events, listeners, timers, and callbacks. Handling data I/O. Implementing HTTP services in Node.js.									
ANGULAR JS									9
Introduction to AngularJS, AngularJS Architecture, Working with Directives, Data Binding, Controllers and Scope, Forms and Validation.									
EXPRESS JS									9
Implementing Express in Node.js, Configuring routes, Using request and response objects, Angular basics: TypeScript, components, expressions, data binding, and built-in directives.									
REACT									9
MERN stack overview- Basic React applications, React components and state, Express REST APIs, Modularization and Webpack. Routing with React Router.									
Total Periods:									45
Text Book:									
1. Brad Dayley, Brendan Dayley, Caleb Dayley, Node.js, MongoDB, and Angular Web Development, Addison-Wesley, 2nd Edition, 2018. 2. Vasan Subramanian, Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Apress, 2nd Edition, 2019.									
References:									
1. Brown, Ethan. <i>Web Development with Node and Express</i> . O'Reilly Media, 2019. 2. Choi, David, “ <i>Full-Stack React, TypeScript, and Node</i> ” O'Reilly Media, 2020.									

3. Casciaro, Mario, “*Node.js Design Patterns*”, Packt Publishing, 2014.
 4. Mead, Andrew, “*Learning Node.js Development*”, O'Reilly Media, 2017.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K2	3	2	2	1								3	3	
CO2	K2	2	3	2	1								2	3	
CO3	K3	2	2	1	3								3	2	
CO4	K3	1	1	2	2								2	1	
CO5	K3	3	2	3	2							2	2	3	3
CO6	K3	3	2	3	2							2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV45		FRAMEWORKS FOR MICROSERVICES			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE
Prerequisite:		NIL						
Aim:	To equip students with the knowledge and skills to design, develop, secure, and deploy scalable microservices-based applications using modern tools and frameworks.							
Course Outcomes: The Students will be able to								
CO1:	Define and explain the characteristics and challenges of microservices architecture.							
CO2:	Apply microservices decomposition strategies and frameworks like Spring Boot, FastAPI in system design.							
CO3:	Construct inter-service communication and configuration using REST, gRPC, Kafka, and Consul							
CO4:	Analyze security, testing, and observability techniques in microservices environments.							
CO5:	Build and deploy containerized microservices using Docker and Kubernetes.							
CO6:	Design a CI/CD pipeline and deploy a complete microservices application as a capstone project.							
INTRODUCTION TO MICROSERVICES ARCHITECTURE								9
Definition and characteristics of microservices- Comparison with monolithic architecture- Principles of microservices: scalability, autonomy, decentralized data management- Use cases and industry adoption- Challenges in microservices								
Microservices Design and Frameworks								9
Microservices decomposition strategies- Domain-Driven Design (DDD) and Bounded Context- Overview of frameworks: Spring Boot, Spring Cloud, FastAPI, ASP.NET Core- REST API development using microservices frameworks- Service registration and discovery: Eureka, Consul								
Infrastructure & Communication								9
Configuration management (Spring Cloud Config, Consul)- Inter-service communication: REST, gRPC, Message Brokers (Kafka, RabbitMQ)- API Gateway pattern: Introduction and implementation- Load balancing and client-side/server-side discovery								
Security, Testing, and Observability								9
Security in microservices: OAuth2, JWT, API Gateway security- Testing strategies: Unit, Integration, Contract testing (Pact)- Logging and Monitoring: ELK Stack, Prometheus, Grafana- Distributed tracing: Zipkin, Jaeger								
Containerization and Orchestration								9
Docker basics and Dockerizing microservices- Docker Compose for local environments- Introduction to Kubernetes: Pods, Deployments, Services- CI/CD pipelines for microservices- Capstone: Deploying a sample microservices application to Kubernetes								
Total Periods:								45
Text Book:								
1. "Building Microservices: Designing Fine-Grained Systems", Sam Newman ,2nd Edition,2021 2. “Microservices Patterns: With Examples in Java”, Chris Richardson, First Edition,2018								
References:								
1. https://dotnet.microsoft.com/en-us/learn/dotnet/architecture-guides 2. https://spring.io/projects/spring-cloud 3. https://fastapi.tiangolo.com/								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K3	2	3	3	1							2	2	3	
CO2	K3	2	3	3	2							2	2	3	
CO3	K2	3	2	3	2							2	2	3	
CO4	K3	1	2	2	2							2	3	3	
CO5	K3	3	2	2	1							2	3	3	
CO6	K3	3	3	2	1							2	3	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV46		.NET PROGRAMMING			L	T	P	C
					3	0	0	3
Programme:		B.E Computer Science and Engineering		Sem:	-	Category:		PE
Prerequisite:		-						
Aim:	To study about the .NET framework tools and various types of .NET programming							
Course Outcomes: After Successful completion of the course, students will be able to								
CO1:	Recall the fundamentals of the .NET Framework, its history, CLR, assemblies, namespaces, and NuGet.							
CO2:	Outline the concepts of Visual Basic .NET (VB.NET), and design and implement database connectivity							
CO3:	Develop Windows Forms applications with various controls, event handling, and interactive UI components.							
CO4:	Build and manage ASP.NET applications using web controls, AJAX, and data-binding techniques.							
CO5:	Develop expertise in ADO.NET by exploring data access and manipulation, applying data operations, and constructing and executing data-binding techniques in web applications.							
CO6:	Create database-driven ASP.NET web applications using data display and source controls, and manage data connectivity and binding.							
INTRODUCTION TO .NET PROGRAMMING								9
Overview of .NET Framework - Introduction to .NET, History of .NET, Key Features of .NET Framework, Development Tools and IDE, Understanding the .NET Ecosystem: CLR (Common Language Runtime), .NET Standard vs. .NET Core vs. .NET Framework: Platform targeting in .NET Core and .NET 5+, Assemblies and Namespaces, Introduction to NuGet								
VISUAL BASIC.NET								9
Introduction: Data Types, Operators, Arrays, Dynamic Arrays, String Handling, Classes and Objects: Defining Classes and Objects, Access Modifiers , Inheritance and Polymorphism, Interfaces and Abstract Classes, Exception Handling: Try-Catch-Finally Block, Error Logging, connecting to a Database: Establishing Database Connection, Retrieving and Displaying Data, Updating Data in the Database								
WINDOWS CONTROLS								9
Introduction: Buttons, Checkbox, Radio Buttons, Panel, List Boxes, Combo Boxes, Scrollbars, Splitters, Track Bars, Pickers, Notify Icons, Timers, Menus, Event Handling in Windows Forms: Introduction to Events ,Delegates and Event Handlers, Tree and List View: Toolbars, Status Bars, Progress Bars, Tab Controls, Debugging and Error Handling: Types of Errors, Exceptions and Structured Exception Handling								
ASP.NET								9
ASP.NET 10. Introduction: File Types, Importing Namespaces,The Page Class, Http Request, Http Response, Server Utility, Basic Web Controls: List Controls, Validation and Rich Controls, Data Controls, Custom Controls, Overview of AJAX Controls, Data Binding: Introduction, Simple Data Binding, Complex Data Binding, Implementing Data Binding								
ADO.NET & DATA BINDING								9
Accessing Data using ADO.NET, SQL Statements, working with ADO.NET, Overview of ADO.NET Objects Data Grid View Control, Accessing Data using Server Explorer, creating a new data connection, accessing data using data adaptors and data sets, previewing data from data adaptors Connecting to an MS Jet database, Accessing data with server explorer, Creating a web applications using data display controls								
Total Periods:								45

Text Book:	
	1. Mastering .NET Framework: Comprehensive Guide to Software Development by Asha Sohal and Ramesh Kait (2024) 2. Karli Watson, Christian Nagel, Jacob Hammer Pedersen, Jon Reid, and Morgan Skinner, BEGINNING VISUAL C# 2015, Wiley Publishing, Inc
References:	
	1. Stephen C. Perry, Core C# and .NET, Pearson Education, 2006. 2. Herbert Scheldt, C#: The Complete Reference, TATA McGraw Hill Publishing. 3. Kevin Hoffman, Microsoft Visual C# 2005 Unleashed, Sams Pearson India

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K1	3		1									3	2	
CO2	K2	3	2	3	3										
CO3	K1	3	2	2	2										
CO4	K4	3	3	3	3							2	2	2	
CO5	K2	3	3	2								1	3	2	3
CO6	K2	3	2	3	3							3	3	2	3

231CSV47		DATABASE TECHNOLOGIES			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE
Prerequisite:		Database Management Systems						
Aim:		To equip students with the knowledge and skills to model, query, and manage data using advanced relational and NoSQL databases for modern applications.						
Course Outcomes: The Students will be able to								
CO1:		Relate the installation, configuration, and administration of Mongo DB databases and user accounts..						
CO2:		Demonstrate connecting and manipulating Mongo DB databases using Node.js backend applications.						
CO3:		Apply Mongo DB operations and query patterns in Python applications, including geospatial data						
CO4:		Analyze the role of Mongo DB in modern web applications and perform CRUD operations via backend						
CO5:		Design and develop full-stack web applications integrating Mongo DB with React for dynamic frontend						
CO6:		Develop authentication and authorization mechanisms to secure Mongo DB-connected web applications.						
DATABASE AND USER MANAGEMENT IN MONGO DB								9
Installing Mongo DB-Starting Mongo DB-Stopping Mongo DB-Accessing Mongo DB from the Shell Client-Administering User Accounts-Listing Users-Creating User Accounts-Removing Users-Configuring Access Control-Administering Databases-Displaying a List of Databases-Changing the Current Database-Creating Databases-Deleting Databases-Copying Databases-Managing Collections.								
Database Access and Manipulation Using Node.js and Mongo DB								9
Adding the Mongo DB Driver to Node.js-Connecting to Mongo DB from Node.js-Understanding the Objects Used in the Mongo DB Node.js Driver-Accessing and Manipulating Databases-Accessing and Manipulating Collections-Manipulating Mongo DB Documents from Node.js-Accessing Mongo DB from Node.js..								
INTERFACING MONGO DB WITH PYTHON APPLICATIONS								9
Connecting to Mongo DB with Python- Getting a Database Handle- Inserting a Document into a Collection- Introduction to Mongo DB Query Language- Common MongoDB and Python Patterns- A Uniquely Document-Oriented Pattern: Embedding- Location-based Apps with Mongo DB: GeoSpatial Indexing.								
MONGO DB FUNDAMENTALS FOR WEB APPLICATIONS								9
Overview of Mongo DB as a NoSQL document database- Role of Mongo DB in modern web application- Benefits of using Mongo DB for web development- Installing Mongo DB (local and cloud options)- Connecting Web Applications to Mongo DB-Establishing a database connection from backend code- Managing connection strings (local vs. cloud)- CRUD Operations in Web Apps- Data Modeling and Patterns.								
BUILDING WEB APPLICATIONS WITH MONGO DB AND REACT								9
Overview of Mongo DB as a NoSQL document dataaset-Introduction to React library and component-based UI-Benefits of combining Mongo DB with React in modern web apps-Setting up								

React environment using Create React App-Connecting React to Mongo DB via REST API-Creating, reading, updating, and deleting documents-React forms and state management for data input-Displaying data fetched from Mongo DB in React components-Designing Mongoose schemas-Embedding vs referencing documents for React apps-Authentication and Authorization.	
Total Periods: 45	
Text Book:	
1. MongoDB Fundamentals, Amit Phaltankar, Juned Ahsan, Michael Harrison, Liviu Nedov, Packt Publishing. 2. Get Programming with Node.js, Jonathan Wexler, 2017. 3. MongoDB and Python, Niall O'Higgins, September 2011.	
References:	
1. http://www.mongodb.org/display/DOCS/Manual . 2. https://www.amazon.com/Pro-MERN-Stack-Development-Express/dp/1484243900	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K3	2	3	3	1							2	2	3	
CO2	K3	2	3	3	2							2	2	3	
CO3	K2	3	2	3	2							2	2	3	
CO4	K3	1	2	2	2							2	3	3	
CO5	K3	3	2	2	1							2	3	3	
CO6	K3	3	3	2	1							2	3	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV48		WEB APPLICATION SECURITY			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE
Prerequisite:		-						
Aim:	To equip students with the knowledge and skills necessary to identify, analyze, and mitigate security vulnerabilities in web applications, ensuring the development of secure, resilient, and trustworthy web-based systems by applying best practices, secure coding techniques, and industry-standard security frameworks.							
Course Outcomes: The Students will be able to								
CO1:	Gain the skills to identify and mitigate web application security threats, implement secure authentication, authorization, SSL/TLS, session management, and input validation techniques.							
CO2:	Learn to apply security testing, incident response planning, and industry frameworks like Microsoft SDL, OWASP CLASP, and SAMM to enhance web application security.							
CO3:	Implement session cookies, token-based authentication, encryption, rate limiting, OAuth2, and threat analysis to secure APIs and microservices for service-to-service and incoming API requests							
CO4:	To learn the basics of vulnerability assessment and penetration testing							
CO5:	Identify, evaluate, and mitigate security risks across diverse environments, demonstrating proficiency in security practices at a higher cognitive level							
CO6:	To understand the fundamentals of web application security							
FUNDAMENTALS OF WEB APPLICATION SECURITY								9
The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation								
SECURE DEVELOPMENT AND DEPLOYMENT								9
Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)								
SECURE API DEVELOPMENT								9
API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.								
ULNERABILITY ASSESSMENT AND PENETRATION TESTING								9
Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.								
HACKING TECHNIQUES AND TOOLS ARCHITECTURE								9
Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.								
Total Periods:								45
Text Book:								

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

References:

1. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams
6. Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K2	3	3			3				3			3	2	
CO2	K3	3		3		2				2			3	3	
CO3	K1	3	3	3						2	1		3	2	1
CO4	K1	3	3		2					1			3	1	
CO5	K1	3	3		1	2				1			3	1	
CO6	K1	3	3		1	2				1			3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)



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 An ISO 9001:2015 Certified Institution



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

UG REGULATION – 2023
CHOICE BASED CREDIT SYSTEM
CURRICULUM [V – VIII SEMESTERS and VERTICALS FULL-TIME] (Candidates admitted from 2023–2024 onwards)
Total Credits: 164

VERTICAL V – ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TECHNOLOGIES

COURSE DESIGNER FOR VERTICAL V

S. No.	Course Code	Course Title	Category	Vertical Coordinator	Course Designer
1.	231CSV51	Optimization Techniques for Machine Learning	PE	Ms J Janorious Hermia	Ms.V.G.Saranyavaishalini
2.	231CSV52	Ethics In Intelligent Systems	PE		Ms.V.G.Saranyavaishalini
3.	231CSV53	Soft Computing	PE		Dr.S.Singaravelan
4.	231CSV54	Computational Linguistics	PE		Ms.V.Maheswari
5.	231CSV55	Computer Vision	PE		Ms.M.Jayapriya
6.	231CSV56	ML Model Deployment and MLOps	PE		Ms J Janorious Hermia
7.	231CSV57	Healthtech Artificial Intelligence	PE		Ms.V.Maheswari
8.	231CSV58	Trustworthy and Generative Artificial Intelligence	PE		Ms.J Janorious Hermia



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

UG REGULATION – 2023 CHOICE BASED CREDIT SYSTEM
CURRICULUM [V – VIII SEMESTERS and VERTICALS FULL-TIME] (Candidates admitted from 2023–2024 onwards)
Total Credits: 164

VERTICAL V – ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TECHNOLOGIES

COURSE DESIGNER FOR VERTICAL V

S. No.	Course Code	Course Title	Category	Vertical Coordinator	Course Designer
1.	231CSV51	Optimization Techniques for Machine Learning	PE	Ms J Janorious Hermia	Ms.V.G.Saranyavaishalini
2.	231CSV52	Ethics In Intelligent Systems	PE		Ms.V.G.Saranyavaishalini
3.	231CSV53	Soft Computing Techniques	PE		Dr.S.Singaravelan
4.	231CSV54	Computational Linguistics	PE		Ms.V.Maheswari
5.	231CSV55	Computer Vision	PE		Ms.M.Jayapriya
6.	231CSV56	ML Model Deployment and MLOps	PE		Ms J Janorious Hermia
7.	231CSV57	Healthtech Artificial Intelligence	PE		Ms.V.Maheswari
8.	231CSV58	Trustworthy and Generative Artificial Intelligence	PE		Ms.J Janorious Hermia

231CSV51		OPTIMIZATION TECHNIQUES FOR MACHINE LEARNING			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-		Category:	PE
Aim:		To provide insight to the mathematical formulation of real-world problems.						
Course Outcomes: The Students will be able to								
CO1:		Identify various optimization techniques and their uses.						
CO2:		Demonstrate the right optimization tool for a given task.						
CO3:		Infer correct objective functions and constraints for different optimization scenarios.						
CO4:		Apply the methods of optimization in real life situation.						
CO5:		Solve problems under Markovian queuing models.						
CO6:		Use appropriate multivariable optimization methods for complex systems.						
OPTIMIZATION AND TECHNIQUES								9
Introduction of Operations Research - mathematical formulation of LPP, Engineering application of Optimization, Formulation of design problems as mathematical programming problems, Single variable optimization, Lagrange’s method of multipliers.								
LINEAR PROGRAMMING								9
Standard form of a linear programming problem, Simplex method, Duality in linear programming, Quadratic programming, Stochastic linear programming, Relevant applications, Traveling salesman problem.								
OPTIMIZATION PROBLEM AND DESIGN								9
Design variable - Constraints-Objective Function-variable Bounds- Unconstrained problems – necessary and sufficient conditions - Newton- Raphson method, Constrained problems – equality constraints – inequality constraints - Kuhn-Tucker conditions.								
QUEUING MODELS								9
Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels.								
MULTIVARIABLE OPTIMIZATION TECHS								9
Optimality Criteria ,Unidirectional Search , Direct Search Methods - Box’s Evolutionary Optimization Method - Simplex Search Method - Hooke-Jeeves Pattern Search Method - Powell’s Conjugate Direction Method ,Gradient-based Methods- Cauchy’s (Steepest Descent) Method-Newton’s Method- Marquardt’s Method.								
Total Hours								45
Text Book:								
1. Rao, S. S., & Rao, S. S., Engineering optimization: theory and practice. John Wiley & Sons ,5th edition version was released in 2023								
Reference Book:								
1. Hadley, G., Linear programming, Narosa Publishing house. 2002								
2. Kalyanmoy Deb, “Optimization for Engineering Design - Algorithms and Examples”, Prentice Hall of India, 1995.								
3. Taha, H. A., Operations research: An introduction. Pearson Education India. 2019.								
4. Deb. K, Optimization for engineering design: Algorithms and examples. PHI LearningPvt. Ltd. 2021.								
5. Kumar, D. N., Multicriterion analysis in engineering and management. PHI LearningPvt. Ltd. 2010.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K4							K4	K6	K4	K2
CO1	K2	2	3	2	2								1	2	3
CO2	K2	2	3	2	2								1	2	3
CO3	K2	2	3	2	2								1	2	3
CO4	K3	3	3	3	2							2	1	2	3
CO5	K3	3	3	3	2								1	2	3
CO6	K3	3	3	3	2								1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV52		ETHICS IN INTELLIGENT SYSTEMS				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE	
Aim:		To provide insight to the mathematical formulation of real-world problems.							
Course Outcomes: The Students will be able to									
CO1:		Recall the fundamental concepts of ethics in computing and digital systems.							
CO2:		Infer the act responsibly and ethically within IT teams.							
CO3:		Apply the code of ethics for software development.							
CO4:		Use ethical guidelines during software .							
CO5:		Identify and follow legal guidelines for respecting intellectual property.							
CO6:		Apply privacy related laws and regulation to enlighten the legal constraints.							
INTRODUCTION TO ETHICS									9
Introduction- Overview of Ethical Theories - Subjective Relativism –Professional Ethics –Ethics in Business World - Ethics in Information Technology - Ethics for IT Workers and IT users									
CORPORATE ETHICS IN IT MANAGEMENT									9
Key Ethical Issues for Organizations-Contingent Workers-H-1B Workers-Application Process - outsourcing-offshore outsourcing-pros and cons-strategies-Whistle Blowing-Protection for whistle blowers and Private sector Workers Green Computing									
SOFTWARE SOLUTIONS DEVELOPMENT									9
Legal perspective-Licensing-Selling software-selling buying –Torts-Strategies for engineering Quality Software-Software Product Liability-Key issues in software development –Impact of IT on productivity and quality of life.									
Intellectual Property									9
Intellectual Property Rights – types - Benefits of Intellectual Property Protection - Limits to Intellectual Property Protection - Protecting Intellectual Property - Fair Use - Digital Recording Technology - Audio Home Recording Act-Diamond Multimedia- Google Books- New Restrictions on Use and their rights.									
PRIVACY AND POLICY									9
Privacy Protection and the Law - Key Privacy and Anonymity issues - Identity Theft - Electronic Discovery – Consumer Profiling - Treating Consumer Data Responsibility - Workplace Monitoring.									
						Total Hours		45	
Text Book:									
1. George_Reynolds,” Ethics in Information Technology”, Cengage Learning, 6th edition 2019									
Reference Book:									
1. Michael J. Quinn ,”Ethics for the Information Age”, Pearson Edu, Fifth Edition, 2012									
2. Lee, Wanbil W., Information Security Management: Semi-intelligent Risk-analytic Audit, Verlag Dr Muller, 2010									
3. Deborah G.Johnson ,”Computer Ethics”,Pearson,4th Edition ,2009									
4. Kallman, E.A. & Grillo, J.P,” Ethical Decision Making and Information Technology”, McGraw-Hill, Second									
5. Edition,2006									

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K4			K2					K6	K4	K2
CO1	K1	1	2	1	1			1						2	1
CO2	K1	1	2	1	1			1						2	1
CO3	K3	3	3	3	2			2					1	2	3
CO4	K3	3	3	3	2			2				2	1	2	3
CO5	K2	2	3	2	2			2				2	1	1	3
CO6	K3	3	3	3	2			2					1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV53		SOFT COMPUTING TECHNIQUES			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:		AI & ML						
Aim:	To equip students with foundational and advanced knowledge of soft computing techniques such as fuzzy logic, neural networks, and genetic algorithms.							
Course Outcomes: The Students will be able to								
CO1:	Explore the fundamentals of fuzzy logic operators and inference mechanisms.							
CO2:	Outline neural network architecture for AI applications such as classification and clustering.							
CO3:	Relate the functionality of Genetic Algorithms in Optimization problems.							
CO4:	Identify hybrid techniques involving Neural networks and Fuzzy logic							
CO5:	Analyze the functionality of Neuro-Fuzzy adaptive networks analysis							
CO6:	Apply soft computing techniques in real world applications.							
INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC								9
Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems								
NEURAL NETWORKS								9
Supervised Learning Neural Networks – Perceptrons - Backpropagation -Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks								
GENETIC ALGORITHMS								9
Chromosome Encoding Schemes -Population initialization and selection methods - Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function								
NEURO FUZZY MODELING								9
ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum - Analysis of Adaptive Learning Capability								
APPLICATIONS								9
Modeling a two input sine function - Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction.								
Total Periods:								45
Text Book:								
1. JANG, J.-S. R., SUN, C.-T., & MIZUTANI, E., Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Pearson Education, 2015. 2. Himanshu Singh , Yunis Ahmad Lone , Deep Neuro-fuzzy System with Python with Case Studies and Applications form the Industry,Apress,2020.								
References:								

1. Roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
3. Samir Roy, UditChakraborty, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
4. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K4	K3						K4	K6	K4	K2
CO1	K2	2	3	2	2							2	1	2	3
CO2	K2	2	3	2	2							2	1	2	3
CO3	K2	2	3	2	2							2	1	2	3
CO4	K3	3	2	3	2							2	1	2	2
CO5	K2	2	3	2	2							2	1	2	3
CO6	K3	3	2	3	2	2						2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV54		COMPUTATIONAL INTELLIGENCE			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:		Machine Learning / Deep Learning						
Aim:	This course equips learners with foundational NLP knowledge, including formal grammar models (CFG, PCFG), the nuances of sentence meaning (semantics and pragmatics), and the principles of speech processing (analysis and modeling).							
Course Outcomes: The Students will be able to								
CO1:	Understand the fundamentals of natural language processing							
CO2:	Infer CFG and PCFG in NLP							
CO3:	Interpret the role of sentence semantics and pragmatics							
CO4:	Apply speech production and related parameters of speech.							
CO5:	Use the Short Time Fourier Transform (STFT) in speech analysis.							
CO6:	Analyze the application of Linear Predictive Coefficients (LPC) and other coefficients in analyzing speech signals.							
INTRODUCTION AND WORD LEVEL ANALYSIS								9
Origins and challenges of NLP – language modeling: grammar-based and statistical language models – regular expressions, finite-state automata – English morphology, transducers for lexicon and rules, tokenization, detecting and correcting spelling errors, minimum edit distance – unsmoothed n-grams, evaluating n-grams, smoothing, interpolation and back off – word classes, part-of-speech tagging (rule-based, stochastic, transformation-based) – issues in POS tagging – hidden Markov and maximum entropy models.								
SYNTACTIC ANALYSIS								9
Context free grammars, grammar rules for English, treebanks, normal forms for grammar – dependency grammar – syntactic parsing, ambiguity, dynamic programming parsing – shallow parsing – probabilistic CFG, probabilistic CYK, probabilistic lexicalized CFGs – feature structures, unification of feature structures.								
SEMANTICS AND PRAGMATICS								9
Requirements for representation, first-order logic, description logics – syntax-driven semantic analysis, semantic attachments – word senses, relations between senses, thematic roles, selectional restrictions – word sense disambiguation using supervised, dictionary & thesaurus, bootstrapping methods – word similarity using thesaurus and distributional methods.								
BASIC CONCEPTS OF SPEECH PROCESSING								9
Speech fundamentals: articulatory phonetics – production and classification of speech sounds; acoustic phonetics – acoustics of speech production; review of digital signal processing concepts; short-time Fourier transform, filter-bank and LPC methods.								
SPEECH ANALYSIS AND SPEECH MODELING								9
Features, feature extraction and pattern comparison techniques: speech distortion measures – mathematical and perceptual – log-spectral distance, cepstral distances, weighted cepstral distances and filtering, likelihood distortions, spectral distortion using a warped frequency scale, LPC, PLP and MFCC coefficients, time alignment and normalization – dynamic time warping, multiple time-alignment paths – hidden Markov models: Markov processes, HMMs – evaluation, optimal state sequence – Viterbi search, Baum-Welch parameter re-estimation, implementation issues.								
Total Periods:								45

Text Book:

1. Daniel Jurafsky, James H. Martin “*Speech and Language Processing: An Introduction to Natural Language Processing*”, Computational Linguistics and Speech, Pearson Publication, 2023.
2. “*Python for Natural Language Processing*” by Pierre M. Nugues — published in 2024.
3. “*Natural Language Processing: “A Textbook with Python Implementation* by Raymond S. T. Lee — 2nd edition, published 2025
4. “**Python Natural Language Processing Cookbook” - Second Edition** by Zhenya Antić and Saurabh Chakravarty — released **2024**.

References:

1. Frederick Jelinek, “*Statistical Methods Of Speech Recognition*”, MIT Press, 1997.
2. Breck Baldwin, “*Language Processing with Java and LingPipe Cookbook*”, Atlantic Publisher, 2015
3. Richard M Reese, “*Natural Language Processing with Java*”, O’Reilly Media, 2015.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K4							K4	K6	K4	K2
CO1	K2	2	3	2	2							1	2	2	
CO2	K2	2	3	2	2							1	2	2	
CO3	K2	2	3	2	2							1	2	2	
CO4	K3	3	2	3	2							1	2	2	1
CO5	K2	3	3	2	2							1	2	2	1
CO6	K2	3	3	2	2							1	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV55		COMPUTER VISION				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:		Category:		PE
Prerequisites:		-							
Aim:	Students will enable computers and systems to interpret, understand, and make decisions based on visual data (such as images and videos) in a way that mimics human vision.								
Course Outcomes: The Students will be able to									
CO1:	Understand the fundamental image processing techniques required for computer vision.								
CO2:	Outline shape analysis and boundary tracking techniques.								
CO3:	Apply Hough Transform for line, circle, and ellipse detections								
CO4:	Analyze 3D vision techniques and motion related techniques								
CO5:	Develop applications using computer vision techniques								
CO6:	Organize visual data to enable decision-making or automation.								
IMAGE PROCESSING FOUNDATIONS									9
Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.									
SHAPES AND REGIONS									9
Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.									
HOUGH TRANSFORM									9
Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.									
3D VISION AND MOTION									9
Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.									
APPLICATIONS									9
Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.									
Total Periods:									45
Text Book:									

1. **Image Processing Techniques and its Applications in Computer Vision and Artificial Intelligence** — Alauddin, Yalawar, Bharathidasan & Thiagarajan (2024)
2. **3D Computer Vision: Foundations and Advanced Methodologies** — Yu-Jin Zhang (2024)
3. **Advanced Image Processing and Computer Vision** (MDPI Reprint, 2025)

References:

1. **Computer Vision: Algorithms and Applications** by Richard Szeliski — 2nd Edition (2022)
2. **Handbook of Image Processing and Computer Vision** by Arcangelo Distanto & Cosimo Distanto — 1st Edition (2021)

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K4								K6	K4	K2
CO1	K1	1	2	1	1									1	2
CO2	K2	2	3	2	2								1	2	3
CO3	K3	3	3	3	2								1	2	3
CO4	K3	3	3	3	2								1	2	3
CO5	K3	3	3	3	2								1	2	3
CO6	K4	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV56		MLOPS				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:		Category:		PE
Prerequisite:		Machine Learning							
Aim:	To equip learners with essential machine learning concepts, practical programming skills, and MLOps knowledge to build, deploy, and maintain effective ML models in real-world applications.								
Course Outcomes: The Students will be able to									
CO1:	Understand Machine Learning fundamentals and applications.								
CO2:	Apply mathematical principles to implement ML algorithms.								
CO3:	Use Python/R for ML programming and perform data engineering.								
CO4:	Identify models through feature engineering, training, and testing.								
CO5:	Develop MLOps practices: pipeline automation, versioning, CI/CD.								
CO6:	Build ML models using containerization, cloud, and interpretability tools.								
MACHINE LEARNING FUNDAMENTALS									9
Introduction to ML, Types of Learning -Supervised, Unsupervised, Reinforcement, Mathematics for ML-Linear Algebra: Vectors, matrices, operations, Probability & Statistics: Distributions, statistical testing. Calculus: Derivatives, gradients, chain rule, Optimization Basics: Loss functions, gradient descent									
PROGRAMMING AND DATA ENGINEERING									9
Programming Languages-Python: NumPy, pandas, scikit-learn, R basics, Data Engineering -Data collection, ingestion ,Cleaning and preprocessing ,Validation and transformation techniques									
ADVANCED ML TECHNIQUES									9
Model Selection and Architectures-Classification, regression, clustering, Decision trees, SVMs, ensemble methods, Intro to neural networks & deep learning.Feature Engineering- Creation, transformation, selection.Training and Validation-Train/test/validation splits, Cross-validation.Model Evaluation-Accuracy, precision, recall, F1-score, ROC-AUC									
MLOPS FUNDAMENTALS									9
Intro to MLOps-MLOps vs DevOps,Importance in real-world ML.Pipeline Automation- Tools: Airflow, Kubeflow, Automating data & model workflows.Model Management- Experiment tracking (MLflow, DVC),Git-based version control									
DEPLOYMENT, MONITORING, AND CLOUD MLOPS									9
Model Deployment-Batch, real-time, streaming, Tools: Flask, FastAPI, TensorFlow Serving, TorchServe.Monitoring and Logging- Model drift, performance tracking, Dashboards and logging tools.CI/CD for ML- GitHub Actions, Jenkins.Cloud Infrastructure-AWS, GCP, Azure for ML.Containerization and Orchestration- Docker for ML models,Kubernetes for deployment. Interpretability & Retraining- SHAP, LIME, model explainability,Retraining triggers and automation.									
Total Periods:									45
Text Book:									

1. "Introducing MLOps" by Mark Treveil & the Dataiku Team – O'Reilly Media ,2020
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron – O'Reilly , 2022
3. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy – MIT Press,2012

References:

1. "Pattern Recognition and Machine Learning" by Christopher M. Bishop – Springer, 2016

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K4	K3							K6	K4	K2
CO1	K2	2	3	2	2								1	2	3
CO2	K3	3	3	3	2								1	2	3
CO3	K3	3	3	3	2								1	2	3
CO4	K2	2	3	2	2								1	2	3
CO5	K3	3	3	3	2								1	2	3
CO6	K3	3	3	3	2	3							1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV57		ARTIFICIAL INTELLIGENCE IN HEALTHCARE			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:		Artificial intelligence and machine learning						
Aim:	It Aims to equip learners to enhance medical diagnosis, treatment, and patient care through intelligent data analysis and automation.							
Course Outcomes: The Students will be able to								
CO1:	Understand the role of AI and ML for handling healthcare data.							
CO2:	Apply advanced AI algorithms for healthcare problems.							
CO3:	Classify various computational intelligence techniques for healthcare application.							
CO4:	Interpret evaluation matrices for evaluating healthcare systems							
CO5:	Develop NLP applications for healthcare using various NLP techniques.							
CO6:	Construct AI and ML algorithms for building healthcare applications.							
INTRODUCTION								9
Overview of AI and ml multifaceted discipline, application of AI in healthcare-prediction, diagnosis, personalized treatment and behavior modification , drug discovery follow-up care, etc., realizing potential of AI and ml in healthcare and its use cases.								
AI, ML, DEEP LEARNING AND DATA MINING METHODS FOR HEALTHCARE								9
Knowledge discovery and data mining, multi classifier decision fusion, ensemble learning, meta learning and other abstract methods- evolutionary algorithms, illustrative medical application- multi-agent infectious disease propagation and outbreak prediction, automated amblyopia screening system- computational intelligence techniques, deep learning, unsupervised learning, dimensionality reduction algorithms								
EVALUATING LEARNING FOR INTELLIGENCE								9
Model development and workflow, evaluation metrics, parameters and hyper parameters, hyper parameter tuning algorithms, multivariate testing, ethics of intelligence.								
NLP AND INTELLIGENT PERSONAL HEALTH RECORD								9
NLP Task In Medicine, Low Level NLP Components, High Level NLP Components, NLP Methods- Clinical NLP resources and tools, NLP applications in healthcare, model interpretability using explainable AI for NLP applications- guided search for disease information, recommending SCA's- recommending HHP's continuous user monitoring.								
FUTURE OF HEALTHCARE USING AI AND ML								9
Evidence based medicine, personalized medicine, connected medicine, digital health and therapeutics, conversational AI, virtual and augmented reality, block chain for verifying supply chain, patient record access, robot-assisted surgery, smart hospitals- case studies on use of AI and ml for disease risk diagnosis from patient data, augmented reality applications for junior doctors.								
Total Periods:								45
Text Book:								
1. Machine Learning and AI for Healthcare by Arjun Panesar, published by A Press, 2020 2. Medical Applications of Artificial Systems by Arvin Agah, published by CRC Press. 2013								

References:	
1. Ranschaert, Sergey Morozov, Pau – <i>Opportunities, Applications and Risks</i>, Springer. 2019 2. Sergio Consoli, Diego Reforgiato Recupero, Milan Petkovic – <i>Data Science for Healthcare: Methodologies and Applications</i>, Springer. 2019 3. Dac-Nhuong Le, Chung Van Le, Jolanda G. Tromp, Gia Nhu Nguyen – <i>Emerging Technologies for Health and Medicine</i>, Wiley. 2021 4. S. Ceophes, Aeilko H. Zwinderman – <i>Machine Learning in Medicine: Complete Overview</i>, 2020	

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K4							K4	K6	K4	K2
CO1	K2	2	3	2	2							2	1	2	3
CO2	K3	3	3	3	2							2	1	2	3
CO3	K2	2	3	2	2							2	1	2	3
CO4	K3	3	3	3	2							2	1	2	3
CO5	K3	3	3	3	2							2	1	2	3
CO6	K3	3	3	3	2							2	1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV58		GENERATIVE AI			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:		Category:		PE
Prerequisite:		Artificial Intelligence & Deep Learning						
Aim:	To equip learners with the knowledge to build ethical, fair, and robust AI systems, including generative AI, for responsible real-world use.							
Course Outcomes: The Students will be able to								
CO1:	Understand the principles and significance of trustworthy AI, including ethical and regulatory considerations.							
CO2:	Interpret the mitigate bias in datasets and AI systems using fairness and explainability tools.							
CO3:	Outline the architecture and functioning of generative models like VAEs, GANs, and diffusion models.							
CO4:	Identify the risks, impacts, and detection techniques for synthetic media.							
CO5:	Apply responsible AI practices in developing and deploying generative AI systems							
CO6:	Demonstrate the case studies of generative AI tools with respect to ethics, transparency, and trust.							
FOUNDATIONS OF TRUSTWORTHY AI								9
Introduction to Trustworthy AI -Definition and importance, Pillars: Fairness, accountability, transparency, safety, and privacy. Ethics in AI -Ethical frameworks and case studies, Bias in algorithms and data. Regulatory and Legal Aspects -AI governance and global policies (e.g., EU AI Act),Explainability requirements and risk levels								
FAIRNESS, EXPLAINABILITY, AND ROBUSTNESS								9
Fairness in AI Systems -Types of bias (dataset bias, algorithmic bias),Fairness metrics and mitigation strategies. Explainable AI (XAI) -Interpretability vs explainability,Tools and techniques: LIME, SHAP, counterfactual explanations. Robustness and Reliability -Adversarial attacks and defences, Uncertainty quantification								
INTRODUCTION TO GENERATIVE AI								9
Generative Modeling Concepts -Discriminative vs generative models, Applications of generative AI. Types of Generative Models -Variational Autoencoders (VAEs),Generative Adversarial Networks (GANs),Normalizing flows and diffusion models. Evaluation of Generative Models -Inception Score, FID, human evaluation								
RESPONSIBLE DEVELOPMENT AND DEPLOYMENT OF GENERATIVE AI								9
Risks of Generative AI -Deepfakes, misinformation, and intellectual property concerns,Detection and watermarking techniques. Data Governance -Dataset sourcing, licensing, and consent. Human-in-the-Loop and AI Alignment -Incorporating human values in generative AI systems,RLHF (Reinforcement Learning from Human Feedback)								
TRUSTWORTHY AI IN PRACTICE AND CASE STUDIES								9
Auditing and Monitoring AI Systems -Tools for continuous monitoring and compliance,Post-deployment auditing processes. Trust in Generative AI Tools -Case studies: ChatGPT, DALL·E, GitHub Copilot. Emerging Trends and Research -Federated learning, privacy-preserving ML,Multi-modal generative models (e.g., text-to-image, text-to-video),Open challenges and future directions								
Total Periods:								45
Text Book:								

1. "Trustworthy AI" Author: Beena Ammanath Publisher: Wiley, 2022	
2. "Deep Learning with Python" Author: François Chollet Publisher: Manning, 2025	
References:	
1. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" Author: David Foster Publisher: O'Reilly, 2023	

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K4	K3		K2					K6	K4	K2
CO1	K2	2	3	2	2			2					1	2	3
CO2	K2	2	3	2	2	2							1	2	3
CO3	K2	2	3	2	2								1	2	3
CO4	K2	2	3	2	2								1	2	3
CO5	K3	3	3	3	2								1	2	2
CO6	K2	2	3	2	2	2						2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

VERTICAL VI – DATA SCIENCE AND ENGINEERING

S. No.	Category	Course Code	Course Title	Hours / Week			Total Periods	Credits
				L	T	P		
1.	PE	231CSV61	R-Programming	3	0	0	3	3
2	PE	231CSV62	Bio Informatics and Health Data Science	3	0	0	3	3
3	PE	231CSV63	Image and Video Analytics	3	0	0	3	3
4	PE	231CSV64	Business Analytics	3	0	0	3	3
5	PE	231CSV65	Predictive Analytics	3	0	0	3	3
6	PE	231CSV66	Exploratory Data Analysis	3	0	0	3	3
7	PE	231CSV67	Data Visualization Tools	3	0	0	3	3
8	PE	231CSV68	SQL for Data Science	3	0	0	3	3

S. No.	Category	Course Code	Course Title	Vertical Coordinator	Course Designer
1	PE	231CSV61	R-PROGRAMMING	Dr.RN	Ms.M. Uma Maheswari
2	PE	231CSV62	BIO INFORMATICS AND HEALTH DATA SCIENCE		Mr.P. Velayutha Perumal
3	PE	231CSV63	IMAGE AND VIDEO ANALYTICS		Dr.R. Natchadalingam
4	PE	231CSV64	BUSINESS ANALYTICS		Mr.P. Gopi Kannan
5	PE	231CSV65	PREDICTIVE ANALYTICS		Dr.R. Natchadalingam
6	PE	231CSV66	EXPLORATORY DATA ANALYSIS		Mr.P. Gopi Kannan
7	PE	231CSV67	DATA VISUALIZATION TOOLS		Ms.M. Uma Maheswari
8	PE	231CSV68	SQL FOR DATA SCIENCE		Mr.P. Velayutha Perumal

231CSV61	R- PROGRAMMING				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:	PE	
Prerequisite:	Basic understanding of statistics and programming concepts							
Aim:	To equip the students to acquire expertise in statistical computing and graphics							
Course Outcomes:	The students will be able to							
CO1:	Illustrate the concepts of Various Analytics Techniques.							
CO2:	Apply the various concepts of R Programming Basics.							
CO3:	Identify techniques to import and handle various types of data within the R programming environment.							
CO4:	Evaluate various data visualization approaches in R to enhance analytical insights.							
CO5:	Develop efficient, consistent, and reproducible workflows through effective coding and data analysis practices.							
CO6:	Apply statistical and machine learning methods including Decision Trees, Random Forest, Regression, and Time Series Analysis to analyze data.							
INTRODUCTION TO DATA ANALYTICS							9	
Overview of Data Analytics, Need of Data Analytics, Nature of Data, Types of data and data Analytics- Characteristics of Data, Applications of Data Analytics. Business Intelligence and Analytics, Business Analytics Optimization.								
PROGRAMMING BASICS							9	
Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages								
GETTING DATA INTO R:							9	
Introduction to Reading and getting data into R (External Data)-Using CSV files, XML files, Web Data, JSON files, Databases, Excel files.								
WORKING WITH R CHARTS AND GRAPHS							9	
Introduction to Working with R Charts and Graphs- Histograms, Boxplots, Bar Charts, Line Graphs, Scatter plots, Pie Charts.								
STATISTICS WITH R							9	
Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression, Survival Analysis.								
Total Periods:							45	
Textbook:								
1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team,2008								
References:								
1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2018. 2. Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000. 3. G Casella and R.L. Berger, Statistical Inference, Thomson Learning, Second Edition 2002.								

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K2	3	2	1	-	-	-	-	-	-	1	-	3	2	
CO2	K3	3	2	2	-	-	-	-	-	-	-	-	3	3	
CO3	K1	3	3	3	2	2	-	-	-	-	-	-	3	2	1
CO4	K1	3	2	3	3	2	-	-	-	-	1	-	3	1	
CO5	K1	3	3	3	3	2	-	-	-	-	-	-	3	1	
CO6	K1	3	2	3	3	3	-	-	-	2	2	1	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV62		BIOINFORMATICS AND HEALTH DATA SCIENCE				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:	-	Category:		PE
Prerequisite:		Basic Biology, Statistics, and Programming							
Aim:	To equip students with computational and analytical skills in processing biological and healthcare data, enabling the development of data-driven applications in bioinformatics and health informatics.								
Course Outcomes: The students will be able to									
CO1:	Recall the fundamentals of bioinformatics, genome structure, and biological databases.								
CO2:	Apply sequence alignment and gene prediction techniques using computational tools.								
CO3:	Demonstrate large-scale biological and healthcare data using machine learning methods.								
CO4:	Interpret electronic health records and perform meaningful health data analytics.								
CO5:	Explain predictive models for healthcare using statistical and AI techniques.								
CO6:	Apply data privacy and ethical considerations in bio-health applications.								
INTRODUCTION TO BIOINFORMATICS AND HEALTH DATA SCIENCE									9
Biological databases: NCBI, GenBank, EMBL, UniProt - Genome structure and gene expression - Basics of Health Informatics - Types of health data: clinical, behavioral, genomic									
SEQUENCE ALIGNMENT AND GENE PREDICTION									9
DNA, RNA, protein structure recap - Pairwise and multiple sequence alignment: Needleman-Wunsch, Smith-Waterman - BLAST and FASTA - Gene prediction: HMM, ab initio approaches									
MACHINE LEARNING FOR BIO-HEALTH DATA									9
Data preprocessing techniques - Classification and clustering algorithms (SVM, KNN, Decision Trees, K-Means) - Feature engineering and selection – Case studies in disease prediction									
HEALTHCARE DATA ANALYTICS AND VISUALIZATION									9
Electronic Health Records (EHR) and data standards (FHIR, HL7) - Tools: Pandas, NumPy, SciPy- Data visualization: Matplotlib, Seaborn - Dashboards and clinical decision support									
ETHICS, PRIVACY, AND APPLICATIONS									9
Data privacy laws: HIPAA, GDPR - Ethical AI and bias in medical datasets - Applications: drug discovery, personalized medicine, telehealth - Wearable devices and real-time monitoring									
Total Periods:									45
Textbook:									
1. Roche, Daniel. Bioinformatics with Python Cookbook, 2nd Ed., Packt Publishing, 2018. 2. Mark Ryan. Deep Learning for Medical Image Analysis, Elsevier, 2022. 3. Dimiter V. Dimitrov. Biomedical Data Science, Springer, 2020.									
References:									
1. Arthur M. Lesk. Introduction to Bioinformatics, 5th Ed., Oxford University Press, 2019. 2. Peter B. Jensen et al. Mining Electronic Health Records, Elsevier, 2015. 3. S. Mohammed. Healthcare Data Analytics and Management, CRC Press, 2021. 4. Shweta Rekhi. Applied Bioinformatics: A Practical Guide, Wiley India, 2022.									

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	1	2	1	1									2	1
CO2	K3	3	3	2	2								3	3	
CO3	K2	3	3	3	3	2							3	3	2
CO4	K2	2	3	3	2	2	1			1			3	3	2
CO5	K3	2	2	3	3	2				1			2	3	2
CO6	K3	2	2	2	3		3	3	2			2	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV63		IMAGE AND VIDEO ANALYTICS			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE
Prerequisite:		Fundamental concepts of image processing, computer vision, and video analysis.						
Aim:		To equip the students with the techniques and methods used in image and video analytics.						
Course Outcomes: The students will be able to.								
CO1:		Recall the fundamentals of digital images and video streams						
CO2:		Apply image processing techniques for enhancement and segmentation.						
CO3:		Develop feature extraction and representation methods for images and videos.						
CO4:		Explain object detection and tracking algorithms.						
CO5:		Apply video analytics methods for activity recognition and event detection.						
CO6:		Develop practical solutions for real-world image and video analytics applications.						
INTRODUCTION TO IMAGE AND VIDEO ANALYTICS								9
Digital image fundamentals: pixels, color models, image formats - Video fundamentals: frames, frame rate, compression basics - Applications of image and video analytics - Overview of computer vision and pattern recognition.								
IMAGE PROCESSING TECHNIQUES								9
Image enhancement: filtering, histogram equalization, noise reduction - Image segmentation: Thresholding, edge detection, region growing, clustering - Morphological operations - Image transformation: Fourier transform, wavelets.								
FEATURE EXTRACTION AND REPRESENTATION								9
Feature types: corners, edges, blobs, textures - Feature descriptors: SIFT, SURF, ORB, HOG - Dimensionality reduction techniques (PCA, LDA) - Bag of Visual Words (BoVW) model								
OBJECT DETECTION AND RECOGNITION								9
Classical approaches: template matching, Haar cascades - Machine learning-based methods: SVM, Random Forests - Deep learning approaches: CNNs for detection (YOLO, SSD, Faster R-CNN) - Evaluation metrics: precision, recall, mAP.								
OBJECT TRACKING IN VIDEOS								9
Tracking problem definition and challenges - Tracking algorithms: Kalman filter, Particle filter, Meanshift, CAMshift - Deep learning for tracking - Multi-object tracking and data association - Applications and Case Studies: Surveillance systems - Autonomous vehicles and driver assistance - Medical imaging and diagnostics Multimedia indexing and retrieval								
Total Periods:								45
Textbooks:								
1. Digital Image Processing Rafael C. Gonzalez, Richard E. Woods Pearson 4th Edition, 2017 2. Computer Vision: Algorithms and Applications Richard Szeliski Springer 2010 3. Multiple View Geometry in Computer Vision Richard Hartley, Andrew Zisserman Cambridge University Press 2nd Edition, 2004 4. Deep Learning for Vision Systems Mohamed Elgendy Manning 5. Learning OpenCV 4: Computer Vision with Python Adrian Kaehler, Gary Bradski O'Reilly Media 2nd Edition, 2020. 6. Video Analytics for Business Intelligence Alexander Hauptmann Wiley 2016								

References:	(Online Resources)
1.	Coursera: "Computer Vision" by University of Michigan
2.	Stanford CS231n: Convolutional Neural Networks for Visual Recognition
3.	OpenCV tutorials and documentation
4.	Papers from CVPR, ICCV, ECCV on video analytics

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K2	3	2	2	1	-	-	-	-	-	1	-	3	2	-
CO2	K3	3	3	3	2	1	-	-	-	-	-	-	3	3	-
CO3	K3	3	3	3	3	2	-	-	-	1	-	-	3	3	2
CO4	K2	3	3	3	3	2	-	-	-	1	1	-	3	3	2
CO5	K3	3	3	3	3	3	-	-	-	2	1	-	2	3	2
CO6	K3	3	3	3	3	3	-	-	-	2	2	1	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV64	BUSINESS ANALYTICS				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:	PE	
Prerequisite:	A solid understanding of mathematics, statistics, and data analysis							
Aim:	To provide the knowledge of business analytics for decision making.							
Course Outcomes: The students will be able to								
CO1:	Apply the analytics life cycle to solve business problems through data collection, preparation, modeling, evaluation, and deployment using data science methodologies..							
CO2:	Summarize the process of acquiring Business Intelligence.							
CO3:	Classify the various types of analytics for Business Forecasting.							
CO4:	Explain the supply chain management for Analytics.							
CO5:	Apply analytics for different functions of a business.							
CO6:	Demonstrate the predictive analytics for customers behaviour in marketing.							
INTRODUCTION TO BUSINESS ANALYTICS								9
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration								
BUSINESS INTELLIGENCE								9
Data Warehouses and Data Mart – Knowledge Management –Types of Decisions – Decision-Making Process – Decision Support Systems – Business Intelligence –OLAP – Analytic functions								
BUSINESS FORECASTING								9
Introduction to Business Forecasting and Predictive analytics – Logic and Data-Driven Models – Data Mining and Predictive Analysis Modeling –Machine Learning for Predictive analytics.								
HR & SUPPLY CHAIN ANALYTICS								9
Human Resources – Planning and Recruitment – Training and Development – Supply chain network – Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain. Apply HR Analytics to make a prediction of the demand for hourly employees for a year.								
MARKETING & SALES ANALYTICS								9
Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales. Do predictive analytics for customers’ behaviour in marketing and sales.								
Total Periods:								45
Textbook:								
1. R. Evans James, Business Analytics, 2017.								
References:								
1. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016. 2. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016. 3. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010. 4. Mahadevan B, “Operations Management -Theory and Practice”, 3rd Edition, Pearson Education, 2018.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K3	3	3	3	3								2	3	3
CO2	K2	2	3	2	2								1	3	2
CO3	K2	3	3	3	3								2	3	3
CO4	K2	3	3	3	3								1	3	3
CO5	K3	3	3	3	3								1	3	3
CO6	K2	2	3	2	2								1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV65		PREDICTIVE ANALYTICS			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		
Prerequisite:		Data Structures, Mathematics, Probability and Statistics						
Aim:	To equip students with theoretical and practical skills for building and evaluating predictive models in data science using statistical and machine learning approaches.							
Course Outcomes: The students will be able to.								
CO1:	Classify the various types of predictive modeling.							
CO2:	Apply regression techniques for prediction and inference.							
CO3:	Develop classification models using supervised learning methods.							
CO4:	Identify model performance using statistical and cross-validation techniques.							
CO5:	Explain feature engineering and data transformation for predictive modeling.							
CO6:	Identify end-to-end predictive modeling workflows using industry tools.							
INTRODUCTION TO PREDICTIVE MODELING								9
Overview of predictive modeling and its applications - Types of models: regression, classification, time series -Predictive modeling process - Bias-variance trade-off								
REGRESSION MODELS								9
Simple and multiple linear regression - Polynomial regression - Model assumptions and diagnostics Regularization techniques: Ridge, Lasso.								
CLASSIFICATION MODELS								9
Logistic regression - Decision trees and Random Forest - Naive Bayes and Support Vector Machines Model comparison and ROC analysis.								
MODEL EVALUATION AND VALIDATION								9
Confusion matrix, precision, recall, F1-score - Cross-validation and resampling techniques -Hyperparameter tuning and grid search - Overfitting and model generalization								
DATA PREPROCESSING AND AUTOMATION								9
Feature selection and extraction - Handling missing data and outliers -Scaling and transformation - Automating predictive modeling using scikit-learn or similar tool								
Total Periods:								45
Textbooks:								
1. Max Kuhn and Kjell Johnson. Applied Predictive Modeling, Springer, 2013. 2. Gareth James et al. An Introduction to Statistical Learning with Applications in R, Springer, 2021. 3. Ian H. Witten et al. Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2016.								
References:								
1. Trevor Hastie, Robert Tibshirani, Jerome Friedman. The Elements of Statistical Learning, Springer, 2017. 2. Sebastian Raschka, Vahid Mirjalili. Python Machine Learning, Packt Publishing, 2020. 3. Jason Brownlee. Master Machine Learning Algorithms, Machine Learning Mastery, 2016. 4. John D. Kelleher, Brendan Tierney. Data Science, MIT Press, 2018.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	3	2	1	-	-	-	-	-	-	-	-	3	2	-
CO2	K3	3	3	2	2	-	-	-	-	-	-	-	3	3	-
CO3	K3	3	3	3	3	2	-	-	-	-	-	-	3	3	2
CO4	K3	2	3	3	2	2	1	-	-	1	-	-	3	3	2
CO5	K2	2	2	3	3	2	-	-	-	1	-	-	2	3	2
CO6	K3	2	2	2	3	-	3	3	2	-	-	2	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV66		EXPLORATORY DATA ANALYSIS			L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:	PE	
Prerequisite:	A foundational understanding of basic programming (like Python), basic math and statistics, and a general understanding of data concepts.							
Aim:	To provide knowledge of Exploratory Data Analysis and its importance.							
Course Outcomes: The students will be able to								
CO1:	Recall the fundamentals of exploration data analysis.							
CO2:	Recall the data Visualization using Matplotlib.							
CO3:	Identify univariate data exploration and analysis.							
CO4:	Apply bivariate data exploration and analysis.							
CO5:	Develop proficiency in analyzing complex datasets by applying multivariate analysis and time-series visualization techniques.							
CO6:	Apply TSA for visualizing, grouping and resampling of data.							
UNIT I - EXPLORATORY DATA ANALYSIS								9
EDA fundamentals – Understanding data science - Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA – Visual Aids for EDA – Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.								
UNIT II - EDA USING PYTHON								9
Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.								
UNIT III - UNIVARIATE ANALYSIS								9
Introduction to Single Variable: Distribution Variables – Numerical Summaries of Level and Spread – Scaling and Standardizing – Inequality.								
UNIT IV - BIVARIATE ANALYSIS								9
Relationships between Two Variables – Percentage Tables – Analysis Contingency Tables – Handling Several Batches – Scatterplots and Resistant Lines.								
UNIT V - MULTIVARIATE AND TIME SERIES ANALYSIS								9
Introducing a Third Variable – Causal Explanations – Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.								
Total Periods:								45
Textbook:								
1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020. 2. Jake Vander Plas, “Python Data Science Handbook: Essential Tools for Working with Data”. First Edition, O Reilly, 2017. (Unit 2) 3. Catherine Mars, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)								
References:								
1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.								

2. Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly Publications, 2019.
3. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	2	3	2	2								1	3	2
CO2	K2	2	3	2	2								1	3	2
CO3	K2	3	3	3	3								2	3	3
CO4	K3	3	2	3	3								1	3	3
CO5	K3	3	2	3	3								1	3	3
CO6	K3	3	2	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV67		DATA VISUALIZATION TOOLS				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:	-	Category :		PE
Prerequisite:		A foundation in analytical skills, mathematics, and statistics is essential, along with some familiarity with programming languages like Python or R.							
Aim:		To equip the students to identify patterns, trends and outliers in large data sets.							
Course Outcomes: The students will be able to									
CO1:		Describe the fundamental principles of visual perception used in data visualization.							
CO2:		Illustrate appropriate visualization techniques for analyzing numerical data.							
CO3:		Apply knowledge of visual design principles to create effective visualizations tailored to various data analysis problems.							
CO4:		Analyze requirements and design an interactive information dashboard that communicates key data insights clearly and effectively.							
CO5:		Illustrate the basic techniques to visually represent large datasets and interpret complex relationships within them.							
CO6:		Interpret visualization techniques suitable for non-numerical data types.							
UNIT I- INTRODUCTION									9
Visualization – visualization process – role of cognition – Pseudocode conventions – Scatter plot Data foundation: Types of data - Structure within and between records - Data preprocessing – Human perceptions and information processing									
UNIT II -VISUALIZATION FOUNDATIONS									9
Semiology of graphical Symbols – Eight Visual Variables – Historical Perspective- Visualization Techniques for spatial data – One-dimensional data- two-dimensional data – Three-dimensional data- dynamic data – combining techniques- Visualization of Geospatial data – Visualization of Point, line, area data									
UNIT III -DESIGNING EFFECTIVE VISUALIZATION									9
Steps in Designing Visualization – problems in Designing Effective Visualization – Comparing and evaluating visualization techniques – Visualization Systems									
UNIT IV -INFORMATION DASHBOARD DESIGN									9
Characteristics of dashboards – Key goals in visual design process – Dashboard display media – Designing dashboards for usability – Meaningful organization – Maintaining consistency – Aesthetics of dashboards – Testing for usability – Case Studies: Sales dashboard, Marketing analysis dashboard									
UNIT V- VISUALIZATION SYSTEMS									9
Systems based on Data type-systems based on Analysis type – Text analysis and visualization – Modern integrated visualization systems – toolkit-Research directions in visualization – issues of cognition, perception and reasoning –issues of evaluation - issues of Hardware.									
Total Periods:									45
Textbook:									
1. Desireé Abbott, Everyday Data Visualization (2024), Manning Publications.									

2. Matthew O. Ward, Georges Grinstein, Daniel Keim, Interactive Data Visualization: Foundations, Techniques, and Applications (2nd Edition, 2015), CRC Press.

References:

1. Andy Kirk, Data Visualization: A Handbook for Data Driven Design, 2024, Sage Publications, Inc.

2. Ben Fry, Visualizing Data: Exploring and Explaining Data with the Processing Environment, 2013, O'Reilly Media.

3. Andy Kirk, "Data Visualization: A Handbook for Data Driven Design", 2nd Edition, Sage Publications, India, 2019.

4. Claus O. Wilke, "Fundamentals of Data Visualization", 1st Edition, O'Reilly Media, USA, 2019

5. Stephen Few, "Now you see it: Simple Visualization Techniques for Quantitative Analysis", 1st Edition, Analytics Press, 2009.

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K2	3	2	1	-	-	-	-	-	-	1	-	3	2	
CO2	K3	3	3	2	-	-	-	-	-	-	-	-	3	3	
CO3	K1	3	3	3	2	2	-	-	-	-	-	-	3	2	1
CO4	K1	3	2	3	3	2	-	-	-	-	1	-	3	1	
CO5	K1	3	3	3	3	2	-	-	-	-	-	-	3	1	
CO6	K1	3	3	3	3	3	-	-	-	2	2	1	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSV68		SQL FOR DATA SCIENCE			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE
Prerequisite:		Basic understanding of databases and data analysis						
Aim:	To provide students with the ability to use SQL for querying, managing, and analyzing data in the context of data science and decision-making.							
Course Outcomes: The students will be able to								
CO1:	Recall the fundamentals of relational databases and SQL syntax.							
CO2:	Build SQL queries to extract, filter, and sort data from large datasets.							
CO3:	Apply joins, subqueries, and set operations for complex data retrieval.							
CO4:	Identify aggregation, grouping, and statistical analysis using SQL.							
CO5:	Integrate SQL with data science workflows using tools like Python or R.							
CO6:	Apply best practices in data handling, cleaning, and transformation using SQL.							
INTRODUCTION TO DATABASES AND SQL								9
Introduction to RDBMS (Relational Database Management System) and SQL (Structured query language) - Data types, Tables, Constraints - Basic SQL commands: SELECT, INSERT, UPDATE, DELETE - Data filtering and sorting (WHERE, ORDER BY)								
ADVANCED SQL QUERIES								9
JOIN operations: INNER, LEFT, RIGHT, FULL - Subqueries and Nested SELECT - UNION, INTERSECT, EXCEPT - Using CASE and IF conditions in SQL								
AGGREGATION AND GROUPING								9
Aggregate functions: COUNT, SUM, AVG, MIN, MAX - GROUP BY and HAVING clauses - Window functions and ranking: RANK, DENSE_RANK, ROW_NUMBER - Date and time functions								
SQL FOR DATA CLEANING AND TRANSFORMATION								9
Data type conversions and formatting - Handling missing and NULL values - Creating views and temporary tables - String manipulation and regular expressions in SQL								
SQL IN DATA SCIENCE WORKFLOWS								9
Integrating SQL with Python (using SQLite, PostgreSQL, MySQL connectors) - Using SQL in Jupyter Notebooks - Basic data visualization using SQL queries in BI tools (e.g., Tableau, Power BI) - Case studies in data science using SQL								
Total Periods:								45
Textbook:								
1. Ben Forta. SQL in 10 Minutes, Sams Teach Yourself, 5th Ed., Pearson, 2019. 2. Foster D. Provost and Tom Fawcett. Data Science for Business, O'Reilly, 2013. 3. Cathy O’Neil and Rachel Schutt. Doing Data Science, O’Reilly Media, 2013.								
References:								
1. Jesse Liberty. Learning SQL, 3rd Edition, O'Reilly Media, 2020. 2. Alan Beaulieu. Learning SQL, 2nd Edition, O’Reilly Media, 2009. 3. Chad Cooper. SQL for Data Analytics, Packt Publishing, 2021. 4. Thomas Nield. Getting Started with SQL: A Hands-On Approach, O’Reilly Media, 2016.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	
CO1	K2	3	2	1									3	2	
CO2	K2	3	3	3	2								3	3	
CO3	K3	3	3	3	3	2							3	3	2
CO4	K2	2	3	3	3	2	1			1			3	3	2
CO5	K2	2	2	3	3	2				1			2	3	2
CO6	K3	2	2	2	3		3	3	2			2	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial

231CSH01		AGILE TECHNOLOGIES				L	T	P	C
						3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:		Category:		PE
Prerequisite:		Nil							
Aim:	develop and manage small-scale software projects using the Scrum methodology.								
Course Outcomes: The Students will be able to									
CO1:	Illustrate the common characteristics of an agile development process.								
CO2:	Develop contrast state of the practice agile methodologies.								
CO3:	Apply agile software development process models and plan driven process models.								
CO4:	Identify software project characteristics that would be suitable for an agile process.								
CO5:	Identify software project characteristics that would not be suitable for an agile process.								
CO6:	Develop a small scale software project using the Scrum process methodology								
INTRODUCTION TO AGILE METHODOLOGIES									9
History of Agile Methodologies, Agile and Lean Software Development: Basics and Fundamentals, Extreme Programming, Scrum, Agile and Scrum Principles Agile Manifesto, Twelve Practices of XP									
AGILE ARCHITECTURE									9
Agile Estimation & Planning, Agile Requirements, Agile techniques to improve requirements, User Stories, Backlog Management: scrum product backlog, product backlog, Agile Architecture									
AGILE PROJECTS									9
Tracking Agile Projects: Time tracking agile projects, Tracking agile development project progress. Lean Software Development, Agile model driven development, Agile Risk management									
AGILE TOOLS									9
Agile Project Tools, Enterprise Agility, Dynamic Systems Development Method, Continuous Integration (CI).									
TESTING									9
Team Dynamics and Collaboration, Enterprise agile project team, Agile Testing, Scaling Agile for Large Projects, Best Practices for Achieving Agile at Scale									
Total Periods:									45
Text Book:									
1. Ken Schwaber & Mike Beedle, “Agile Development with Scrum” Prentice Hall, 2001 2. Peter Schuh, Charles “Integrating Agile Development in the Real World”, River Media, 2005									
References:									
Alistair Cockburn, “Agile Software Development – The Cooperative Game” , 2/e ,2007 1. Mike Cohn, Addison Wesley, “Succeeding With Agile, Software Development Using Scrum”, 2010									

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2									3	2
CO2	K3	3	3	3	3								1	3	3
CO3	K3	3	3	3	3								1	3	3
CO4	K3	3	3	3	3								1	3	3
CO5	K3	3	3	3	3								1	3	3
CO6	K3	3	3	3	3	2							1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSH02		NETWORK SIMULATION AND MODELLING			L	T	P	C
Programme:		B.E. Computer Science and Engineering		Sem:	-		Category:	PE
Prerequisites:								
Aim:		To develop the ability to apply simulation techniques, queuing models, and performance metrics.						
Course Outcomes: The Students will be able to								
CO1:	Identify basic simulation concepts including time-driven vs. event-driven simulations, validation techniques, and performance metrics like throughput and delay.							
CO2:	Outline initialization and termination steps, basic simulation examples, and debugging methods.							
CO3:	Interpret how external data integration and performance evaluation are applied in real-world simulations such as honeypot communities.							
CO4:	Implement importance sampling, variance reduction, and error analysis to evaluate network reliability and electric vehicle charging.							
CO5:	Apply Kendall’s notation to model different queuing systems such as M/M/1, M/M/m, and M/G/1 and analyze their performance using Little’s Law.							
CO6:	Use queuing disciplines like FIFO, LIFO, and priority to evaluate their effects on Quality of Service (QoS) in real-world networks such as VoIP and mobile networks.							
Fundamentals of Modeling and Simulation								9
Types of models: physical, mathematical, analytical, and simulation - Purpose and scope of modelling - Time-driven vs. event-driven simulations - The system development life cycle (SDLC) - Model abstraction and assumptions - Validation and verification techniques - Performance metrics (e.g., throughput, delay, utilization).								
Discrete-Event Simulation (DES) Framework								9
Concepts of events, entities, and attributes - Simulation clock and time advancement mechanisms -Event list management (future event set) - Scheduler and dispatcher roles - Initialization and termination conditions -"Hello World" simulation implementation -Two-node protocol simulation example -Debugging and tracing in simulation.								
CASiNO Simulation Framework								9
Overview of CASiNO architecture - Components - Configuring simulation scenarios - Creating custom entities and behavior classes - Object-oriented approach to simulation - Multi-agent interaction modelling - Integration of CASiNO with external data sources - Real-world example: modeling honeypot communities - Performance evaluation using CASiNO.								
Monte Carlo Simulation Techniques								9
Principles of Monte Carlo simulation - Generating random numbers and variables - Uniform, exponential, and normal distributions - Importance sampling and variance reduction - Statistical error analysis - Confidence intervals and sample size selection - Use cases in network reliability and capacity estimation - Application to electric vehicle charging station modelling.								
Queuing Theory and Traffic Modeling								9
Basics of queuing systems and notation (Kendall’s notation) - M/M/1, M/M/m, M/G/1 queue models - Little’s Law and system performance - Queueing disciplines (FIFO, LIFO, priority) - Modeling packet-switched and circuit-switched networks - Impact of traffic on Quality of Service (QoS) - Real-world applications: VoIP, mobile networks, cloud queues.								
Total Periods:								45
Text Books:								
1. Mohsen Guizani, Ammar Rayes, Bilal Khan, Ala Al-Fuqaha, "Network Modeling and Simulation: A Practical Perspective" ,ISBN 9780470035870, February 2010, First Edition.								
2. Averill M. Law, “Simulation Modeling and Analysis”, ISBN 9780073401324 ,2014, Fifth								

Edition.	
References:	
1. Klaus Wehrle, Mesut Günes, James Gross , “Modeling and Tools for Network Simulation”, ISBN 9783642097174, September 2010, First Edition. 2. Nandini Mukherjee, Debashis Saha, “Computer Network Simulation Using NS2” ISBN 978-0367253533, 2020, First Edition. 3. Mor Harchol-Balter, “Performance Modeling and Design of Computer Systems”, ISBN 9781107027503, February 2013, First Edition.	

1: Slight
(Low)
2:

Moderate (Medium) 3: Substantial (High)

Course Outcomes		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K1	3	3	2	2								2	3	2
CO2	K1	3	3	2	3								1	3	3
CO3	K2	3	3	3	3								2	3	3
CO4	K2	3	3	2	3								1	3	3
CO5	K3	2	3	2	2								1	3	2
CO6	K3	3	3	3	2								1	3	3

231CSH03		TEST AUTOMATION AND QUALITY ASSURANCE			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering			Sem:	-	Category:	PE
Prerequisites:		231CS61 – Object Oriented Software Engineering						
Aim:	To produce quality product using automation and quality assurance							
Course Outcomes: The Students will be able to								
CO1:	Recall the basic concept of testing.							
CO2:	Explain various process included in the test planning.							
CO3:	Discuss the tools used for automation.							
CO4:	Illustrate the factors, applications involved in software reliability.							
CO5:	Demonstrate various models in software reliability.							
CO6:	Outline the quality factors and certifications for quality assurance.							
FOUNDATIONS OF TESTING								9
Introduction - Role of Testing- Verification and Validation- Notion of Software Reliability- Failure, Error, Fault, and Defect- Test Levels- White-Box and Black-Box Testing- Monitoring and Measuring Test Execution - Test Tools and Automation.								
SYSTEM TEST PLANNING								9
Structure- Test Approach, suite structure, environment-Test execution strategy-Test effort estimation- Scheduling and Test Milestones.								
TEST AUTOMATION								9
System Test Automation- Evaluation and Selection of Test Automation Tools- Test Selection Guidelines for Automation- Characteristics of Automated Test Cases- Structure of an Automated Test Case- Test Automation Infrastructure.								
SOFTWARE RELIABILITY								9
Reliability-Software Reliability-Factors influencing Software Reliability-Applications of Software Reliability-Reliability models.								
QUALITY ASSURANCE								9
Five Views of Software Quality- McCall’s Quality Factors and Criteria- ISO 9126 Quality Characteristics- ISO 9000:2000 Software Quality Standard.								
Total Periods:								45
Text Books:								
1. Kshirasagar Naik, Priyadarshi Tripathy, “Software testing and Quality Assurance”, Wiley Publication, 2016.								
References:								
1. Srinivasan Desikan, Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education, 2006.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K2	K2	K3	K3							K2	K2	K3	K3
CO1	K2	2	3	2	1							1		2	
CO2	K3	2	3	2	2							2		3	2
CO3	K3	2	2	1	3							3	2	3	2
CO4	K3	2	3	2	2							2	3	3	2
CO5	K2	3	3	2	3							3	2	3	3
CO6	K2	3	2	3	3							3	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSH04		IDENTITY AND ACCESS MANAGEMENT			L	T	P	C
					3	0	0	3
Programme:		B.E. Computer Science and Engineering		Sem:	-	Category:		PE
Prerequisite:		-						
Aim:	To provide foundational and practical knowledge on designing and managing secure Identity and Access Management (IAM) systems in enterprise environments.							
Course Outcomes: The Students will be able to								
CO1:	Explain the fundamental concepts of Identity and Access Management (IAM)							
CO2:	Demonstrate the ability to navigate IAM user interfaces and command-line interfaces (CLI) for managing user access.							
CO3:	Compare Single Sign-On (SSO) techniques, access control mechanisms, and password management strategies to streamline authentication across system.							
CO4:	Illustrate the principles of identity federation.							
CO5:	Apply identity management and user provisioning techniques, including Multi-Factor Authentication (MFA), auditing.							
CO6:	Develop enterprise IAM systems, including components of identity managers and IAM governance frameworks.							
INTRODUCTION TO IAM								9
Introduction to IAM, Enterprise or Organizational Identities, Electronics and non-electronics Identities, Review of Identity and Access Management: Theory & Practice, Role Based Access Management, Modeling Enterprise Identity and Access Management Systems								
USER INTERFACE AND DIRECTORIES								9
Navigating the user interface, Using the command line interface (CLI), Access management Directories: Introduction to Lightweight Directory Access Protocol (LDAP), LDAP Concepts & Architecture, LDAP Replication.								
SINGLE SIGN-ON (SSO) CONCEPTS AND METHODS								9
Single Sign-On Techniques, Access Control, Password Management, Introduction to Single Sign On Methods.								
INTRODUCTION TO FEDERATION								9
Federation Overview, Federation Protocols, Governance Risk and Compliance.								
IDENTITY MANAGEMENT AND PROVISIONING								9
Multi Factor authentication (MFA),Origin of MFA, Introduction to Auditing & Reporting, Identity Management and User Provisioning, Introduction to Identity Manager, Identity Manager Structure & Components, , Identity & Access Management Governance.								
Total Periods:								45
Text Book:								
1. Omondi Orondo “Identity & Access Management: A Systems Engineering Approach”, 2014								
References:								
1. Graham Williamson, David Yip “Identity Management: A Primer”, 2. Ertem Osmanoglu “Identity and Access Management: Business Performance Through Connected Intelligence” , 2013.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3								K5	K2	K3
CO1	K2	2	3	2	2								1	3	2
CO2	K2	2	3	2	2								1	3	2
CO3	K2	3	3	3	3								1	3	3
CO4	K2	2	3	2	2								1	3	2
CO5	K3	3	3	3	3								1	3	3
CO6	K3	3	3	3	3								1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231CSH05	GAME PROGRAMMING				L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:		PE
Prerequisites:	--							
Aim:	To teach students how to build and develop interactive 2D and 3D games utilizing latest game development tools and platforms.							
Course Outcomes: Upon completion of the course, students will be able to								
CO1: Discuss the concepts of Game design and development.								
CO2: Design the processes, and use mechanics for game development.								
CO3: Explain the Core architectures of Game Programming.								
CO4: Use Game programming platforms, frame works and engines.								
CO5: Create interactive Games.								
CO6: Analyze game performance and implement debugging strategies.								
3D GRAPHICS FOR GAME PROGRAMMING								9
3D Transformations, Quaternions, 3D Modeling and Rendering, Ray Tracing, Shader Models, Lighting, Color, Texturing, Camera and Projections, Culling and Clipping, Character Animation, Physics-based Simulation, Scene Graphs.								
GAME ENGINE DESIGN								9
Game engine architecture, Engine support systems, Resources and File systems, Game loop and real-time simulation, Human Interface devices, Collision and rigid body dynamics, Game profiling.								
GAME PROGRAMMING								9
Application layer, Game logic, Game views, managing memory, controlling the main loop, loading and caching game data, User Interface management, Game event management.								
GAMING PLATFORMS AND FRAMEWORKS								9
2D and 3D Game development using Flash, DirectX, Java, Python, Game engines - Unity. DX Studio, Unity.								
GAME DEVELOPMENT								9
Developing 2D and 3D interactive games using DirectX or Python – Isometric and Tile Based Games, Puzzle games, Single Player games, Multi Player games.								
Total Periods:								45
Text Books:								
1. Mike Mc Shaffrly and David Graham, “Game Coding Complete”, 4/e, Cengage Learning, PTR, 2012. 2. Jason Gregory, “Game Engine Architecture”, CRC Press / A K Peters, 2009. 3. David H. Eberly, “3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics”, 2/e, Morgan Kaufmann, 2006.								
References:								
1. Ernest Adams, Andrew Rollings, “Fundamentals of Game Design”, 2/e, Prentice Hall / New Riders, 2009. 2. Eric Lengyel, “Mathematics for 3D Game Programming and Computer Graphics”, 3/e, Course Technology PTR, 2011. 3. Jesse Schell, “The Art of Game Design: A book of lenses”, 1/e, CRC Press, 2008.								

Course Outcomes		Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
		K2	K2	K3	K3							K2	K2	K3	K3
CO1	K2	2	3	2	1							1		2	
CO2	K3	2	3	2	2							2		3	2
CO3	K3	2	2	1	3							3	2	3	2
CO4	K3	2	3	2	2							2	3	3	2
CO5	K2	3	3	2	3							3	2	3	3
CO6	K2	3	2	3	3							3	2	3	3

231CSH06		Natural Language Processing and Chatbots			L	T	P	C
					3	0	0	3
Programme:	B.E. Computer Science and Engineering			Sem:	-	Category:		PE
Prerequisite:	231CS51 – Artificial Intelligence and Machine Learning.							
Aim:	To understand how computers process and understand human language, and to learn how to build and deploy Chatbots that can effectively communicate with users.							
Course Outcomes: After Successful completion of the course, students will be able to								
CO1:	List the different stages in the NLP pipeline.							
CO2:	Outline various morphological analysis techniques.							
CO3:	Summarize the effectiveness of word embedding and semantic vector model							
CO4:	Demonstrate Hidden Markov Models and Post Tagging.							
CO5:	Recall the techniques for POS tagging.							
CO6:	Explain the concepts of design, development, and implementation involved in creating functional chatbots.							
INTRODUCTION TO NATURAL LANGUAGE PROCESSING								9
Introduction to NLP - Various stages of NLP –NLP Pipeline, The Ambiguity of Language: Parts of Speech, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language: Cross entropy, Text Prepossessing: Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis								
MORPHOLOGY AND LANGUAGE MODELLING								9
Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer. Bag of words, skip-gram, Continuous Bag-Of-Words, N gram model, n-gram Models over Sparse Data: Bins: Forming Equivalence Classes- - Statistical Estimators- Combining Estimators								
VECTOR SEMANTICS AND EMBEDDINGS								9
Lexical Semantics-Vector Semantics-Words and Vectors-Cosine for measuring similarity- TF-IDF: Weighing terms in the vector- Pointwise Mutual Information (PMI) -Applications of the TF-IDF or PPMI vector models-Word2vec -Visualizing Embeddings-Semantic properties of embeddings-Bias and Embeddings-Evaluating Vector Models								
MARKOV MODEL AND POS TAGGING								9
Markov Model: Hidden Markov model, Three Fundamental questions of HMM, Implementation properties, and Variants of HMMs, Multiple input observation. POS: The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging								
CHATBOTS								9
Application of chatbots. General chatbot architecture, Basic concepts in chatbots, Chatbot framework & Architecture, Conversational Flow & Design, Intent Classification (ML and DL based techniques), Dialogue Management Strategies, Introduction to popular chatbot frameworks – Google Dialog flow, Microsoft Bot - Framework, Amazon Lex, RASA Channels: FacebookMessenger, Google Home, Alexa, WhatsApp, Custom Apps								
Total Periods:								45
Text Book:								
1. Daniel Jurafsky and James H. Martin “Speech and Language Processing”, 3/e, Prentice Hall, 2024 2. T V Geetha, “Understanding Natural Language Processing”. (Machine Learning and Deep Learning Perspectives), 1/e, Pearson, 2024.								
References:								

1. Christopher D. Manning and Hinrich Schutze, “*Foundations of Natural Language Processing*”, 6/e, The MIT Press Cambridge, Massachusetts London, England, 2003 2009
2. Alexander Clark, Chris Fox, Shalom Lappin, “*The Handbook of Computational Linguistics and Natural Language Processing*”, Wiley-Blackwell, 2016.
3. Michael McTear, “*Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots*”, Second Edition, Moran and Claypool Publishers, 2020.

Course Outcome s		Program Outcomes (POs)										Program Specific Outcomes (PSOs)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
		K3	K2	K3	K3	K3					K2	K3	K5	K2	K3
CO1	K1	1	2	1	1	1						1		2	1
CO2	K1	1	2	1	1	1						1		2	1
CO3	K2	2	3	2	2	2						2		3	2
CO4	K3	3	3	3	3	3						3		3	3
CO5	K1	1	2	1	1	1						1		2	1
CO6	K2	2	3	2	2	2						2		3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BAE1	WOMEN STUDIES AND WOMEN EMPOWERMENT			L	T	P	C
				3	0	0	3
Programme:	B.E. / B.Tech		Sem:	--	Category:	OE	
Aim:	To study the legal provisions for women and women’s access to justice and also familiarize the students with the notion of gender and its operation in society.						
Course Outcomes: The students will be able to							
CO1:	Make use of the laws related to women’s, rights protection.(AP)						
CO2:	Organize the students to look at stereotypical representation of women in the media and equip them to critique them. (AP)						
CO3:	Illustrate the specific cultural contexts of women in India.(UN)						
CO4:	Explain the legal provisions for women and women’s access to justice. (UN)						
CO5:	Illustrate with the notion of gender operation in society. (UN)						
CO6:	Explain work place related issues and discriminatory wages.(UN)						
WOMEN’S STUDIES: AN INTRODUCTION							9
Women’s Studies -Definition, Scope and Controversies. Basic concepts of Women’s Studies- Women’s Studies perspectives- Gender: Perspectives-Gender sensitive approach- Gender and sex- Biological determinism- stereotyping- Socialization- Patriarchy- Devaluation- Marginalization- Silencing- Male Gaze- Power politics- Gynocriticism- Gender mainstreaming- Gender and work- Invisibility-Glass ceiling. Women’s Studies in India.							
LEGISLATION AND GENDER JUSTICE							9
Women’s rights as human rights, UN Conventions, Convention on the Elimination of all forms of Discrimination against Women (CEDAW), Millennium Development Goals (MDGs) - Women’s Rights in the Indian Constitution, Fundamental Rights, Directive Principles- Protective legislation for women in the Indian constitution- Anti dowry, SITA, PNDT, and Prevention Sexual Harassment at Workplace (Visaka case), Domestic violence (Prevention) Act- Women’s Rights to property, Uniform Civil Code, Property rights according to religions background Muslim, Christian.							
FEMINIST THEORIES							9
Early feminist thinkers- J.S Mill, Mary Wollstonecraft - Women’s Movements before and during the world war.- Recent trends in feminist thinking- Masculinities, Eco-feminism, queer theory, transgender politics, Cyber feminism, Post-colonial - Different Schools of feminist through in the Indian contest- National and regional feminist thoughts.							
GENDER AND MASS MEDIA							9
Definition of gender, difference between sex and gender- Feminist terminology, stereotyping, patriarchy, silencing, margin alisation - Male Gaze, Feminist film criticism, thematic and semiotic analysis- Various forms of mass media. Print media, radio, visual, new media- internet, feminism and cyber space, texting, SMS and cell phone usage - Influence of media in society, patriarchy - in operation, use of feminist methods for - critiquing media representation, practice sessions.							
WOMEN AND SOCIETY IN INDIA							9
Women’s position from Vedic times to the present, women participation in India’s independence movement - Social construction of gender and gender roles – Socialisation - Women in family- Women in family- feminization of poverty, violence against women, empowerment measures - Women and environment- eco-feminist movements, women and globalization- women’s labour, discriminatory wages, changing working conditions and work place related issues.							
Total Periods:							45
Text Books:							
1.Roberta Rosenberg, “Women’s Studies: An Interdisciplinary Anthology”, Peter Lang, 2001.							
2.Jean Fox O'Barr, “Feminism in Action: Building Institutions and Community through Women's Studies”, University of North Carolina Press. 1994.							

References:

1. Jill Duerr Berrick, "Faces of Poverty: Portraits of Women and Children on Welfare", Oxford University Press, 1997.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1					3		3				2				
CO2		1				3				3						
CO3						3						2				
CO4						3						2				
CO5						3			2			2				
CO6						3			2			2				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BAE2		ENTREPRENEURSHIP				L	T	P	C
						3	0	0	3
Programme:		B.E. / B.Tech		Sem:	--	Category:		OE	
Aim:	To impart entrepreneurial skills to run a business effectively.								
Course Outcomes: The students will be able to									
CO1:	Compare entrepreneur and entrepreneurship. (UN)								
CO2:	Demonstrate characteristics of a successful entrepreneur. (UN)								
CO3:	Develop feasible business plans and project reports for initiating businesses. (AP)								
CO4:	Analyze the sources of financing the business. (AN)								
CO5:	Categorize the ways of sickness in business and corrective measures. (AN)								
CO6:	Make use of Government policies and growth strategies for Small Scale Enterprises. (AP)								
ENTREPRENEURSHIP								9	
Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth. Entrepreneur Vs. Entrepreneurship, Entrepreneur Vs. Manager.									
MOTIVATION								9	
Attributes and Characteristics of a successful Entrepreneur, Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives -women Entrepreneurs.									
BUSINESS PLAN PREPARATION								9	
Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of information – Classification of needs and agencies.									
FINANCING AND ACCOUNTING								9	
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.									
SUPPORT TO ENTREPRENEURS								9	
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.									
Total Periods:								45	
Text Books:									
1. Hisrich, Entrepreneurship, Edition 9, Tata McGraw Hill, New Delhi, 2014									
2. S. S. Khanka, Entrepreneurial Development, S.Chand and Co. Ltd., New Delhi, (Revised Edition), 2013.									

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2					3			3		3	3				
CO2	2					3			2		2	2				
CO3	2	3	3	3							1	1				
CO4								1				1				
CO5											2	1				
CO6	1								3	1	2	1				

231BAE3		PROFESSIONAL ETHICS IN ENGINEERING			L	T	P	C
					3	0	0	3
Programme:		B.E. / B.Tech		Sem:	--	Category:		OE
Aim:		To enable the students to create an awareness on Engineering Ethics and Human Values.						
Course Outcomes: The students will be able to								
CO1:		Infer human values in professional society. (UN)						
CO2:		Identify the core values that shape the ethical behavior of an engineer. (AP)						
CO3:		Illustrate codes of conduct and responsibilities of engineers in professional society. (UN)						
CO4:		Explain the awareness about ethical concerns and conflicts. (UN)						
CO5:		Interpret the safety and risk analysis. (UN)						
CO6:		Analyze the global issues in ethics. (AN)						
HUMAN VALUES								9
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.								
ENGINEERING ETHICS								9
Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories								
ENGINEERING AS SOCIAL EXPERIMENTATION								9
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – a balanced outlook on Law.								
SAFETY, RESPONSIBILITIES AND RIGHTS								9
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.								
GLOBAL ISSUES								9
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.								
Total Periods:								45
Text Books:								
1. Mike Martin and Roland Schinzinger, ‘Ethics in Engineering’, McGraw Hill, New York, 2012. 2. Charles E Harris, Michael S Pritchard and Michael J Rabins, ‘Engineering Ethics – Concepts and Cases’, 6 th Edition, Ray James, Elian Englehardt Wadsworth publishing co, 2013.								
References:								
1. Charles D Fleddermann, ‘Engineering Ethics’, Prentice Hall, New Mexico, 2012. 2. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, 2013. 3. Edmund G Seebauer and Robert L Barry, ‘Fundamentals of Ethics for Scientists and Engineers’, Oxford University Press, 2013. 4. David Erman & Michele Shauf, ‘Computers, Ethics and Society, Oxford University Press, 2012.								

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2					3			3		3	3				
CO2	2					3		2	2		2	2				
CO3	2	3	3	3							1					
CO4								1				1				
CO5								2			2					
CO6	1							2	3	1	2	1				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BAE4		ENGINEERING ECONOMICS AND ACCOUNTING			L	T	P	C
					3	0	0	3
Programme:		B.E. / B.Tech		Sem:	--	Category:		OE
Aim:		To enable the students and provide an analytical idea about economics and accounting practices.						
Course Outcomes: The students will be able to								
CO1:		Interpret the concepts of economic theories and demands. (UN)						
CO2:		Illustrate the concept of Supply and production. (UN)						
CO3:		Investigate the concept of cost. (AP)						
CO4:		Analyze the concepts of pricing and capital budgeting. (AN)						
CO5:		Examine financial accounting systems. (AN)						
CO6:		Analyze the cost accounting techniques. (AN)						
INTRODUCTION TO ECONOMICS& DEMAND								9
Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function - Demand elasticity - Demand forecasting.								
SUPPLY, PRODUCTION AND COST CONCEPTS								9
Supply - Determinants of supply - Supply function - Supply elasticity. Production function - Introduction - Production Process & Function - One Variable and Two Variable Inputs - Isoquants - Returns to scale. Cost Concepts - Cost function – Types of Cost - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.								
PRICING AND CAPITAL BUDGETING								9
Pricing - Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice. Capital Budgeting - Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.								
FINANCIAL ACCOUNTING								9
Financial Accounting - Trail balance, balance sheet and related concepts: Trading Account, Profit & Loss Statement and related concepts - analysis & interpretation of financial statements - Financial Ratio Analysis.								
COST ACCOUNTING								9
Cost Accounting - Types of costing - traditional costing approach - activity based costing - full cost pricing - marginal cost pricing - going rate pricing - bid pricing - feasibility reports - technical, economic and financial feasibility.								
Total Periods:								45
Text Books:								
1. McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics, Cengage Learning, 13 th Edition, 2013.								
2. Prasanna Chandra. 'Fundamentals of Financial Management', Tata McGraw Hill Publishing Ltd., 8 th Edition, 2011.								
References:								
1. Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007.								
2. Sasmitha Mishra, ‘Engineering Economics and costing’, PHI Learning, 2 nd Edition, 2010.								

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		1				3					3	1				
CO2	1										3	2				
CO3				2							3	1				
CO4											3	1				
CO5		2									3	1				
CO6		2									3	1				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

231BAEC		ESSENTIALS OF MANAGEMENT				L	T	P	C
						3	0	0	3
Programme:		B.E. / B.Tech		Sem:	--	Category:		OE	
Aim:	To study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.								
Course Outcomes: The students will be able to									
CO1:	Demonstrate knowledge of managerial functions, types of organizations, managers, and managerial roles and skills. (UN)								
CO2:	Apply the planning, organizing and control processes.(AP)								
CO3:	Analyze organizational structure, and organizational control and culture.(AN)								
CO4:	Explain motivation and leadership qualities and effective communicate through both oral and written presentations.(UN)								
CO5:	Analyze information by using both human and technological resources.(AN)								
CO6:	Illustrate the control management system and process.(UN)								
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, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.									
PLANNING								9	
Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.									
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.									
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.									
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	
Text Books:									
1.Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata McGraw Hill, 12th edition, 2014.									
2.James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert Jr., 'Management', Prentice-Hall of India, 6 th edition, 2012.									
References:									
1. JAF Stoner, Freeman R.E and Daniel R Gilbert 'Management', 6th Edition, Pearson Education, 2004.									
2. Robert Kreitner & Mamata Mohapatra, 'Management', Biztantra, 2008.									
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, 'Fundamentals of Management', 7th									

Edition, Pearson Education, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2								3		3	1				
CO2									3		3					
CO3						2		2								
CO4									1	3						
CO5		3		3	3						2					
CO6	1				1						3					

231BAE6	INTELLECTUAL PROPERTY RIGHTS				L	T	P	C
					3	0	0	3
Programme:	B.E. / B.Tech			Sem : --	Category:		OE	
Aim:	To provide an idea about IPR, registration and its enforcement.							
Course Outcomes: The students will be able to								
CO1:	Make use of the Intellectual property rights in professional society.(UN)							
CO2:	Identify the process that shapes the registration of various categories of Intellectual Property Rights.(AP)							
CO3:	Explain agreements, and legislations of act relating to IPR.(UN)							
CO4:	Identify digital products and respective legislations.(AP)							
CO5:	Develop the ability of individuals to recognize and enforcing the legislations.(AP)							
CO6:	Interpret an idea about IPR, registration and its enforcement.(UN)							
INTRODUCTION								9
Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.								
REGISTRATION OF IPRs								9
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.								
AGREEMENTS AND LEGISLATIONS								9
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.								
DIGITAL PRODUCTS AND LAW								9
Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.								
ENFORCEMENT OF IPRs								9
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.								
Total Periods:								45
Text Books:								
1. S.V. Satarkar, ‘Intellectual Property Rights and Copy Rights’, ESS Publications, New Delhi, 2002.								
2. Vinod V. Sople, ‘Managing Intellectual Property’, PHI Learning Pvt. Ltd, 4 th Edition, 2014.								
References:								
1. Deborah E. Bouchoux, ‘Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets’, Cengage Learning, Third Edition, 2012.								
2. Prabuddha Ganguli, ‘Intellectual Property Rights: Unleashing the Knowledge Economy’, McGraw Hill Education, 2011.								
3. Derek Bosworth and Elizabeth Webster, ‘The Management of Intellectual Property’, Edward Elgar Publishing Ltd., 2013.								

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2					3		3			3	2				3
CO2					1	2		2			2					2
CO3						2		2				2				
CO4	1				2	2		2		1						2
CO5								2			3			1		
CO6						2		2	2		2					2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)