

ACADEMIC PROGRAMME GUIDE
of
INTEGRATED BACHELOR OF COMPUTER
APPLICATIONS-MASTER OF COMPUTER
APPLICATIONS (INT. BCA-MCA)

*Based on Choice Based Credit System (CBCS)/Elective Course
System*



w.e.f.
Academic Year: 2019-20

Department of Computer Applications
Chitkara University, Himachal Pradesh, India

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1. GENERAL INFORMATION

Integrated BCA-MCA is a Five-year postgraduate course which deals with information technology and computer applications. The course includes subjects such as core programming languages Java and C++, data structure, networking and others. Integrated BCA-MCA postgraduates have good job prospects both in the government and private sector companies. After successfully passing their Integrated BCA-MCA course, students can easily find lucrative job opportunities in leading IT companies across the world.

2. ELIGIBILITY FOR ADMISSION

The candidate must have passed his/her 10+2 from recognized board of central or state government with minimum 50% marks. The candidate should have good moral character and must be in good mental and physical condition.

3. PROGRAM OVERVIEW

The Indian economy is on an extremely positive note; growth is across sectors, both in traditional industries and non IT sectors. In such an environment, corporate India will need young and talented youths to actively participate, manage, design, develop and lead several IT initiatives. It has not been better than this for aspirants of Integrated BCA-MCA. The program imparts comprehensive knowledge with equal emphasis on theory and practice in the field of information technology. An Integrated BCA-MCA postgraduate would be able to demonstrate advanced skills in the effective analysis, design and realization of business systems utilizing contemporary information technology. The broad objective of the program is to provide sound academic base from which an advanced career in Computer Applications can be developed. Conceptual grounding in computer usage as well as its practical business application will be provided making candidates suitable for IT sector entry-level jobs.

3.1 PROGRAM OBJECTIVES:

1. To equip postgraduate with the skills, knowledge and attitude necessary to work as a responsible software professional.
2. To develop appropriate intellectual, professional and personal attributes to succeed in a competitive environment.
3. Train future ready IT/Software industry professionals.
4. Impart comprehensive knowledge with equal emphasis on theory and practice.
5. To prepare tomorrow's responsible and sensible human beings.

3.2 PROGRAMME EDUCATIONAL OBJECTIVES (PEO):

PEO1: Excel in professional career and/or higher education by acquiring knowledge in mathematical, computing and engineering principles.

PEO2: Exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning.

PEO3: To develop the ability to plan, analyze, design, code, test, implement and maintain the software product for real time systems

PEO4: To prepare the students to pursue higher studies in computing and related fields and to work in the fields of teaching and research.

3.3 PROGRAMME OUTCOMES (PO)

The Programme is designed to provide the knowledge and skills. The precise aim of this course is to develop and transfer the right talent to meet the demand of corporate India and to bridge the gap between industry and academics. In such an environment, corporate India will need young and talented youth to actively participate, manage, design, develop and lead several IT initiatives. It has not been better than this for aspirants of Integrated BCA-MCA. The students shall be further groomed to work in a variety of organizational settings. The Programme Outcomes of Integrated BCA-MCA are summarized as below:

PO1: Application of Knowledge: Apply knowledge of software development paradigms in a systematic manner to solve real-time problems.

PO2: Employability: Build skills, knowledge and attitude necessary to work as responsible software professional.

PO3: Societal & Environmental Concern: Design solution for software application problems with appropriate consideration for societal and environmental issues.

PO4: Modern Tool Usage: Create, select and apply appropriate techniques, resources and modern IT tools.

PO5: Professional Ethics: Apply ethical principles and practices towards the use of technology and commit to professional ethics and responsibilities.

PO6: Individual & Team Work: Function effectively as an individual, and as a member or a leader in diverse teams and multi-disciplinary fields.

PO7: Communication Efficacy: Communicate effectively and write effective reports and Design documents, make effective presentations and give and receive clear instructions.

PO8:Life-long Learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PO9:Problem Analysis: Prepare plan, design and develop solutions for the real-world problems of the industry.

PO10:Innovation and Entrepreneurship: Identify opportunities; develop entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society.

3.3UNIVERSITY VISION AND MISSION VISION:

To be a globally recognized organization promoting academic excellence through interdisciplinary applied research and to expand realms of knowledge through innovation.

Mission:

M1: To carry out the academic processes in accordance with global standards through active teacher-student-industry participation.

M2: To promote research, innovation and entrepreneurship in collaboration with industry, research laboratories and academic institutions of global repute.

M3: To inculcate high moral, ethical and professional values amongst our students, faculty & staff.

M4: To contribute in building skillful society.

4. DURATION AND STAGES

An academic year shall be divided into regular semesters (known as term) for all the programs. The program of studies leading to the award of degree consists of 10 terms as approved by the Academic council. The maximum permissible duration for completion of degree is 5 years, after the day of first registration.

Normal duration of the degree program	Maximum time allowed for completion of program
5 years	8 years

5. RULES FOR ATTENDANCE

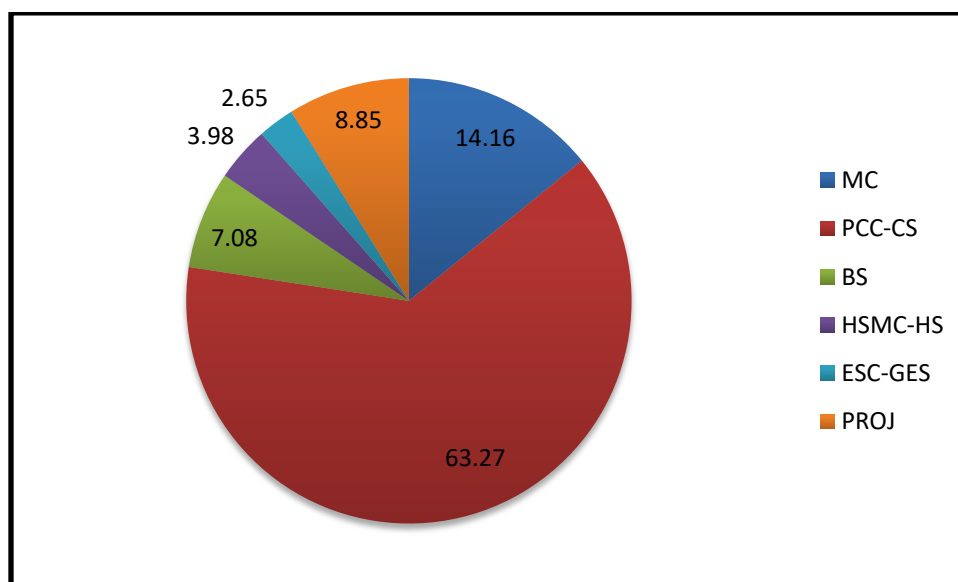
The program being highly rigorous, all the students are expected to show utmost regularity in attendance. Even a day's absence is detrimental to student's interest. The university expects its students to be regular in attending the classes. 75% attendance is compulsory in a course in order to be eligible to appear for end term examination. The students are also encouraged for participating in co-curricular activities conducted by prestigious institutions at national/International level. Such students would be eligible for grant of special duty leaves (limited by a cap decided by the Vice Chancellor) to make up for the attendance, in case any class work is missed during this period. This privilege extended to students, will not be termed as right and is limited to the attendance benefit only 10% concession in attendance requirements is possible only in case of extreme circumstances and at the sole discretion of the Vice Chancellor.

6. CREDIT ALLOCATION

CourseCredit Distribution

Year/Category	MC	PCC-CS	BS	HSMC-HS	ESC-GES	PROJ	TOTAL
Semester - I	10	7	5	2			24
Semester - II		18	4	2			24
Semester - III		18	4	2			24
Semester - IV		24					24
Semester - V	10	9			3		22
Semester - VI	8	14					22
Semester - VII		13	3	2			18
Semester - VIII	2	20			3		25
Semester - IX	2	20		1			23
Semester - X						20	20
Total	30	143	16	9	6	20	226

Course Category-wise Credit Distribution



Course Category and Definition

Course Category	Definition
BS	Basic Science Courses
HSMC-HS	Humanities, Social Sciences, Management
ESC-GES	Engineering Science course
PCC-CS	Professional Core Courses
MC	Mandatory Course
Proj	Project

Credit Allocation (Semester Wise)

SEMESTER	CREDITS
Semester I	24
Semester II	24
Semester III	24
Semester IV	24
Semester V	22
Semester VI	22
Semester - VII	18
Semester - VIII	25
Semester - IX	23
Semester - X	20
Total	226

7. COURSE STRUCTURE

The various courses prescribed for a program may be categorized in terms of their academic affinity or their functional objectives as Core Courses and Elective courses.

Core Courses: Core courses are compulsory set of papers which also include those offered for specialization in the branch/discipline.

Electives Courses: The category called “Electives” is conceptually different and operationally wider. For each program there may be a specified number of electives classified as Program Electives or Open Electives.

A faculty advisor may be appointed to guide the students to opt for the elective courses those are relevant to the subject in which student is registered for the program.

A credit is a convenient device to anticipate the number of hours per week of total effort including the class work of a student. The system recognizes only the formal contact hours in the class room /studio and laboratory apart from self-study.

Integrated BCA-MCA Course Scheme

The term-wise program consists of a prescribed set of courses described in the course scheme, adding to a certain total number of credits in each term. For each program, the term-wise pattern presented in the course scheme conveys a sense of what comes first and what comes later.

Year – I				
Semester – I				
Course Category	Course Code	Course Name	(L-T-P)	Credits
MC	CA101	Introduction to Information Technology	4-0-0	4
MC	CA102	Introduction to Information Technology-Lab	0-0-4	2
MC	CA103	PC Assembly and Troubleshooting	3-0-0	3
MC	CA104	PC Assembly and Troubleshooting Lab	0-0-2	1
PCC-CS	CA105	Programming Concepts	5-0-0	5
PCC-CS	CA106	Programming Concepts Lab	0-0-4	2
BS	AM107	Foundation Course in Mathematics	5-0-0	5
HSMC-HS	ES101	Environmental Sciences	2-0-0	2
Total Semester Credits				24

Semester II				
Course Category	Course Code	Course Name	(L-T-P)	Credits
PCC-CS	CA107	Introduction to Programming Languages	4-0-0	4
PCC-CS	CA108	Introduction to Programming Languages Lab	0-0-4	2
PCC-CS	CA142	Networking Fundamentals	4-0-0	4
PCC-CS	CA143	Networking Fundamentals-Lab	0-0-4	2
PCC-CS	CA111	UI Design for Website Lab	0-0-4	2
PCC-CS	CA112	Software Engineering	4-0-0	4
BS	AM108	Basics of Statistical Mathematics	4-0-0	4
HSMC-HS	HR101	Human Values & Professional Ethics	2-0-0	2
Total Semester Credits				24

Year – II				
Semester III				
Course Category	Course Code	Course Name	(L-T-P)	Credits
PCC-CS	CA113	Fundamentals of Object Oriented Programming	4-0-0	4
PCC-CS	CA114	Fundamentals of Object Oriented Programming Lab	0-0-4	2
PCC-CS	CA115	Relational Database Management System	4-0-0	4
PCC-CS	CA116	Relational Database Management System Lab	0-0-4	2
PCC-CS	CA118	Web Programming using PHP	0-0-4	2
PCC-CS	CA144	Artificial Intelligence	4-0-0	4
BS	AM109	Discrete Mathematics	4-0-0	4
HSMC-HS	DM101	Disaster Management	2-0-0	2
Total Semester Credits				24

Semester IV				
Course Category	Course Code	Course Name	(L-T-P)	Credits
PCC-CS	CA121	Data Structures	4-0-0	4
PCC-CS	CA122	Data Structures Lab	0-0-4	2
PCC-CS	CA123	Client-Side Scripting	4-0-0	4
PCC-CS	CA124	Client-Side Scripting Lab	0-0-4	2
PCC-CS	CA125	Introduction to Java Programming	4-0-0	4
PCC-CS	CA126	Introduction to Java Programming Lab	0-0-4	2
PCC-CS	CA119	Operating System Concepts	4-0-0	4
PCC-CS	CA145	Operating System –Lab	0-0-4	2
Total Semester Credits				24

Year – III				
Semester V				
Course Category	Course Code	Course Name	(L-T-P)	Credits
PCC-CS	CA129	Data Warehousing & ETL Technologies	4-0-0	4
PCC-CS	CA130	Data Warehousing & ETL Technologies-Lab	0-0-2	1
MC	CA131	Digital Marketing	4-0-0	4
MC	CA132	Programming in Python	0-0-4	2
ESC-GES	CS501	Cyber Security	3-0-0	3
		Electives Set I (Students to opt for any one of the elective sets)		
MC	CA127	Software Testing	4-0-0	4
	CA127A	Object Oriented Software Engineering		
	CA127B	Business Analytics		
		Electives Set II (Students to opt for any one of the elective sets)		
PCC-CS	CA133	Major Project	4-0-0	4
PCC-CS	CA133A	Software Project Management (Based on PMI Guidelines)		
Total Semester Credits				22

(a) For Students opting for Regular Semester

Semester VI				
Course Category	Course Code	Course Name	(L-T-P)	Credits
PCC-CS	CA135	Advanced Java	4-0-0	4
PCC-CS	CA136	Advanced Java Lab	0-0-4	2
MC	CA157	Basics of Data Sciences	4-0-0	4
MC	CA150	Data Sciences-Lab	0-0-4	2
PCC-CS	CA138	Programming Practicum	4-0-0	4
MC	CA140	Logical Reasoning	0-0-4	2
		Electives Set III (Students to opt for any one of the elective sets)		
PCC-CS	CA139	Basics of Cloud & IoT	4-0-0	4
	CA139A	Introduction to Internet of Things		

	CA139B	Dynamic Programming		
Total Semester Credits				22

(b) For Students opting for Industrial Training (6 Month Duration)

Semester VI			
Course Category	Course Code	Course Name	Credits
PROJ	CA141	Industrial Training	22

Year – IV				
Semester – VII				
Course Category	Course Code	Course Name	(L-T-P)	Credits
PCC-CS	CA403	Advanced Data Structures and algorithms design	3-0-0	3
PCC-CS	CA401	Advanced Database Management System	3-0-0	3
BS	AM110	Operation Research	3-0-0	3
PCC-CS	CA405	Computer Organization and Architecture	3-0-0	3
PCC-CS	CA404	Data Structures using Python Laboratory	0-0-4	2
PCC-CS	CA402	Advanced Database Management System Laboratory	0-0-4	2
HSMC-HS	CA407	Society Project Based on Design Thinking	0-0-4	2
Total Semester Credits				18

Semester-VIII				
Compulsory Subjects				
Course Category	Course Code	Course Title	L-T-P	Credits

PCC-CS	CA421	Rapid Application Development (Advance Java)	3-0-0	3
PCC-CS	CA422	Rapid Application Development (Advance Java)	0-0-4	2
ESC-GES	CA423	Theory of Computation	3-0-0	3
PCC-CS	CA424	Data Communication & Computer Networks	3-0-0	3
PCC-CS	CA425	Operating System Principals(Windows, Unix/Linux and Introduction to Mobile OS Android)	3-0-0	3
PCC-CS	CA426	OS Lab (Windows Programming/ Android Programming/Linux)	0-0-4	2
PCC-CS	CA427	Open Elective-I	1-0-2	2
MC	CA428	Soft Skills-Presentation & Gateway to Industry	0-0-4	2
TRACK : Software and Application Development				
PCC-CS	CA429AA	Full Stack Development (Server Side:PHP,ASP Client Side: CSS,JavaScript, JQuery)	2-0-4	4
PCC-CS	CA429A	Project	0-0-2	1
TRACK: Digital Marketing				
PCC-CS	CA429BA	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	1-0-2	2
PCC-CS	CA429BB	Search Engine Marketing (SEO & PPC), Web Analytics and Email Marketing & Management	1-0-2	2
PCC-CS	CA429B	Integrated Project	0-0-2	1
TRACK: Cloud Computing				
PCC-CS	CA429CA	Cloud Infrastructure & foundation	1-0-2	2
PCC-CS	CA429CB	IoT and Wireless Technologies	1-0-2	2
PCC-CS	CA429C	Project Based on Cloud	0-0-2	1
TRACK: UX & UI				
PCC-CS	CA429DA	Fundamental Of Design and Interactive Design	1-0-2	2

PCC-CS	CA429DB	UX Design & Digitalization	1-0-2	2
PCC-CS	CA429D	Project Based on UI & UX	0-0-2	1
TRACK: DBA				
PCC-CS	CA429EA	Object Oriented Database with UML	1-0-2	2
PCC-CS	CA429EB	Database and System Administration	1-0-2	2
PCC-CS	CA429E	Project	0-0-2	1
TRACK: Research Associate				
PCC-CS	CA429FA	Research Methodology	1-0-2	2
PCC-CS	CA429FB	Statistical Data Analysis using R	1-0-2	2
PCC-CS	CA429F	Research Paper	0-0-2	1
TRACK: Entrepreneurship				
PCC-CS	CA429GA	Accounting and Financial Management	1-0-2	2
PCC-CS	CA429GB	Managerial Economics	1-0-2	2
PCC-CS	CA429G	Society Project/Survey Project	0-0-2	1
TRACK: Cyber Security				
PCC-CS	CA429HA	Cybersecurity & Cyber Forensics	1-0-2	2
PCC-CS	CA429HB	Digital Security and Advanced Cryptography	1-0-2	2
PCC-CS	CA429H	Project	0-0-2	1
Total Semester Credits				25

Open Electives-I				
PCC-CS	CA427A	Data Mining & Data Warehousing	1-0-2	2
PCC-CS	CA427B	Parallel and Distributed Computing	1-0-2	2
PCC-CS	CA427C	Digital Image Processing	1-0-2	2

PCC-CS	CA427D	Software Project Management	1-0-2	2
PCC-CS	CA427E	Organizational Behavior	1-0-2	2
PCC-CS	CA427F	Agile Methods for Software Development	1-0-2	2
PCC-CS	CA427G	Web Services	1-0-2	2
PCC-CS	CA427H	Cyber Law and IT Security	1-0-2	2

YEAR-V				
Semester-IX				
		Compulsory Subjects		
Sr No	Course Type	Course Title	L-T-P	Credits
PCC-CS	CA431	Computer Graphics and Multimedia	3-0-0	3
PCC-CS	CA432	Computer Graphics and Multimedia Lab	0-0-4	2
PCC-CS	CA433	Compiler Design	3-0-0	3
PCC-CS	CA434	Software Engineering Design Testing and Quality Assurance	3-0-0	3
PCC-CS	CA435	Software Testing Lab (Selenium)	0-0-4	2
PCC-CS	CA436	Open Elective-II	1-0-2	2
HSMC-HS	CA437	Intellectual Property Rights	2-0-0	1
MC	CA438	Gateway to Industry and Communication	0-0-4	2
TRACK : Software and Application Development				
PCC-CS	CA439AA	Advanced Web Technologies-II(MongoDB, Express, Angular, React, Node)	2-0-4	4
PCC-CS	CA439A	Project	0-0-2	1
TRACK: Digital Marketing				
PCC-CS	CA439BA	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	1-0-2	2
PCC-CS	CA439BB	Affiliate Marketing and Online Reputation Management (ORM)	1-0-2	2
PCC-CS	CA439B	Project	0-0-2	1

TRACK: Cloud Computing				
PCC-CS	CA439CA	Cloud Computing with AWS	1-0-2	2
PCC-CS	CA439CB	Distributed System and Cloud Architecture	1-0-2	2
PCC-CS	CA439C	Project	0-0-2	1
TRACK: UX & UI				
PCC-CS	CA439DA	Empathy & Its Tools	1-0-2	2
PCC-CS	CA439DB	User Interface Design	1-0-2	2
PCC-CS	CA439D	Design Thinking Project	0-0-2	1
TRACK: DBA				
PCC-CS	CA439EA	Database Technologies & Essentials (Database Cloud Control, Database Security, Database Firewall)	1-0-2	2
PCC-CS	CA439EB	DataBase Administration-II(Database Performance. Management and Tuning)	1-0-2	2
PCC-CS	CA439E	Project	0-0-2	1
TRACK: Research Associate				
PCC-CS	CA439FA	Matlab Programming	1-0-2	2
PCC-CS	CA439FB	Advanced Research Methodology	1-0-2	2
PCC-CS	CA439F	Research Paper	0-0-2	1
TRACK: Entrepreneurship				
PCC-CS	CA439GA	E-Commerce and E-Governance, ERP	1-0-2	2
PCC-CS	CA439GB	Management Information Systems	1-0-2	2
PCC-CS	CA439G	Society Project	0-0-2	1
TRACK: Cyber Security				
PCC-CS	CA439HA	Secure Software Development	1-0-2	2

PCC-CS	CA439HB	Malware Analysis and Reverse Engineering	1-0-2	2
PCC-CS	CA439H	Project	0-0-2	1
Total Semester Credits				23

Open Electives-II				
PCC-CS	CA436A	Artificial Intelligence and Neural Networks	1-0-2	2
PCC-CS	CA436B	Human Resource Management	1-0-2	2
PCC-CS	CA436C	Block Chain Technologies	1-0-2	2
PCC-CS	CA436D	Open Source Technologies	1-0-2	2
PCC-CS	CA436E	Cryptography and Network Security	1-0-2	2
PCC-CS	CA436F	Deep Learning	1-0-2	2
PCC-CS	CA436G	Data Science	1-0-2	2
PCC-CS	CA436H	Big Data Analytics	1-0-2	2
PCC-CS	CA436I	Natural Language Processing & Fuzzy Logics	1-0-2	2
PCC-CS	CA436J	Machine Learning Using Python	1-0-2	2

Semester IX			
For Students opting for Industrial Training (1 Year Duration)			
		Course Name	Credits
PROJ	CA440A	Co-OP Training	43

Semester X			
		Course Name	Credits
PROJ	CA440B	Industrial Training	20

List of Courses:

Basic Science Courses (BS)			16
Course Code	Course Name	L-T-P	Credits
AM108	Basics of Statistical Mathematics	5+0+0	5
AM109	Discrete Mathematics	4+0+0	4
AM107	Foundation Course in Mathematics	4+0+0	4
AM110	Operation Research	3+0+0	3

Humanities, Social Science and Management Courses (HSMC-HS)			9
Course Code	Course Name	L-T-P	Credits
ES101	Environmental Sciences	2+0+0	2
HR101	Human Values & Professional Ethics	2+0+0	2
DM101	Disaster Management	2+0+0	2
CA407	Society Project Based on Design Thinking	0+0+4	2
CA437	Intellectual Property Rights	2+0+0	1

Mandatory Course (MC)			30
Course Code	Course Name	L-T-P	Credits
CA101	Introduction to Information Technology	4+0+0	4
CA102	Introduction to Information Technology-Lab	0+0+4	2
CA103	PC Assembly and Troubleshooting	3+0+0	3
CA104	PC Assembly and Troubleshooting Lab	0+0+2	1
CA131	Digital Marketing	4+0+0	4
CA127	Software Testing	4+0+0	4
CA132	Programming in Python	0+0+4	2
CA137	Advanced Digital Marketing	4+0+0	4
CA140	Logical Reasoning	0+0+4	2
CA428	Soft Skills-Presentation & Gateway to Industry	0+0+4	2
CA438	Gateway to Industry and Communication	0+0+4	2

Professional Core Courses (PCC-CS)			253
Course Code	Course Name	L-T-P	Credits
CA105	Programming Concepts	5+0+0	5
CA106	Programming Concepts Lab	0+0+4	2
CA107	Introduction to Programming Languages	4+0+0	4
CA108	Introduction to Programming Languages Lab	0+0+4	2
CA142	Networking Fundamentals	4+0+0	4

CA143	Networking Fundamentals-Lab	0+0+4	2
CA111	UI Design for Website Lab	0+0+4	2
CA112	Software Engineering	4+0+0	4
CA113	Fundamentals of Object Oriented Programming	4+0+0	4
CA114	Fundamentals of Object Oriented Programming Lab	0+0+4	2
CA115	Relational Database Management System	4+0+0	4
CA116	Relational Database Management System Lab	0+0+4	2
CA118	Web Programming using PHP Lab	0+0+4	2
CA117	Web Programming using PHP	4+0+0	4
CA121	Data Structures	4+0+0	4
CA122	Data Structures Lab	0+0+4	2
CA123	Client-Side Scripting	4+0+0	4
CA124	Client-Side Scripting Lab	0+0+4	2
CA125	Introduction to Java Programming	4+0+0	4
CA126	Introduction to Java Programming Lab	0+0+4	2
CA119	Operating System Concepts	4+0+0	4
CA145	Operating System –Lab	0+0+4	2
CA129	Data Warehousing & ETL Technologies	4+0+0	4
CA130	Data Warehousing & ETL Technologies-Lab	0+0+2	1
CA133	Major Project	4+0+0	4
CA148	Software Project Management (Based on PMI Guidelines)	4+0+0	4
CA135	Advanced Java	4+0+0	4
CA136	Advanced Java Lab	0+0+4	2
CA138	Programming Practicum	4+0+0	4
CA139	Basics of Cloud & IoT	4+0+0	4
CA401	Advanced Data Structures and algorithms design	3+0+0	3
CA403	Advanced Database Management System	3+0+0	3
CA405	Computer Organization and Architecture	3+0+0	3
CA402	Data Structures using Python Laboratory	0+0+4	2
CA404	Advanced Database Management System Laboratory	0+0+4	2
CA421	Rapid Application Development (Advance Java)	3+0+0	3
CA424	Data Communication & Computer Networks	3+0+0	3
CA425	Operating System Principals(Windows, Unix/Linux and Introduction to Mobile OS Android)	3+0+0	3
CA427	Open Elective-I	1+0+2	2
CA422	Rapid Application Development (Advance Java)	0+0+4	2
CA426	OS Lab (Windows Programming/ Android Programming/Linux)	0+0+4	2
CA429AA	Advanced Web Technologies-I (Server Side:PHP,ASP Client Side: CSS,JavaScript, JQuery)	2+0+4	4
CA429A	Project	0+0+2	1
CA429BA	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	1+0+2	2
CA429BB	Search Engine Marketing (SEO & PPC), Web Analytics and Email Marketing & Management	1+0+2	2
CA429B	Integrated Project	0+0+2	1

CA429CA	Cloud Infrastructure & foundation	1+0+2	2
CA429CB	IoT and Wireless Technologies	1+0+2	2
CA429C	Project Based on Cloud	0+0+2	1
CA429DA	Fundamental Of Design and Interactive Design	1+0+2	2
CA429DB	UX Design & Digitalization	1+0+2	2
CA429D	Project Based on UI & UX	0+0+2	1
CA429EA	Object Oriented Database with UML	1+0+2	2
CA429EB	Database and System Administration	1+0+2	2
CA429E	Project	0+0+2	1
CA429FA	Research Methodology	1+0+2	2
CA429FB	Statistical Data Analysis using R	1+0+2	2
CA429F	Research Paper	0+0+2	1
CA429GA	Accounting and Financial Management	1+0+2	2
CA429GB	Managerial Economics	1+0+2	2
CA429G	Society Project/Survey Project	0+0+2	1
CA429HA	Cybersecurity & Cyber Forensics	1+0+2	2
CA429HB	Digital Security and Advanced Cryptography	1+0+2	2
CA429H	Project	0+0+2	1
CA427A	Data Mining & Data Warehousing	1+0+2	2
CA427B	Parallel and Distributed Computing	1+0+2	2
CA427C	Digital Image Processing	1+0+2	2
CA427D	Software Project Management	1+0+2	2
CA427E	Organizational Behavior	1+0+2	2
CA427F	Agile Methods for Software Development	1+0+2	2
CA427G	Web Services	1+0+2	2
CA427H	Cyber Law and IT Security	1+0+2	2
CA431	Computer Graphics and Multimedia	3+0+0	3
CA433	Compiler Design	3+0+0	3
CA434	Software Engineering Design Testing and Quality Assurance	3+0+0	3
CA436	Open Elective-II	1+0+2	2
CA432	Computer Graphics and Multimedia Lab	0+0+4	2
CA435	Software Testing Lab (Selenium)	0+0+4	2
CA439AA	Advanced Web Technologies-II(MongoDB, Express, Angular, React, Node)	2+0+4	4
CA439A	Project	0+0+2	1
CA439BA	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	1+0+2	2
CA439BB	Affiliate Marketing and Online Reputation Management (ORM)	1+0+2	2
CA439B	Project	0+0+2	1
CA439CA	Cloud Computing with AWS	1+0+2	2
CA439CB	Distributed System and Cloud Architecture	1+0+2	2
CA439C	Project	0+0+2	1
CA439DA	Empathy & Its Tools	1+0+2	2
CA439DB	User Interface Design	1+0+2	2

CA439D	Design Thinking Project	0+0+2	1
CA439EA	Database Technologies & Essentials (Database Cloud Control, Database Security, Database Firewall)	1+0+2	2
CA439EB	DataBase Administration-II(Database Performance. Management and Tuning)	1+0+2	2
CA439E	Project	0+0+2	1
CA439FA	Matlab Programming	1+0+2	2
CA439FB	Advanced Research Methodology	1+0+2	2
CA439F	Research Paper	0+0+2	1
CA439GA	E-Commerce and E-Governance, ERP	1+0+2	2
CA439GB	Management Information Systems	1+0+2	2
CA439G	Society Project	0+0+2	1
CA439HA	Secure Software Development	1+0+2	2
CA439HB	Malware Analysis and Reverse Engineering	1+0+2	2
CA439H	Project	0+0+2	1
CA436A	Artificial Intelligence and Neural Networks	1+0+2	2
CA436B	Human Resource Management	1+0+2	2
CA436C	Block Chain Technologies	1+0+2	2
CA436D	Open Source Technologies	1+0+2	2
CA436E	Cryptography and Network Security	1+0+2	2
CA436F	Deep Learning	1+0+2	2
CA436G	Data Science	1+0+2	2
CA436H	Big Data Analytics	1+0+2	2
CA436I	Natural Language Processing & Fuzzy Logics	1+0+2	2
CA436J	Machine Learning Using Python	1+0+2	2

YEAR –I (SEMESTER I)

CA101	Introduction to Information Technology	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Understand the computing basics, network applications, human computer interactions. Evaluate the fundamentals of computers, IT and the various related technologies to enhance IT related skills.
- CLO 2. Appreciate the benefits of different number systems and be able to perform appropriate computations on different number systems as well as able to understand computer codes.
- CLO 3. Enhance calculation skills using binary arithmetic. Evaluate the Boolean expressions and reduce those to simplified forms.
- CLO 4. Learn Skills of designing digital circuits using the logic gates. Comprehend the need, benefits and functions of operating systems in computers.
- CLO 5. Realize the significance of open source movement and the various licenses available under open source paradigm. To understand basic concepts of Microprocessors.

Syllabus:

Basics of Computer System: Evolution/Generations/Types of computer systems, Block diagram of computer, Application Areas of Computers. Memory and Storage, Need, Types of computer memory. Data storage devices. Number System: need, types, conversions from one number system to another number system. Arithmetic Operations (addition, subtraction, multiplication and division) on numbers of different number systems. Computer Codes. Boolean algebra: Concepts, Postulates, Principles, forms of Boolean expressions. Logic Gates and Logic Circuits Computer Software: Introduction, types and categories. Programming languages: Need, categories. Outline view of translators I/O devices. Computer Networking: basics, types, topologies, devices employed in networking. Introduction to Internet, cloud and cloud-based services, effects of cloud-based services on business. Brief introduction to networking protocols (http, https, ftp, telnet and DNS) Operating System: Need, functions, basic operations. Open source Software: History, principles, success, methodologies, various open-source licensing

options. Viruses: introduction to different kind of viruses and their anti-dots. Introduction to net etiquettes.

Suggested Books:

1. Sinha, P. K. & Sinha P., 2010, “Computer Fundamentals”, 4th Ed., BPB Publications.
2. V. Rajaramna, “Introduction to Information Technology”, 3rd Edition (2018), PHI
3. Norton P., 2012, “Introduction to Computers”, 9th Ed., Tata McGraw-Hill

CA102	Introduction to Information Technology-Lab	0+0+4	2
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Course Learning Outcomes (CLO):

CO1: Create various text formatting features, image formatting features, mail merge feature and table formatting features in Writer document.

CO2: Construct spreadsheets through Libre-Office Calc

CO3: Evaluate data values and use the Calc functions, graphs and charts for basic statistical computations.

CO4: Learn skill of presentations through Slide Masters and Templates using LibreOffice Impress

CO5: Illustrate the benefits of animations in the slides.

Syllabus :

Introduction to Ubuntu Interface - Unity Launcher, Using Terminal, Terminal commands:

System Information Commands: date, cal, uptime, cat, man, du, df, free, whereis, Terminal commands: File Commands: ls, pwd, cd, cp, mv, rm, rmdir, mkdir, man, sudo. Searching: grep, locate, File Permissions: chmod, Installation: make, make install, Compression: tar, gzip

Process Management: ps, kill, killall, bg, fg, Network: ping, whois, wget, Introduction to Libre Office Comparison with MS-Office, Components: Writer, Calc, Impress, Math, Draw, Base Opening, saving, closing a document in Writer Text Formatting: Selecting text, Cutting, copying, and pasting text, Finding and replacing text and formatting, Inserting special characters, Formatting paragraphs, Formatting characters, Auto-formatting, Creating numbered or bulleted lists, Using footnotes and endnotes Formatting pages: Set headers and footers, page numbers, Working with Pictures/Images Adding images to a document, Modifying an image: Crop, resize, rotate, transparency, Using Writer's drawing tools: Creating, resizing, grouping of drawing objects, Positioning images within the text, Adding captions to images, Using Tables in Writer Creating a table, creating nested tables Formatting the table layout: Resizing and positioning the table, resizing rows and columns, merging cells, specifying table border, setting background color and graphics, Formatting the table text: rotating text in table cells, sorting table text, automatic formatting Data entry and manipulation in tables Additional table

operations: Merging and splitting tables, Copying table, inserting paragraph before and after a table, Using Mail Merge Introduction and benefits of mail merge, Creating and registering the data source, Deregistering a data source, Re-registering an existing data source, Creating a form letter, Printing mailing labels. Printing envelopes, Using the Mail Merge Wizard to create a form letter. Introduction to Calc Spreadsheets, sheets and cells

Creating, opening and saving spreadsheets, Navigating within spreadsheets, Selecting items, Inserting/deleting columns and rows Working with sheets: Insert new sheets, deleting sheets, renaming the sheets, moving and copying sheets Viewing Calc: Freezing/Unfreezing rows and columns, Splitting the screen. Content Handling in Calc Merging and splitting cells, Sharing content between sheets, Editing data, Formatting data, AutoFormat of cells and sheets, Value highlighting, Using conditional formatting, Hiding and showing data, Sorting records Using Functions in Calc: ROUND, SUM, AVERAGE, PRODUCT, QUOTIENT, POWER, MIN, MAX, COUNT, COUNTIF, MEDIAN, MODE, QUARTILE, RANK, FLOOR CEILING, ODD, EVEN. Charts and Graphs Chart Wizard, Chart types, Editing and Formatting charts and graphs, Adding drawing objects to charts, Resizing and moving the chart, Exporting charts, Introduction to Impress Creating a new presentation, Importing/cropping/resizing/rotating pictures, Writing text, using tables, Formatting a presentation, Running a slide show, Presenter Console, Using Slide Masters and Templates Creating and applying slide master, Creating, applying and exporting templates.

Suggested Books:

1. Sinha, P. K. & Sinha P., 2010, “Computer Fundamentals”, 4th Ed., BPB Publications
2. Helmke M, Graner A., 2012, "The Official Ubuntu Book", Seventh Edition, Prentice Hall, published under the Creative Commons Attribution-ShareAlike 3.0 license, available at <http://creativecommons.org/licenses/by-sa/3.0/>
3. Norton P., 2012, “Introduction to Computers”, 9th Ed., Tata McGraw-Hill

CA103	PC Assembly and Troubleshooting	3-0-0	3
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Course Learning Outcomes:

- CLO 1. Identify the main components for the PC to enable new startup.
- CLO 2. Learn about power supplies and the skills to trouble-shoot various power-related problems.
- CLO 3. Have an idea about the processor generations used in PCs starting from the first Intel generations to current CPU families.
- CLO 4. Familiarize themselves with PC memories such as RAM and ROM devices. This includes RAM types, RAM upgrading, ROM BIOS, and the CMOS chip.
- CLO 5. Know about motherboards and the various technologies connected to main boards such as Chipsets, Buses, and various BIOS types. Terms such as PCI, ISA, AGP, MCA, POST, Bootstrap loader, IDE controllers, Regulators, Heat sinks, and others will be familiar to the students to become entrepreneurs.

Syllabus:

Physical identification of components of desktops/laptops. Brief overview of motherboards, expansion slots, system buses (Control, address and data buses), various kinds of ports, cabinets and power supplies. Introduction to BIOS, BIOS features, BIOS and Boot sequence, BIOS troubleshooting and BIOS upgrade. Brief introduction and comparisons of Windows 10, Linux and Apple operating system. Introduction of their respective file system. Installation sequence of Windows 10 and Linux. Name of software drivers requirement for running computers (Sound, Camera, Chipset, and Keyboard and display driver). Windows diagnostic tools (Defrag, clean up etc.) Web browsers: Introduction to different kind of web browsers (Internet edge, Chrome, Firefox and safari) and their configuration settings (like privacy setting, parental control etc.) Printers: Introduction to printer technologies. How to attach and install printers on respective operating system. Troubleshooting: Trouble shooting procedure (Fault location, fault finding aids, test and measuring tools).

Suggested Books:

1. Minasi, M., & Petroustos, E., 2016, 16th Ed., "The complete PC upgrade and maintenance guide", San Francisco, CA: Sybex.

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2. Mueller, S., 2003, Upgrading and repairing PCs. 2nd Ed., Que Publishing.
 3. Sinha, P. K. & Sinha P., 2010, “Computer Fundamentals”, 4th Ed., BPB Publications.

CA104	PC Assembly and Troubleshooting-Lab	0+0+2	1
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Course Learning Outcomes(CLO):

CLO1: Working on various the basic hardware components of computer systems required for entrepreneurship .

CLO2: Working on PC memories such as RAM and ROM devices. This includes RAM types, RAM upgrading, ROM BIOS, and the CMOS chip.

CLO3: Analyze about power supplies and the skills to trouble-shoot various power-related problems.

CLO4: Recall the various tools available in Windows or provided by third-party companies that helps in PC troubleshooting and maintenance.

CLO5: Implement about Video technologies directly connected to PCs such as CRT monitors and VGA cards.

Syllabus

Understand various tools required to Assemble/ Disassemble a PC with safety precautions. Demonstrate the brief overview of motherboards, expansion slots, system buses (Control, address and data buses), various kinds of ports, cabinets and power supplies.

Introduction to BIOS, BIOS features, BIOS and Boot sequence, BIOS troubleshooting and BIOS upgrade. Perform disk partitioning and formatting of a hard disk, Create an Image of an Operating System Introduction to Operating System. Brief introduction and comparisons of Windows10, Linux and Apple operating system. Install Windows Operating System on a computer & concept of DUAL booting. Installation sequence of Windows10 and Linux. Name of software drivers requirement for running computers (Sound, Camera, Chipset, and Keyboard and display driver). Windows diagnostic tools (Defrag, clean up etc.) Installation/Uninstall/Updating Ubuntu Software Center, Synaptic Package Manager, Unity Dash, Introduction to different kind of web browsers (Internet edge, Chrome, Firefox and safari) and their configuration settings (like privacy setting, parental control etc.) Printers: Introduction to printer technologies. How to attach and install printers on respective operating system. Sharing: Introduction to sharing, Networks Utilization of Resources, Troubleshooting: Trouble shooting procedure (Fault location, fault finding aids, test and measuring tools).

Suggested Book(s):

1. Minasi, M., & Petroustos, E. (2016). The complete PC upgrade and maintenance guide (No. 1). San Francisco, CA: Sybex.
2. Mueller, S. (2003). Upgrading and repairing PCs. Que Publishing.
3. Sinha, P. K. & Sinha P., 2010, "Computer Fundamentals", 4th Ed., BPB Publications.

AM107	Foundation Course In Mathematics	5-0-0	5
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Course Learning Outcomes:

- CLO 1. Student will construct and analyze the graphs of trigonometry functions. Students will apply the concepts of trigonometry to any angle in a rectangular co-ordinate plane.
- CLO 2. Describe how circle, parabola, ellipse and hyperbola form the sections of cone and drive the standard equations of conics.
- CLO 3. Understand the respective application areas such as maxima-minima and area of a plane region through an overview of differentiation and integration respectively.
- CLO 4. Enhance mathematical skills to solve computer related problems.
- CLO 5. Develop Skills to correlate programming problems with mathematics.

Syllabus:

Matrices & Determinants: Types, Properties, Inverse. Solution of Linear System of equations, Rank, Consistency of linear system of equations, Cayley Hamilton Theorem, Eigen values and Eigen vectors, Diagonalization of matrices. Expansion & Properties of Determinants, Cramer's Rule. Coordinate Geometry: Review, Equations of Straight Lines, Circle, Ellipse, Parabola, and Hyperbola. Differentiation: Derivatives, Derivatives Of Sum, Differences, Product and Quotients, chain Rule, Composite functions, Logarithmic Differentiation, Maxima & Minima.

Suggested Books:

1. Riley, K. F., & Hobson, M. P. (2011). Foundation Mathematics for the Physical Sciences. Cambridge University Press.
2. Dr.J.S.Bindra and K.S. Gill (2016), "Applied Mathematics (Vol. II)", 5th revised edition, 5th Ed., Khanna Publications.
3. Bindra J S & Gill K S, "Applied Mathematics – II", 2nd Ed., 2015, Bindra Publications.

CA105	Programming Concepts	5-0-0	5
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Course Learning Outcomes:

- CLO 1. Understand the requirement of program in software development
- CLO 2. Develop the logic building ability for given problem
- CLO 3. Understand the program constructs and its related activities to improve logical skills
- CLO 4. Convert a given logic into a Pseudo code and flowcharts to improve logical skills.
- CLO 5. Able to convert given algorithm to its corresponding code and enhance coding skills.

Syllabus:

Overview of Computers and Logic: Simple program logic, program development cycle, developing pseudo code statements, Flowcharts, need of sentinel values. Understanding programming and user environments, programming models. Working with Data, Creating Modules, and Designing Quality Programs. Modularization, creating hierarchy charts. Structured programming: need, paradigms and techniques for structuring and modularizing unstructured logic Decision making: Evaluating Boolean expressions to make comparisons, various operators used in programming logic, precedence rules for operators. Iteration: Concept, need, application, types of loops, nested loops, common mistakes using loops Arrays: Concept, memory occupancy, array usage, traversal, manipulation of specific values in array, manipulating arrays to replace nested decisions, searching, and parallel arrays. Note: Implementation of above concepts/techniques to be implemented in C Language.

Suggested Books:

1. Farrell, Joyce, 2014, "Programming Logic and Design Comprehensive", sixth edition, Cengage Learning.
 2. Yashwant, K., 2017, "Let us C, Array and Pointers", 16th edition, BPB publication.
- Balagurusamy, E., 2016, "Programming in ANSI C", Tata McGraw-Hill Education

CA106	Programming Concepts Lab	0-0-4	2
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Course Learning Outcomes (CLO):

CL O1: Have the practical exposure of pseudo code for basic real life situations.

CLO2: Apply logics in order to develop programs in any programming language.

CLO3: Implement looping concepts for implementing an iterative condition using flowchart construct required for employability

CLO4: Create a working module of a stated problem and to develop a blueprint for developing a program in any programming language.

CLO5: Recall the syntax and semantics of the “C” language as well as data types offered by the language.

CLO6: Use the various constructs of a programming language viz. conditional, iterations.

Syllabus:

Development of Simple program logic, program development cycle, developing pseudo code statements, Flowcharts, need of sentinel values. Understanding programming and user environments, programming models. The special track is organized as a series of lectures, and exercises using C programming languages and focusing on discussing how to write a program of moderate complexity by using C language. Modularization, Creating hierarchy charts. Structured programming: need, paradigms and techniques for structuring and modularizing unstructured logic. Demonstrate the use of various Format Specifiers. Decision Control Statements (If-else, switch etc.), Implementation of Looping Constructs using while, do while & for. Implementation of one dimensional array and two dimensional array and their operations traversal, manipulation of specific values in array, manipulating arrays to replace nested decisions, searching, and parallel arrays. String functions. Demonstrate the use of User defined Function. How to create, initialize, assign and access a pointer variable. Read and print student details using structure pointer, demonstrate example of structure with pointer, create memory for int, char and float variable at run time, Dynamic Memory Allocations and Storage classes available in C.

Note: Implementation of above concepts/techniques to be implemented in C Language.

Suggested Books:

1. Farrell, Joyce, 2014, “Programming Logic and Design Comprehensive”, sixth edition, Cengage Learning.
2. Yashwant, K., 2017, “Let us C, Array and Pointers”, 16th edition, BPB publication.
3. Balagurusamy, E., 2016, “Programming in ANSI C”, Tata McGraw-Hill Education

ES101	Environmental Sciences	2-0-0	2
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Course Learning Outcomes:

- CLO 1. Describe about all the natural resources, various ecosystems and energy resources, environmental pollution, waste management, biodiversity and human population.
- CLO 2. Design, identify and analyze both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming) environmental problems.
- CLO 3. Analyze the societal and environmental impacts of energy with respect to meet the growing energy needs for sustainable growth.
- CLO 4. Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world
- CLO 5. Understand the real world issues to improve skills related to pollution.

Syllabus:

Introduction to environmental studies: Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development. Ecosystems: Structure and function of an ecosystem. Producers, consumers and decomposers, energy flow in the ecosystem, food chains, food webs and ecological succession Introduction, types, characteristic features, and case study of the following ecosystems: Forest ecosystem Grassland ecosystem Desert ecosystem Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Natural Resources: Renewable and non-renewable resources Land resources and Land use change; land degradation, soil erosion and desertification Deforestation: Causes and Impacts due to mining, dams building on environment, on forest, biodiversity and tribal populations. Water resources: Use and over exploitation of surface and ground water, floods, drought, conflicts over water (international and inter-state). Energy resources: renewable and non-renewable energy sources use of alternate energy sources, Growing energy needs, Case studies. Biodiversity and Conservation Definition Levels of biological diversity : genetic, species and ecosystem diversity. Bio-geographical classification of India; biodiversity patterns and global biodiversity Hot-spots. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: Habitat loss, poaching of wildlife, man wildlife conflicts, biological invasions;

Conservation of biodiversity: Insitu and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services :Ecological,economic, social, ethical, aesthetic and informational values. Environmental Pollution: Definition :types, Causes, effects and control measures of Air ,Water, Soil, and Noise pollution. Nuclear hazards and human health risks. Solid waste Management: control measures of urban and industrial wastes, Pollution case studies. Environmental Policies & PracticesClimate change, global warming, ozone layer depletion , acid rain and impacts on human communities and agriculture. Environment Laws; Environment Protection Act; Air(Prevention and control of Pollution)Act;Water (Prevention and control of Pollution)Act;Wildlife Protection Act ; Forest Conservation Act.International agreements; Montreal and Kyoto protocols and Conservation on Biological Diversity (CBD).Nature reserves,Tribal Populations and rights, and human wildlife conflicts in Indian context.Human Communities and the Environment: Human Population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies. Disaster management; floods, earthquake, cyclones and landslides. Environmental movements; Chipko, silent valley, Bishnois of Rajasthan. Environmentalethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (CNG vehicles in Delhi).

Suggested Books:

1. Erach Bharucha, “Environmental Studies”, 1st Ed., 2011, UGC Press India Ltd., New Delhi.
2. Shashi Chawla, A Text Book of Environmental Studies, Mc Graw Hill Education, 4th Ed. 2014. Mc Graw Hill.
3. The Basics of Environmental Sciences’ by Manish Randhawa, First edition, 2016. Chitkara University publications.

YEAR I – (SEMESTER II)

CA107	Introduction to Programming Languages	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Develop the logic by understanding the semantics and syntax of C to enhance employability
- CLO 2. Use break, continue and go to in looping constructs.
- CLO 3. Manipulate tabular data (i.e. Arrays)
- CLO 4. Use the user defined data types (structures and unions).
- CLO 5. Modularize their complex problems using derived and user defined data types (data structures).
- CLO 6. Able to write C programs, increasing coding skills to gain employability.

Syllabus:

Functions: Concept, Types, Library and User Defined Functions, Function calls- Call by Value, Call by Reference. Introduction to Arrays: Definition, Their Need and Importance, Types of Arrays, Initialization. Single and Multidimensional Arrays and functions. Strings: Definition, Reading and Writing Strings. String Manipulation, String Manipulations using Functions. Pointers: Concept and Usage, Pointers and Arrays, Pointer Arithmetic, String manipulation using pointers. Pointer to functions, Pointers and Strings, Array of pointers. Recursion, Storage classes, User Defined Data Types - typedef, enumerated data types, Structures: Declaring & initializing structures, Array of structures, Nested Structures, Pointers and structures. Self referential structures. Unions: Declaration, Accessing union members, Difference between Structures and union Types of memory allocations: Static and dynamic memory allocation. C support: Library Functions malloc () and calloc () and realloc(). File Handling: Introduction to Files, Their Importance and Need, Steps in processing a file. File opening modes, Input and output operations of files, Direct/Random Access operations on functions

Suggested Books:

1. Kanetkar, Y., 2017, “Let Us C”, 16th Edition BPB Publication New, Delhi.
2. Gottfried, B. S., 2017, “Theory and Problems of Programming with C”, Schaum’s outline series.

3. Reema Thareja , 2016, “Introduction to C programming “, 3rd Edition Oxford Publication

CA108	Introduction to Programming Languages Lab	0-0-4	2
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Course Learning Outcomes:

- CLO1: Recall the presence and usage of various format specifiers available in C.
- CLO2: Demonstrate the use of logical operators, nested if –else conditions and switch statement comfortably to solve any problem required for employability .
- CLO3: Employ all aspects of looping constructs in real time problem solving easily.
- CLO4: Apply and write programs to implement one dimensional and two dimensional arrays .
- CLO5: Illustrate the use of pre -defined functions available in C libraries, preprocessors and various header file directives
- CLO6: Interpret about the code reusability with the help of user defined functions

Syllabus

Demonstrate the use of various Format Specifiers, Decision Control Statements (If-else, switch etc.), Looping Constructs (while, do..while & for), Arrays(1D), Arrays(2D), Types of Arrays, Initialization. Single and Multidimensional Arrays and functions. Strings: Definition, Reading and Writing Strings. String Manipulation, String Manipulations using Functions. Pointers: Concept and Usage, Pointers and Arrays, Pointer Arithmetic, String manipulation using pointers. Pointer to functions, Pointers and Strings, User defined Function(s) (UDF), Pointers, Dynamic Memory Allocations and Storage classes, Structure and Union, File Handling: Introduction to Files, Their Importance and Need, Steps in processing a file. File opening modes, Input and output operations of files, Direct/Random Access operations on functions.

Suggested Books:

1. Kanetkar, Y., 2017, “Let Us C”, 16th Edition BPB Publication New, Delhi.
2. Gottfried, B. S., 2017, “Theory and Problems of Programming with C”, Schaum’s outline series.

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3. Reema Thareja , 2016, “Introduction to C programming “,3rd Edition Oxford Publication

CA142	Networking Fundamentals	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Describe and analyses the hardware, software, components of a network and the interrelations required for employability.
- CLO 2. Explain networking protocols and their hierarchical relationship hardware and software. Compare protocol models and select appropriate protocols for a particular design.
- CLO 3. Manage multiple operating systems, systems software, network services and security. Evaluate and compare systems software and emerging industry technologies.
- CLO 4. Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.
- CLO 5. Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security. Analyze performance of enterprise network systems.
- CLO 6. Effectively communicate technical information verbally, in writing, and in presentations to improve employability.

Syllabus:

Introduction to Networks : Basics Of Network, LANs, WANs, and the Internet ,Network Trends And Security Overview, Introduction to OSI,TCP/IP models,UDPprotocols, Describe the impact of infrastructure components in an enterprise network : Firewall,accesspoints,wirelesscontrollers.Network protocols:Network protocols and standards, movingdata in the network,network Access: Physical layer overview, network media, data link protocols and media access control,Ethernet,network Layer,transport layer,Cisco IOS,IP Addressing,subnetting,applicationlayer,ideal network.Routing and switching essentials: Switched network overview, VLAN, Routing basics,dynamicrouting,access control list,DHCP.Scaling Networks: Overview,LANredundancy,linkaggregation,wireless LAN,EIGRP overview and basic configuration.Connecting Networks:WAN,Point to point,broadband,site to site connectivity security, network monitoring,troubleshooting, quality of services.

Suggested Books:

1. Behrouz A Forouzan,,2009, Data communications and Networking, fifth edition, TMH.
2. Andrew S. Tanenbaum,,2011, Computer Networks, Seventh edition, Prentice Hall.
3. Kuross and Ross “ Computer Networking : A top Down Approach”, Sixth Edition , 2012 , published by Addison-Wesley

CA143	Networking Fundamentals Lab	0-0-4	2
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Course Learning Outcomes :

CLO1: Identify the role of network devices.

CLO2: Construct straight through cable, cross cable and roll over cable

CLO3: Learn skill to employ IP addressing and understand the concept of subnetting

CLO4: Establish a peer to peer network and confirm the communication between the devices using ping command

CLO5: Establish small network topologies using simulator

CLO6: Connect two or more different networks.

Syllabus:

Introduction to Network & Network Devices. Network Cabling and Connecters. Internet Protocol and IPv4 Subnetting: Various classes of IPv4, Public and Private Address types. Introduction to Peer-to-Peer network. Creation of P2P network, File sharing. Packet Tracer simulator. Working of various routing protocol. Router IOS, H/W of router, Ports of Router, Static Routing, Routing Information Protocol. various troubleshooting Commands such as Ping, Trace Route, Netstat, Ipconfig, Nslookup. DNS, DHCP, Telnet.

Suggested Books:

1. Behrouz. A Forouzan; "Data communication and Networking" third edition; TMH, 1993
2. Andrew S. Tanenbaum; "Computer Networks"; seventh edition, Prentice Hall, 2000

AM108	Basics of Statistical Mathematics	5-0-0	5
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Course Learning Outcomes:

- CLO 1. Possess an ability to solve the problems of data interpretation using measures of central tendency, measures of Variation and concepts of correlation and regression.
- CLO 2. Introduce and form matrices for present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.
- CLO 3. To analyze and correlate many real life problems mathematically and thus find the appropriate solution for them using theory of probability.
- CLO 4. To improve skills on calculating standard measures such as mean , median mode
- CLO 5. Able to gain skills to correlate Programming with Mathematics

Syllabus:

Statistics : Measures of Central Tendency : Arithmetic Mean, Weighted Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean, Measures of Variation : Range and its coefficient, Mean Deviation, Quartile Deviation and its coefficient, Standard Deviation, Coefficient of variation and variance, Correlation and Regression Analysis. Probability : Elementary events, Sample Space, Compound events, Types of events : Mutually exclusive, Independent Events, Additional Law of Probability, Conditional Probability, Multiplication Theorem of Probability, Baye's Theorem. Integration: Fundamental Theorem of Calculus (statement only), Indefinite Integrals (simple problems), Substitution Method, Partial Fractions, By Parts Method, Area of a plane region.

Suggested Books:

1. K.F.Riley and M.P.Hobson, Foundation Mathematics, 3rded 2011Cambridge University Press.
2. Dr.J.S.Bindra and K.S. Gill , "Applied Mathematics (Vol. II)", 5th revised edition, 5th Ed., 2016, Khanna Publications.
3. Bindra J S & Gill K S, "Applied Mathematics – II", 2nd Ed., 2015, Bindra PublicationsS.P.Gupta, M.P.Gupta, Business Statistics, Sultan Chand & Sons

CA111	UI Design for Website-Lab	0-0-4	2
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Course Learning Outcomes :

CLO1: Develop, understand and write basic HTML tags and use of elementary text formatting tags for web pages.

CLO2: Describe the use of superscript, subscript, picture/image handling techniques, Internal as well as external web links in HTML.

CLO3: Learn Skills to Design data in tabular form in HTML.

CLO4: Apply GET and POST methods for data transmission from client to the server for employability

CLO5: Create cascading style sheets as well as user-defined classes will help to design the website better

Syllabus:

Introduction to HTML, Use of HTML, basic structure of HTML file. Text Formatting Tags, Introduction to Lists: Ordered Lists and Unordered Lists, Nesting of Lists, Handling Images: Using tags and its attributes. Setting a picture as a background image. Creating Links: Anchor Tag <a>. Internal and external links. Image-maps: Create an image-map, with clickable regions.

Tables: Introduction, benefits. Basic tags and attributes related to tables. Nested tables, Usage of rowspan and colspan attributes. Forms: Benefits of using forms, creating a form using <form> tag. Form data transmission methods – GET and POST. Various form input type objects – textbox, button, label, textarea, select, etc. Frames: Introduction, creating frames, setting frame size, use of 'target' attribute, use of iframe

HTML Special Characters: Utility of special characters and specific name strings and numeric strings for certain commonly used special characters such as &, ©, “, <, >, ½, ¼, etc.

Introduction to Cascading Style Sheets: Introduction to CSS, benefits, using embedded CSS, external CSS and Inline CSS. Concepts of Classes, using <DIV> and tags. Introduction to JavaScript: utility, writing JavaScript to HTML using <script> tag,

JavaScript syntax, Data types, operators, expressions, arrays, functions. Alert dialog box, prompt dialog box, confirm dialog box.

Suggested Book(s):

Lemay L., Colburn R., Kyrnin J., "Mastering HTML, CSS & Java Script WebPublishing", BPB Publications

CA112	Software Engineering	4-0-0	4
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Course Learning Outcomes:

- CLO 1. How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment.
- CLO 2. To develop skills in one or more significant application domains.
- CLO 3. Work as an individual and as part of a multidisciplinary team to develop and deliver quality software.
- CLO 4. Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.
- CLO 5. Demonstrate the skill to use the techniques and tools necessary for engineering practice

Syllabus:

Introduction to Software Engineering/Software Development, Requirement Analysis Concepts and Principles , Design Concepts : The Design Process, Design Principles, The Design Model , Design Documentation, Coding, Top Down And Bottom Up Approach Of Programming, Structure, Level Of Testing, Test Cases, Test Criteria, Software Testing Strategies, Maintenances Characteristics, Software Project Scheduling And Designing, Software Project Management, Cost Estimation, Project Scheduling, Project Staffing, Risk Management, Quality Assurance, Project Monitoring, Overview of Component based development.

Suggested Book:

1. Pressman, R. S. (2015). Software engineering: a practitioner's approach. McGraw Hill.
2. Ian Sommerville Software Engineering (2017), Sixth Edition, Addison-Wesley Pub. Co.
3. Pankaj Jalote (2016) An Integrated Approach to Software Engineering by, Third Edition Wiley.

HR101	Human Values& Professional Ethics	2-0-0	2
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Course Learning Outcomes

- CLO 1. Understand basic concepts of human values and value education.
- CLO 2. Understand importance of personal development and creation of a positive personality.
- CLO 3. Understand importance of value education towards national and global development.
- CLO 4. Identify constitutional or national values, social, professional, religious and aesthetic values.
- CLO 5. Understand about national Integration and international cooperation necessary employability.
- CLO 6. Acquire basic working knowledge of human rights and institutions engaged in protection of these rights.

Syllabus:

General Concepts Introduction about human rights and value education, aim of education, concept of human values and its type, development: Self -analysis, gender equality, respect to age, experience, maturity, family member, coworker. Personality development and its importance in professional world Character formation through human values: Truthfulness, sacrifice, sincerity ,self-control, tolerance, positive attitude, dignity, ethicsNational values :Democracy, socialism, secularism , equality, justice, liberty, freedomSocial values : sympathy, universal brother-hood, duty towards our society Professional Values: Knowledge thirst ,sincerity towards responsibility, ethics, regularity, punctuality, and faithReligious values: Accept and respect others believes, tolerance, understanding, faithFundamental rights: Introduction and importance of fundamental rights of Indian constitutionRight to Equality: Introduction and its importance, types of rights of equality, equality before law, abolition of untouchability, abolition of titles Rights to freedom: Introduction and its importance, types of rights, freedom of speech ,freedom to reside and settle , freedom to practice any professionRights against exploitation and right to freedom of religion: Introduction and its importance and its effect on human life Cultural and educational rights and rights to constitutional remediesRight to property and right to education : Introduction and its importance, importance of education on our life Human rights-general: Concepts of human rights and its Indian and international

perspective, evolution of human rights, Universal Declaration of Human Rights, significance of the UDHR, analysis of the declaration
Therapeutic Measures : Control of mind through physical exercise, meditation and Yoga: Introduction and its effects on human mind, types of yoga, how to control our thought through yoga and meditation
Human rights of women and children :Social practice and constitutional safeguards, gender discrimination in workplace
Female feticide , physical assault and harassment, domestic violence, condition of working of women, child labor, violation by individuals, nuclear weapons and terrorism safeguard

Suggested Books:

1. Freeman and Michael, 2002, “Human rights: An interdisciplinary approach”, Cambridge: Polity Press.
2. Dr. Satish Memoria &S.V. Gankar, 2011, Dynamics of Human Relations - Dr. C.B. Memoria,2nd Ed. Himalaya Publishing House.
3. Grose, D. N., 2005, “A text book of value education”, Dominant Publishers and Distributors, New Delhi.

YEAR - II (SEMESTER III)

CA113	Fundamentals of Object Oriented Programming	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Develop the logic by understanding the semantics and syntax of C++.
- CLO 2. Modularize their complex problems using derived and user defined data types (data structures).
- CLO 3. Declare constructor to initialize variables.
- CLO 4. Understand the concept of reusability of a code using inheritance and improve employability skills.
- CLO 5. Use the overloading of functions and operators in program domain.
- CLO 6. To be able to convert a real life problem in C++ code and enhance employability probability.

Syllabus:

What is object oriented programming, Structure Of C++ program Keyword, Basic data type Derived data type Declaration of variables, Operators in C++, Control Structure, Function, Storage class specifier, Recursive function, Arrays , Structures, Union, Pointers, Pointers And Function, Pointers And Arrays, This Pointer, Classes, Arrays within class, Friend Functions, Constructor, Copy Constructor, constructor overloading , Destructor, Operator Overloading, Function Overloading, Inheritance, Virtual Base class, Abstract Class, Intro to Virtual Functions .

Suggested Books:

1. E Balaguruswamy (2017), Object Oriented programming with C++ McGraw Hill
2. K. R. VenuGopal (2015)Mastering C++, by Published By 1 ,Tata Mcgraw-Hill Edition
3. Robert Lafore (2017)Object Oriented Programming in C++ by, Techmedia Publication

CA114	Fundamentals of Object Oriented Programming Lab	0-0-4	2
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Course Learning Outcomes :

CLO1: Partition the problems in the form of classes (data and methods).

CLO2: Apply the concept of reusability using various flavours of inheritance.

CLO3: Use the variants of polymorphism via function overloading, operator overloading and virtual functions.

CLO4: Participate in the development process (using OOPS Paradigm) of technological world.

CLO5: Handling of problems in real time for employability.

Syllabus:

Introduction to basic input output statements with format specifiers. Decision control statements: Simple if, if else, nested if else, looping construction: While, for, do while, break, continue, nesting of loops. Populating array, Writing array, Initialization of array, processing of different types of arrays. Introduction to strings and user defined functions. Declaration and initialization of pointer, Pointer Arithmetic, Association of pointers with arrays, Passing by value, passing by address, passing by reference. Dynamic Memory Allocations and Storage classes. Creation of structure and union function. Create, open, close files. Comparison between two files.

Suggested Book(s):

1. E Balaguruswamy (2017), Object Oriented programming with C++ McGraw Hill
2. K. R. VenuGopal (2015)Mastering C++, by Published By 1 ,Tata Mcgraw-Hill Edition
3. Robert Lafore (2017)Object Oriented Programming in C++ by, Techmedia Publication

CA115	Relational Database Management System	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Understand the concept of Relational models, architecture for DBMS, EF Codd's rules, normalization, managing concurrent transactions, recovery and security of database.
- CLO 2. Implement ER model to identify the entities and attributes involved in the database to improve employability chances.
- CLO 3. Implement normalization to have a non-redundant anomaly free database to improve employability.
- CLO 4. Develop a normalized and secured database having backup (Implementation of the recovery techniques) and enhance employability.
- CLO 5. Analyze the difference between RDBMS and other database storing techniques.

Syllabus:

Database System Application and Purpose, Comparison between File based and Database System, Advantages and Disadvantages of DBMS, Database System Architecture: Data Independence and Mapping among Views. Components of DBMS, Responsibilities of Database Administrator, Structure of DBMS. Recent Advances in Database Technology, Database System Architecture Entity Relationship Model: Entity and Relationships, ER Diagram Cardinality and Participation, Weak and Strong Entity. Representation of ER Diagram. Data Models: Hierarchical and Network Model, Relational Data model and Comparison of all the Models, Integrity Rules Relational Algebra: Union, Intersection, Division, Product Relational Calculus: Tuple Calculus, Domain Calculus. SQL: Introduction to SQL (DDL, DML, DCL), Query Representation, Constraints, Dependencies, Anomalies, Normal Forms. Database Transaction and its states, properties of database transaction concurrency Management, Concurrency Related Problems, Dirty Read Concurrency Control, Deadlock Prevention, Deadlock Detection and Recovery, Granularity of Locking, Timestamp-Based Locking. Database Reliability and Recovery: Types of Failures, Detection Scheme, Checkpoints, Recovery Techniques, Shadow Paging Database Security and Integrity: Security and Integrity Threats, Defense Mechanisms., Security Policies, Authorization, Data Encryption, Data Integrity: Integrity Constraint. Big Data Management & NoSQL Databases, Column-oriented Databases, Graph Databases, Key-value pair Databases, Document Databases

Suggested Books:

1. Rob Coronel (2017), "Database Systems", Seventh Edition, Gex Publications.

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2. Bipin C Dessi (2017) ,“Introduction to Database System” ,Seventh Edition, Galgotia Publication
 3. Gerald V.Post (2015) “Database Management Systems”, Second Edition,Tata Mc Graw Hill

CA116	Relational Database Management System Lab	0-0-4	2
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Course Learning Outcomes:

CLO1: To use some basic commands/instructions using MySQL Terminal

CLO2: Use some advanced commands in MySQL interface, such as inserting the data, updating, and selecting the particular records according to the user queries.

CLO3: Perform various select operations on the table.

CLO4: Learn various relational Algebra Skills.

Syllabus:

Introduction To DDL Commands, DML Commands, DCL Commands, Introduction To Logical Operators, miscellaneous Operators, various Set Operators, various Data Constraints used in MySQL, Implementation of various keys in SQL. Learn various Aggregate Functions and performs mathematical functions with it. Date and Numeric Functions, String Functions, Clause, Subqueries, joins, create views of the tables for particular users, create a particular sequence in a table.

Suggested Books

1. Rob Coronel (2017), "Database Systems", Seventh Edition, Gex Publications.
2. Bipin C Dessi (2017) ,"Introduction to Database System" ,Seventh Edition, Galgotia Publication
3. Gerald V.Post (2015) "Database Management Systems", Second Edition, Tata Mc Graw Hill

CA144	Artificial Intelligence	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Use the basic concepts of Artificial Intelligence
- CLO 2. Understand the role of knowledge representation, problem solving, and learning skills in intelligent-system engineering.
- CLO 3. Represent knowledge using propositional calculus and predicate calculus. Use inference rules to produce predicate calculus expression.
- CLO 4. Solve problems using search techniques: depth-first, breadth-first, forward chaining, backward chaining, best-first and heuristic search
- CLO 5. Develop intelligent systems by assembling solutions to concrete computational problems.
- CLO 6. Learn structured knowledge through weak and strong Filler techniques like semantic networks, frame systems, scripts and conceptual dependencies.
- CLO 7. Use and learn Expert system architecture and its development.

Syllabus:

Introduction to Artificial Intelligence , Definition of AI , History of AI , Turing Test and various AI Techniques , Applications of AI, Problem Representation and Search algorithms , Met heuristic Search Algorithms , Production system characteristics , Knowledge Representation , Approaches to Knowledge Representation , Frame Problem , Semantic Nets , Inheritance , Knowledge Representation using Propositional and Predicate Logic, Intelligent Systems – Expert System Features , characteristics , Architecture , Stages in development of Expert System , Probability based expert system , Rule based Expert System , Expert System Tools .

Suggested books:

1. Elaine Rich, Kevin Knight, 2017, ‘Artificial Intelligence’, 9th Edition, Tata Mc-Graw Hill”
2. Dan W. Patterson, Englewood Cliffs,,2013 'Introduction to Artificial Intelligence & Expert Systems, 3rd Ed. (Prentice Hall International)
3. “Giarratano& Riley 2017,” 'Expert Systems Principles and Programming' 3rd Ed. PHI

AM109	Discrete Mathematics	4-0-0	4
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Course Learning Outcomes:

- CLO 1. To investigate and solve a variety of live problems related to sets, Relations and Functions.
- CLO 2. To understand and apply the theory and techniques of Lattice, Logic and Boolean algebra
- CLO 3. To gain skills related to Graph Theory and its relevance within the context of computer science and
- CLO 4. Enhance skills to find solutions of live problems related to shortest path etc.
- CLO 5. Gain skills to solve real life problems using combinatory.

Syllabus:

Set Theory: Sets and Elements, Types, Venn Diagrams, Set Operations, Duality, The Inclusion – Exclusion principle, Partitions. Relations: Representation, Composition, Types, Properties, Equivalence & Partial Ordering relations. Functions: Types, Domain, Co-domain and Range, Into Functions, One-to-One, Onto & Invertible Functions, Cardinality, Composition, Function as a relation. Lattices: Laws, Types : Bounded, Distributive, Complemented Lattices. Boolean Algebra : Duality, Basic Theorems Boolean Algebras as Lattices, SOP form of Sets, SOP form of Boolean Algebras, Logic Gates, Boolean Functions, Truth Tables, Circuits, Karnaugh's map. Graph Theory: Types, Eulerian Paths and Circuits, Hamiltonian graphs, Bipartite Graphs, Weighted graphs, Cut vertices and Cut Edges, Matrix representation, Multi graph, Planar and Non-planar graph, Graph coloring, Isomorphism of graphs, Homeomorphic graphs , Shortest Path Problems: Dijkstra's Permutation, The Pigeonhole principle, Combination.

Suggested Books:

1. S. Lipschutz, M. Lipson, 2009, Schaum's Outline: Discrete Mathematics, Second Edition, Adapted by Varsha Pati.
2. Andrew Simpson ,2011, Discrete Mathematics with example -Tata Macgraw Hill
3. Kenneth H. Rosen ,2014, Discrete Mathematics and its applications, 5th Edition, , Tata Mc Graw Hill

DM101	Disaster Management	2-0-0	2
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Course Learning Outcomes:

- CLO 1. Understand the classification, causes and impacts of disasters including basic concepts and definitions of terminologies and essential skills.
- CLO 2. Describe the principles of disaster management, various parts of disaster cycle and community based approaches of disaster risk reduction.
- CLO 3. Classify the hazard and vulnerability profile of India, enlistment of Acts and policies related with disaster management along with the role of institutions

Syllabus:

Disasters: Classification, Causes, Impacts Introduction to Disasters: Concepts, and definitions (Disaster, Hazard, Vulnerability, Resilience, Risks) Impacts (including social, economic, political, environmental, health, psychosocial, etc.) Differential impacts- in terms of caste, class, gender, age, location, disability) Classification of hazards/disasters and causes Principles of disaster management Approaches to Disaster Risk reduction: Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness, Community based DRR, Components of Disaster Relief: Water, Food, Sanitation, Shelter, and Health, Structural and non-structural measures. Hazard Profile (India) , Disaster Risk Management in India Hazard and Vulnerability profile of India Institutional arrangements (Mitigation, Response and Preparedness ,DM Act and Policy, Other related policies, plans, programmes and legislation) ,Role of Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre, and other stake-holders. Disaster and Development Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc. urban disasters, Waste Management. Global trends in disasters & Adaptation: Global Trends, Complex emergencies, Pandemics Climate change and Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources

Suggested Book:

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1. Tushar Bhattacharya (2010), Disaster Science and Management, 2nd Ed., McGraw Hill Publication.
 2. Alexander, D., & Alexander, D. E. (2000). Confronting catastrophe: new perspectives on natural disasters. 1st Ed., Oxford University Press, USA.
 3. Carter, W. N. (2008). Disaster management: A disaster manager's handbook., 1st Ed. PHI

YEAR II (SEMESTER IV)

CA121	Data Structures	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Define basic static and dynamic data structures and relevant standard algorithms for them: arrays, stack, queue, dynamically linked lists, trees.
- CLO 2. Handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures
- CLO 3. Select basic data structures and algorithms for autonomous realization of simple programs or program parts required to work in industry.
- CLO 4. Know the importance of memory management through dynamic memory allocation and make use of memory efficient data structure like linked list.
- CLO 5. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
- CLO 6. Ability to sensibly select appropriate data structures and algorithms for problems enhance employability.

Syllabus:

Data structures: Need and application, Brief concept of Complexity analysis with various notations. Various Algorithm Conventions. Introduction to array as first data structure. Types of arrays Operations on Arrays, Significance of sorting an array. Sorting techniques. Insertion Sort Advanced sorting techniques. Introduction to linked list as another data structure, linked list versus array, types of linked lists, Operations of linear linked list, Applications of linear and circular linked list: Introduction to two-way list: Operations on two way list, Stack, Operations and Application of stack, Queue, Operations on Queue, Tree, binary search tree.

Suggested Book:

1. Salaria, R. S. (2017). Data Structures & Algorithms Using C++. KHANNA 4th Ed. ,PUBLISHING HOUSE.
2. “Data Structures”, Nineteenth Reprint, Seymour Lipschutz,Tata McGraw Hill, 2016

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3. Thareja, R. (2014). Data structures using C. 4th Ed. Oxford University Press

CA122	Data Structures lab	0-0-4	2
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Course Learning Outcomes :

CLO1: The use of various insertion and deletion operations on array.

CLO2: Recognize and implement Linear and binary search method according to employability need.

CLO3: Implementation ways of various sorting like Bubble, selection, insertion, Quick and merge sort.

CLO4: Learn Skills of merging of arrays.

Syllabus

Differentiate between logical deletion and physical deletion, manipulation of Array. Apply the application of nested loops and arrange the elements in ascending/descending order. Apply the application of nested loops. Implement the working of insertion sort. find any given element in a given array. Differentiate between linear search and binary search and will be able to understand the fastest searching algorithm implementation. Implement merging of arrays using two different approaches. Understand the usage of structure data type and pointers and understand difference between static and dynamic data structure. Insertion of node at various given position in link list. Implement singly and doubly list. Work on stack using array. Implement the working of simple queue and circular queue. Use stack for pre order traversing. Understand the divide and conquer policy. Implement the working of merge sort.

Suggested Book(s):

1. Salaria, R. S. (2017). Data Structures & Algorithms Using C++. KHANNA 4th Ed. ,PUBLISHING HOUSE.
2. "Data Structures", Nineteenth Reprint, Seymour Lipschutz, Tata McGraw Hill, 2016
3. Thareja, R. (2014). Data structures using C. 4th Ed. Oxford University Press

CA123	Client Side Scripting	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Understand the purpose of client side scripting to design and develop websites
- CLO 2. Decide when to use offline and hosted jQuery and DOM .
- CLO 3. Utilize the full strength of jQuery using chaining.
- CLO 4. Apply different iteration on the wrapper set.
- CLO 5. Implement different filters on wrapper set will be achievable by the students.
- CLO 6. Explore core jQuery features which would help in designing GUI.
- CLO 7. Gain skills to start their own website design and development work.

Syllabus:

jQuery Introduction, Install and Use jQuery Library, Un-Obstructive JavaScript. First jQuery Example, jQuery Syntax, How to escape a special characters jQuery concepts, jQuery & standards mode, DOM, Executing jQuery code. Using a hosted version of jQuery, Executing jQuery code when DOM is parsed without using ready(), jQuery chaining. Using destructive jQuery methods, Aspects of the jQuery function. Extracting elements from a wrapper set, using them directly without jQuery, Checking to see if the wrapper set is empty, Using .each() when implicit iteration is not enough, Elements in jQuery wrapper set returned in document order. Custom jQuery filters can select elements when used, Using the is() method to return a Boolean value, Differences between filtering by numeric order vs. DOM relationships, Selecting elements by id when the value contains meta-characters, Grokking the :nth-child() filter, Nesting selector filters, Selecting elements by searching attribute values using regular expressions , Difference between selecting direct children vs. all descendants. Filters, Passing filter() a function instead of an expression, Traversing up the DOM. Creating, operating, and adding HTML on the fly, Grokking the index() method, Grokking the text() method, Update or remove characters using a regular expression. Grokking the .contents() method, Disable/enable form elements, determine if a form element is disabled or enabled. Selecting/clearing a single check box or radio button, Selecting/clearing multiple check boxes or radio button inputs, Determining if a check box or radio button is selected or cleared. Determine if a form element is hidden, Setting/getting the value of an input element, Setting/getting the selected option of a select element,

Setting/getting selected options of a multi-select element, Setting/getting text contained within a <textarea>, Setting/getting the value attribute of a button element, Editing select elements. Attaching/removing events, Programmatically invoke a specific handler via short event methods, jQuery normalizes the event object, Event object attributes. Event object methods, Adding a function to several event handlers, Cancel default browser behavior. Cancel event propagation, Cancelling default behavior and event propagation via return false.

Suggested Books:

1. Lindley, C. (2014). JavaScript Succinctly., 3rd Ed. Syncfusion.
2. McFarland, D. S. (2011). Javascript & jQuery: the missing manual. " 2nd Ed. , O'Reilly Media, Inc."
3. Batross, I. (2016). Web Enabled Commercial Application Development Using HTL, DHTML, Javascript, Perl CGI. Reprint Ed. Bpb Publications.

CA124	Client Side Scripting lab	0-0-4	2
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Course Learning Outcomes :

CLO1: Learn Skills to Structure and design dynamic websites.

CLO2: Memorize how to change CSS properties dynamically and wrapping existing elements into another element.

CLO3: Learn skills to deal with various DOM elements.

CLO4: Discuss chaining techniques and add/remove elements in the fly required for employability.

Syllabus

Installation of JQuery , implement the basic program of JQuery Learn to deal with jquery ready function and text() method. Modify/set attribute values dynamically. Understand click event and adding elements dynamically. Change CSS properties dynamically and wrapping existing elements into another element. Deal with descendants in DOM. Manipulate technique as well as dealing with each () method. Add and remove CSS classes. Understand event handling technique along with CSS manipulation. Understand native JavaScript looping and array technique. Deal with filter () method to modify wrapper set. Understand pattern matching using native JavaScript method. Understand how to traverse in DOM (Document Object Model). Implement HTML forms in jquery, drop down control dynamically. Apply learn event handling model and binding as well as unbinding process. Get aware of delegation event model

Suggested Book(s):

1. Lindley, C. (2014). JavaScript Succinctly., 3rd Ed. Syncfusion.
2. McFarland, D. S. (2011). Javascript & jquery: the missing manual. " 2nd Ed. , O'Reilly Media, Inc."
3. Batross, I. (2016). Web Enabled Commercial Application Development Using HTL, DHTML, Javascript, Perl CGI. Reprint Ed. Bpb Publications.

CA125	Introduction to Java Programming	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Create Java applications that leverage the object- oriented features of the java language, such as encapsulation, inheritance and polymorphism
- CLO 2. Enable the students to understand about interface and its uses to achieve the multiple inheritances.
- CLO 3. Create user exception and handle using exception handling techniques required for industry employability.
- CLO 4. Create an applet which can be executed on web browser through which student can gain insight of interactive web development.
- CLO 5. Enable the student to understand the concept of window based programming by making use of AWT components.

Syllabus:

History and Goals of Java, Java Virtual Machine, Garbage Collection, JAVA BASICS, Identifiers and Keywords, Primitive Data Types, Integral, Operators, Branching and Looping, OO Programming, Creating a Data Type, Arrays: Declaring, Creating, and Accessing Arrays, Initializing Array , Multidimensional Arrays, Copying Arrays, Advanced Class Concepts, exceptions, stream I/O, Servlets, Web Sphere Studio Application Developer Integration Edition, WebSphere Studio Enterprise Developer, Basic Operations with RAD Views and Perspectives, Searching, Setup Compiler Class Path, JRE Switching, Refactoring, Changing Class, Method, and Variable Name, Moving a Class to a Different Package, Extracting Code to a Method, Pull-up Method, Migrating Workspace from WSAD v5.x ,Project Interchange Feature, Migrating J2EE.

Suggested Books:

1. David Flanagan (2011) Java in a Nutshell”, , 4th edition, Reilly Media Publications
2. Patrick Naughton, Herbert Schildt(2017) The Java: Complete Reference”, , (3rd edition.), Osborne/McGraw-Hill.
3. E.Balagurusamy (2016) “Programming with Java”, , 3rd edition, TATA McGraw-Hill Publishing

CA126	Introduction to Java Programming Lab	0-0-4	2
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Course Learning Outcomes:

CLO1: Understanding about the basic compilation and execution of the java program for employability .

CLO2: Applying various control statements like if, if else and looping statement like for, while, do-while, nesting of loops for drawing various patterns in java.

CLO3: Applying Labeled break and continue statements, scanner class to give input to a program from keyboard in java.

CLO4: Understanding about the 1-D array, 2-D arrays, String class and various operations performed on it.

CLO5: Creating classes, creating multiple objects, various arguments passing techniques, returning values to a method and concept of method overloading.

Syllabus

Installation of JDK, JRE. Start programming with java, implement java keywords usage, datatypes available, and use of various operators in programming applications. Use various control statements like if, switch, looping statement like for, while, do-while in java and declaring and using arrays. Develop a code to create classes, define constructor for object initializing. Use the concept of reusability in java and apply Various visibility controls to hide the data. Multiple inheritance with interfaces and abstract classes.

Use various in built packages in programming concept and also can declare their own package as well. Identify the usage of multithreading in java. Know the use of various Exception classes and their respective application to handle the errors. Apply Window and graphic programming in java using Frame class etc. Use various AWT controls and can place them in any respective layout. Apply the power of java in web based applications using Applets. Create their own Applet application and can run it on web browser using HTML applet tags. Use the concept of Event classes in java and can handle Key and Mouse events. Use the concept of Event classes using event listener's interfaces and adapter classes in java.

Suggested Book(s):

1. David Flanagan (2011) Java in a Nutshell”, , 4th edition, Reilly Media Publications
2. Patrick Naughton, Herbert Schildt(2017) The Java: Complete Reference”, , (3rd edition.), Osborne/McGraw-Hill.

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3. E.Balagurusamy (2016) “Programming with Java”, , 3rd edition, TATA McGraw-Hill Publishing

CA119	Operating System Concepts	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Student should be able to identify the different types of Operating System and their components.
- CLO 2. Design and implementation of new system calls and gain skills to work in open source operating system.
- CLO 3. Implementation of existing resource management algorithms in Linux operating system .
- CLO 4. To identify various system security and protection issues and gain necessary skills.
- CLO 5. To completely administer the system using various Operating systems (Windows and Ubuntu) for managing its resources.

Syllabus:

Types of computer systems, System Components, Operating System Services, System Calls/API, System Programs, Applications and operations of operating systems Process Concept – Process Scheduling – Operations on Processes – Cooperating Processes – Inter-process Communication. Threads Multithreading Models. CPU Scheduling, Scheduling Criteria Scheduling Algorithms Multiple-Processor, Scheduling Real Time Scheduling. Process Synchronization - The Critical-Section Problem. Synchronization Hardware, Introduction to Semaphores, System Model, Process Scheduling, Process Priority, Examples of Process, Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention , Deadlock avoidance, Deadlock detection Memory Management: Swapping, paging, Segmentation, Segmentation with paging, Virtual Memory, Demand Paging, Process creation, Page Replacement Algorithms, Allocation of frames, Thrashing. File Concept Access Methods Directory Structure File System Mounting – File Sharing – Protection, File System Structure, File System Implementation Directory Implementation Allocation Methods Free-space Management. Kernel I/O Subsystems. Disk Structure – Disk Scheduling. Security Problem, User Authentication Problem, Program Threats, System Threats, Starvation aging

Suggested Book:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, Sixth Edition, John Wiley & Sons (ASIA) Pvt. Ltd.
2. Tanenbaum, A. (2016). Modern operating systems. 7th Ed. Pearson Education, Inc.,
Stallings, W. (2018). Operating Systems 10th Edition. Pearson Education India.

CA145	Operating System Concepts lab	0-0-4	2
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Course Learning Outcomes :

CLO1: Know first-hand experience of interaction with Ubuntu OS, and would be able to use some basic general purpose commands/instructions using Ubuntu Terminal

CLO2: Realize the need of File Commands navigating through file system using terminals and would be able to use those commands

CLO3: Familiarize the various attributes of the file, inode, hard links, soft links and understand the security feature of Linux.

CLO4: Learn skill to grant ownership and permissions of the files and directories and how to set permissions for files/directories.

CLO5: Demonstrate the proper use of meta characters and redirection in LINUX commands.

Syllabus

Introduction to Ubuntu Interface – Ubuntu Launcher using Terminal, understanding features of Linux, history of Linux, architecture of Linux, Terminal commands: System Information Commands: login, date, cal, clear, who, echo, man, bc, passwd, tty, uname. Introduction to File and disk system: Appreciate the file structure of Linux O.S, knowing absolute pathname. relative pathnames Terminal commands: File Commands: ls, pwd, touch, cat, cd, cp, mv, rm, rmdir, mkdir, mv, file, lp, df, du, ulimit, File permissions, Terminal commands: chmod, od, umask, chown, chgrp, zip, gzip, unzip, tar. The Shell: wildcard characters- *, ? , [], [!], [x-z], \ (escaping), ‘ ‘ (quoting) Redirection: std input(<), >(std output), |(pipes), tee, cmd substitution, Terminal commands: more, wc, pr, cmp, diff, comm., head, tail, cut, paste, sort, uniq, nl, Terminal commands: ps, &, nohup, nice, kill, bg, fg, at, batch, cron, Terminal commands: talk, mesg, finger, telnet, rlogin, mail, Advanced Filters using grep: grep, all options, regular expressions (full character set), egrep, fgrep, Vi –editor: all three modes: Input mode, command mode, last line mode commands (various command for positioning cursor in windows by character, byline, byword, commands for inserting and deleting text in file), Shell programming: Shell scripts based on : Introduction to shell script, keywords, variables, positional parameters. Use of operators: Writing shell scripts based on various operators used by shell like arithmetic operators, relational, logical, string operators and usage of “expr”, Use of conditional statements: Shell scripts based on: Writing shell scripts based on if –else decision based statements and case esac statement.

Suggested Book(s):

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, Sixth Edition, John Wiley & Sons (ASIA) Pvt. Ltd.
2. Tanenbaum, A. (2016). Modern operating systems. 7th Ed. Pearson Education, Inc.,
3. Stallings, W. (2018). Operating Systems 10th Edition. Pearson Education India.

YEAR III (SEMESTER V)

CA129	Data Warehousing & ETL Technologies	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Differentiate between the types of data and learn about historical reasons and goals for development of data warehouse technology
- CLO 2. Identify the major frameworks of data warehousing required as per industry requirements.
- CLO 3. Understand how to start-small and think-big using ETL technologies
- CLO 4. Realize the potential use of multidimensional model and OLAP in data analysis
- CLO 5. Be able to work on various ETL tools required for employability

Syllabus:

Introduction to Data, Structured, Semi-Structured and Unstructured Data. Data Warehousing: Need, characteristics, Ralph Kimball's Approach vs. W.H. Inmon's Approach, Goals of Data warehousing, Data Sources, Extract, Transform, Load, Data Integration, Technologies, Data Quality and Data Profiling, Data Warehousing Components : Sourcing, Acquisition, Cleanup and Transformation Tools. Access Tools. Warehouse Architecture, Data Warehouse and Data Marts, Multidimensional Data Modeling: Basics, Types, Techniques, Fact Table, Dimensional Model, Typical Dimensional Models: Star Schema, Snowflake Schema, Introduction to Meta Data: Repository, Management, Trends, Categorization of OLAP Tools: ROLAP and MOLAP Introduction to Business Intelligence, Business Intelligence Users and Applications, Business Intelligence Roles and Responsibilities. ETL architecture ,importance of ETL testing ,ETL Testing Work flow activities involved, Challenges in DWH ETL Testing compare to other testing. Types of ETL Testing :Data completeness, Data transformation, Data quality, Performance and scalability, Integration testing, User-acceptance testing. SQL Queries for ETL Testing : Incremental load testing ,Initial Load / Full load testing ,Different ETL tools available in the market : Informatica , Ab Initio , IBM Data stage

Suggested Books:

1. Berson, A., & Smith, S. J. (2017). Data warehousing, data mining, and OLAP. 7th Ed. McGraw-Hill, Inc..

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2. Inmon, W. H. (2016). Building the data warehouse. 4th Ed. John Wiley & Sons.
 3. Jiawei, H., Micheline, K., & Jian, P. (2016). Data mining concepts and techniques. 5th Ed.
PHI Publications

CA130	Data Warehousing & ETL Technologies Lab	0-0-2	1
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Course Learning Outcomes :

CLO1: Perform data analysis using pivot Tables.

CLO2: Learn Skills of slicing and dicing operation in MS Excel.

CLO3: Perform Vlook operation on MS Excel.

C LO4: Install Pentaho Data Integration Tool.

Syllabus

Illustrating Data Analysis using Pivot Table and Charts, Slicing and Dicing operations in MS Excel, Implementation of VLook Up, Install and Run Pentaho Data Integration IDE. Transformation, Transformation on Multiple Files, Creating Database Connection, Performing Database to files Transformation, Performing Files to database Transformation, Filtration of records.

Suggested Book(s):

1. Berson, A., & Smith, S. J. (2017). Data warehousing, data mining, and OLAP. 7th Ed. McGraw-Hill, Inc..
2. Inmon, W. H. (2016). Building the data warehouse. 4th Ed. John Wiley & sons.
3. Jiawei, H., Micheline, K., & Jian, P. (2016). Data mining concepts and techniques. 5th Ed. PHI Publications

CA131	Digital Marketing	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Understanding of the key concepts and trends associated with Digital Marketing necessary for entrepreneurship
- CLO 2. Understand the key concepts required for e-marketing & Internet Technologies.
- CLO 3. Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
- CLO 4. Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.
- CLO 5. E-business is booming and so are the opportunities for graduates to start their own e-business, consult existing e-businesses, work at e-business giants ranging from Airbnb.com to Amazon.com

Syllabus:

Digital Marketing Strategy: Introduction, Key terms and concepts, Understanding marketing strategy, Building blocks of marketing strategy; Crafting a digital marketing strategy. Content Marketing Strategy: Introduction, Key terms and concepts, Defining content marketing, Strategic building blocks, Content creation, Content channel distribution, Tools of the trade, Advantages and challenges. Web Presence: How to increase online presence and drive more traffic for a website, Search result visibility in Google for chosen keyword and phrases, Using e-mail marketing to drive traffic for a website, Posting social media content for lead generation, Tools to create and manage content, Use of Blogging as content strategy. Content Management: Writing and posting content on the web and in social networks, creating content: info graphics, the perfect blog and video; create lead and sales funnels; Create, manage and implement a content marketing strategy; Monitoring and recording results to improve content marketing campaigns; Successful content marketing examples, strategies and case studies.

Suggested Books:

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1. Venakataramana Rolla (2009), “Digital Marketing Practice guide for SMB: SEO, SEM and SMM”, CreateSpace Independent Publishing Platform, 1 st edition.
 2. Damian Ryan Kogan (2017) “Understanding Digital Marketing: Marketing strategies for Engaging the Digital Generation”, 3 rd edition.
 3. Shivani Karwal,(2014) “Digital Marketing Handbook: A Guide to search Engine Optimization, Pay Per Click Marketing, Email Marketing and Content Marketing”, Create Space Independent Publishing Platform, 1st edition.

CA132	Programming in Python	0-0-4	2
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Course Learning Outcomes :

CLO1: Learn Python fundamentals and its general purpose behavior.

CLO2: Learn skills to perform operations on numbers and strings.

CLO3: Learn skills Internal data structures like list, sets, tuples and dictionaries.

CLO4: Professional way of writing code using modular approach.

CLO5: The way of developing applications using object oriented approach.

Syllabus:

Introduction to Objects & Python's Math Library: Understanding variables and basic operations on number and string data, dealing with basics of math library (pow, sqrt, round, exp, pi, ceil, floor), displaying strings and numbers, while statement. Exploring String Object Methods: understanding string methods like upper(), lower(), isdigit(), isalnum(), isalpha(), isnumeric(), split(), endswith(), startswith(), join(), count(), strip() and exploring string iterations, basic if statement. Exploring Number Object Operations: working with number literals, dealing with hexadecimal, octal and binary numbers, basic arithmetic operations, mix type conversion, integer to float and float to integer conversion, formatting numbers. Introduction to List Object: creating empty list, initializing list, list indexing and slicing operations, input method, single and multidimensional arrays. Introduction to List Objects-II: Concatenating multiple lists, generating range based lists, list based methods like append (), extend (), insert (), index (), count (), sort (), reverse (), pop () and nested lists. Introduction to Dictionaries: creating empty dictionaries, initializing dictionaries, Accessing dictionary items, merging, and deletion. Introduction to Dictionaries-II: understanding dictionary specific methods, keys (), values (), items (), copy (), update (), pop () and dictionary comprehension. Exploring Statements and Syntax: Iterations, branching, assignment statement and expression statement and exploring print method. Introduction to python Modular Programming: declaring and calling user defined methods, recursive calls and returning multiple values via return statement. Introduction to python Modular Programming-II: Understanding local and global scopes, argument passing techniques (normal arguments: matched by position, keyword arguments: matched by name, default arguments, Using * and ** during calling time and receiving time. Exploring Object- Oriented Programming In Python: Creating classes, objects, attributes. classes v/s dictionaries, constructors and idea of inheritance. Understanding and Installing PyQt4 and QT Designer Interface. Using GUI controls like push-buttons, text-boxes, radio buttons, checkboxes, labels, managing resource files, combo boxes, list boxes, menu's and sub menu's, calendar control and other controls. Understanding signal and slots, Dealing with PyQt4 event handling

mechanism. Push button events, checkbox and radio button events, menu events, combo box and list box events etc.

Suggested Book(s):

1. Lutz, Mark. Learning python. " O'Reilly Media, Inc.", 2013.
2. Barry, Paul. Head first python. " O'Reilly Media, Inc.", 2010.
3. Swaroop, C. H. "A Byte of Python." Enllaç web (2013).

CS501	Cyber Security	3-0-0	3
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Course Learning Outcomes:

- CLO 1. Understand the Information Technology Act of India (ITA).
- CLO 2. Protect themselves from various Cybercrimes.
- CLO 3. Understand the various kind of vulnerabilities.
- CLO 4. Defend the personal data from botnets.
- CLO 5. Understand the frauds used through handheld devices such as mobile phone and PDA.
- CLO 6. Importance of ACI (Authentication, Confidentiality and Integrity) in Cyber.
- CLO 7. Explore the importance of IPR and apply it for entrepreneurship.
- CLO 8. Discover the various cons and pros of the social media.

Syllabus:

Introduction to Cyber Crime: Definition and origins of the world, cyber crime and information security, cyber criminals, classification of cyber crimes, cybercrime and ITA. Cyber Offense: Categories of Cybercrime, How criminals plans the attack, social engineering, cyber stalking, cybercafé and cybercriminals, Botnet, cloud computing. Cloud Computing Cyber Crime: Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and wireless computing era, Security challenges posed by mobile devices, Registry setting for Mobile Devices, Authentication service security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations. Tools and Methods used in Cybercrime: Proxy Server and anonymizers, Phishing, Password cracking, Keyloggers and spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, Dos and DDos Attacks, SQL Injection, Buffer Overflow, Attacks on wireless network Cyber security Organizational Implications : Cost of cyber crimes and IPR issues, Web Threats for Organizations, Security and Privacy Implications from cloud computing, Social Media Marketing, Social Computing and the Associated Challenges for Organizations ,Organizational guidelines for Internet Usage, Safe Computing, Guidelines and Computer Usage Policy, Incident Handling: An essential component of cyber security, Forensic Best Practices for Organizations, Cybercrime and Cyber terrorism: Social Political, Ethical and Psychological Dimensions: Intellectual Property in the Cyberspace,

The ethical dimension of cybercrime, The psychology, mindset and skills of hackers and other cybercriminals, Ethical Hackers Cybercrime: Illustrations, examples and mini-cases: Real Life examples, mini cases

Suggested Book:

1. Singer P.W. and Friedman A., 2014, “Cyber Security and Cyber War “, First Edition, Oxford Publication.
2. Godbole N. and Belapur S., 2014, “Cyber Security”, First Edition, Wiley-India
3. Singer, P. W., & Friedman, A. (2014). Cybersecurity: What everyone needs to know. oup 2nd Ed. USA.

CA127	Software Testing	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Apply software testing knowledge and engineering methods as per industry requirements.
- CLO 2. Design and conduct a software test process for a software testing project.
- CLO 3. Identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods to gain employable skills.
- CLO 4. Use various communication methods and skills to communicate with their teammates to conduct their practice-oriented software testing projects.
- CLO 5. Apply various testing techniques on real life projects.
- CLO 6. Differentiate static testing methods with dynamic testing.
- CLO 7. Write test case and report the bugs at various levels.

Syllabus:

A perspective of Testing, Examples: Basic Testing Vocabulary, Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Levels of testing. Examples: Generalized pseudo code, The triangle problem, Defects and identification of defects, The Multiple Roles of the Software Tester (People Relationships), Scope of Testing, Testing Constraints, Levels of Testing, The “V” Concept of Testing. Test Administration and Test Plan: Test Planning, Customization of the Test Process, Prerequisites to test planning, understand the Characteristics of the Software Being Developed, Build the Test Plan, Write the Test Plan. Testing Techniques: Structural versus Functional Technique Categories, Verification versus Validation, Static versus Dynamic Testing. Path Testing, Data Flow Testing, Boundary value analysis, Robustness testing, Worst-case testing, Special value testing, Examples, Random testing, Equivalence classes, Equivalence test cases for the triangle problem, System Testing. Test Cases: Test case Design, Building test cases, Test data mining, Test execution, Test Reporting, Defect Management, Test Coverage – Traceability matrix. Test reporting: Guidelines for writing test reports, Test Tools used to Build Test Reports. Bug reporting using

Excel Sheets.Automation Testing Basics: Basics of automation testing, Factors for choosing a particular tool, an overview for the major functional testing tools, Overview of Test management and bug tracking tools.

Suggested Books:

1. Naresh Chauhan (2016) , Software Testing Principles and Practices, Second Edition, OXFORD University Press
2. Kshirasagar Naik (2017) , Software Testing and Quality Assurance Theory and Practice, Student Edition, Wiley Publications
3. Myers, G. J., Sandler, C., & Badgett, T. (2011). The art of software testing.2nd Ed. John Wiley & Sons.

CA127A	Object Oriented Software Engineering	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer.
- CLO 2. Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.
- CLO 3. Deliver quality software products by possessing the leadership skills as an individual or contributing to the team development and demonstrating effective and modern working strategies by applying both communication and negotiation management skill.
- CLO 4. Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.
- CLO 5. To learn and understand various object oriented concepts along with their applicability contexts

Syllabus:

Software engineering concepts, software development life cycle, software process models, modeling with UML, project organization & communication, requirements elicitation, analysis & system design, object design & code, mapping models to code, testing, project management strategies, project estimation, project scheduling, risk management, quality management.

Suggested Books:

1. Pressman, R. S. (2015). Software engineering: a practitioner's approach. 7th Ed. Mc Grahill
2. Sommerville, I. (2011). Software Engineering, 9/E. Pearson Education India.
3. Jalote, P. (2012). An integrated approach to software engineering. 5th Ed. Springer Science & Business Media.

CA127B	Business Analytics	4-0-0	4
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Course Learning Outcomes:

- CLO1. To use basic functions and packages in Python.
- CLO2. To understand statistical concepts, skills and different hypothesis tests.
- CLO3. To learn how to prepare data using Python.
- CLO4. To understand statistical concepts and different hypothesis tests.
- CLO5. To learn how to prepare data using Python.

Syllabus:

About data, probability theory, inferential statistics, metrics & charts, hypothesis testing, Python, data preparation using Python, working with relational database in Python, data ingestion & inspection, concatenating data, merging data.

Suggested Books:

1. Persson, M. V., & Martins, L. F. (2016). Mastering Python Data Analysis. 6th Ed. Packt Publishing Ltd.
2. Halterman, R. L. (2011). Learning to program with Python. 3rd Ed. Python Software Foundation
3. Johannes, Ledolter R, 2013 Data Mining and Business Analytics, 3rd Ed. Wiley

CA133A	Software Project Management	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Apply project management concepts and techniques to an IT project necessary for employability.
- CLO 2. Identify issues that could lead to IT project success or failure.
- CLO 3. Explain project management in terms of the software development process.
- CLO 4. Describe the responsibilities of IT project managers.
- CLO 5. Apply project management concepts through working in a group as team leader or active team member on an IT project.

Syllabus:

Importance of Software Project Management – Activities Methodologies (Initiating, Planning, Executing, Monitoring & Controlling, Closing) – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Initiating - Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning. Software process and Process Models – Choice of Process models – mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II A Parametric Productivity Model – Staffing Pattern. objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

Suggested Books:

1. Hughes, B. (2014). MikeCotterell “Software Project Management”. 10th Edition, Tata, McGraw Hill.
2. Ramesh, G. (2015). Managing global software projects. Tata McGraw-Hill Education.
3. Royce, W. (2015). Software project management. Pearson Education India..

YEAR III (SEMESTER VI)

CA135	Advanced Java	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Demonstrate basic concepts of OOPs using JAVA programming language to become employable.
- CLO 2. Explain collection framework and easy way to use data structure in java.
- CLO 3. Define AWT package to create various components of web page.
- CLO 4. Understand swing package and its various components.
- CLO 5. Implement various events classes, event listener and adaptor classes.
- CLO 6. Understand basic steps to perform connectivity of MySQL and Java technology as per industry requirements.
- CLO 7. Create small applications that interact with database and web.

Syllabus:

Introduction to basic concepts of java. Meaning of Collection Framework, Hierarchy of Collection Framework, List Collection (Array List, Linked List & Vector). Iterable & Collection Interface, Collection Interface Methods, Properties of List Collection, Array List v/s linked list, Array List to Vector and Vector to Linked List, Array List Traversal, Linked List Specific Methods. Deque Interface Supporting LIFO and FIFO, Set Usages (Hash Set and Tree Set), Usage of List Iterator. Event handling: Event Delegation Model, Event Classes, Source of Event and Event Listener Interfaces, Adapter classes. AWT (Abstract Window Toolkit): AWT basics, AWT hierarchy introduction, AWT component class. Layout manager: border layout, grid layout, flow layout, Box layout. Swing: introduction, hierarchy of java swing classes, JComponents class methods, creating frame in swing, using JButton, JLabel, JTextField, JCheckBox, JRadioButton, JComboBox, JList. AWT and swing difference. JDBC: introduction, working with MySQL database, registering the drivers, connecting to database Preparing SQL statement, retrieving data from MySQL database.

Suggested Books:

1. E.Balagurusamy,”Programming with Java”, 2016, 3rd Ed., TATA McGraw-Hill Publishing.
2. David Flanagan, “Java in a Nutshell”, 2015, 4th edition, OReilly Media Publications.
3. E. Balagurusamy,” Programming with Java”, 2017, 2nd Ed., TATA McGraw-Hill Publishing.

CA136	Advanced Java Lab	0-0-4	2
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Course Learning Outcomes :

CLO1: Use AWT components to create user friendly interfaces for employability.

CLO2: Understand various packages required for creating java programs.

CLO3: Use swings for creating GUI in Java.

CLO4: Apply skills of event handling to interact with the GUI components.

CLO5: Understand various collections in Java and their application.

Syllabus

Classes, objects and methods: defining a class, constructors, constructor overloading, method overloading, Introduction to arraylist as a collection in Java, Linked list in Java, concept of vector class & queues demonstrate concept of frames, demonstrate layouts in Java, implementation of choice menu, demonstrate concept of swings, database connectivity of Java with MySQL

Suggested Book(s):

1. E.Balagurusamy,"Programming with Java", 2016, 3rd Ed., TATA McGraw-Hill Publishing.
2. David Flanagan, "Java in a Nutshell", 2015, 4th edition, O'Reilly Media Publications.
3. E. Balagurusamy," Programming with Java", 2017, 2nd Ed., TATA McGraw-Hill Publishing.

CA157	Basics of Data Sciences	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Obtain, clean/process, and transform data
- CLO 2. Analyze and interpret data using an ethically responsible approach required for employability.
- CLO 3. Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues
- CLO 4. Apply computing theory, languages, and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses
- CLO 5. Formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges

Syllabus:

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Variables and data types in R, Data frames, solving linear algebra for data sciences. Statistical modeling, probability distributions, fitting a model, hypothesis testing Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA: The Data Science Process, optimization for data sciences. Predictive Modeling, linear regression, model assessment, Cross validation, performance measures.

Suggested Book:

1. Van Der Aalst, W. (2016). Process mining: data science in action 2nd Ed. Heidelberg: Springer.
2. Nelson, R., & Staggers, N. (2016). Health informatics: An Inter-professional approach. 2nd Ed. Elsevier Health Sciences.
3. Zhou, Z. H. (2021). Machine learning. 1st Ed. Springer Nature..

CA138	Programming Practicum	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Understanding the data types, operators, and control structures of C.
- CLO 2. Understand the behavior, working of pointers and strings
- CLO 3. Understand the various concepts of OOPS and its benefits
- CLO 4. Decide when to use static, constant and normal objects
- CLO 5. Utilize the full strength of static polymorphism using function and operator overloading.
- CLO 6. Gain skills to apply different various type conversions and dynamic memory allocation
- CLO 7. Implement runtime polymorphism in different scenarios and inheritance
- CLO 8. Improve skills to search and sort data using algorithms.

Syllabus:

OOPS Fundamentals: Benefits of OOPS and its features. Concept of classes: defining class, defining methods, defining objects and pointer to objects. Constructor, destructor, inline methods, accessing methods, constant object and methods and this pointer. Member objects & Static Members: Member objects, member initializers, constant member object, static data members, accessing static data members. Operator Overloading: Generals, operator functions, friend function, friend classes, operator overloading, Type Conversion & Dynamic Memory Allocation: Conversion constructors, conversion functions, ambiguity of type conversions. The new and delete operator, dynamic allocation for classes and arrays. Polymorphism & Inheritance: Concept of polymorphism, virtual methods, destroying dynamically allocated objects, virtual method table and dynamic cast. Benefits of inheritance, single, multiple and multilevel inheritance. OOPS & Data Structures-I: Understanding time and space complexity, searching and sorting algorithms (bubble sort, selection sort, insertion sort, linear search and binary search). OOPS & Data Structures-II: Singular linked list implementation, doubly linked list implementation, stack implementation, linked list implementation of stack, infix to postfix

implementation using stack, infix to prefix implementation using stack, linear Queue implementation. OOPS & Data Structures-III: Tree & Its Operations Tree data structure and its operations. Graph theory and its basic operations.

Suggested Book:

1. Lynch, D.E. and Yeigh, T., 2013. Teacher Education in Australia: Investigations into Programming, Practicum and Partnership. 2nd Ed., Lulu Publisher.
2. K. R. Venugopal, and N. Chandrakant, C: Test Your Aptitude, 2015, 3rd Ed., McGraw Hills Education.
3. Adam Drozdek, Data Structures & Algorithms Using C++, 2016, 4th Ed., Course Technology.

CA140	Logical Reasoning	0-0-4	2
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Course Learning Outcomes:

- CLO 1. To improve skills required for the Aptitude test and develop an all-around personality with a mature outlook.
- CLO 2. To enhance their logical thinking, verbal reasoning and numerical reasoning.
- CLO 3. To take part effectively and confidently not only in campus placements programs but also in other exams like CAT, GMAT, SSC, Bank Po, UPSC etc.

Syllabus:

Calculation, Number System, Simplification, Surds & Indices, Square & Square roots, Formula Based Problems, HCF & LCM, Percentages, Averages, Ratio & Proportion, Allegation, Profit & Loss & Discount, Simple & Compound Interest & Installment, Partnership, Set Theory, Venn Diagrams, Time & Distances, Trains, Boats & Streams, Races & Game Skills, Time & Work, Pipes & Cisterns, Chain Rule, Geometry, Menstruation-Area, Perimeter, Surface Area & Volume, Permutation & Combination, Probability, Sequence & Series, Equation Linear, Quadratic Equation, Trigonometry, Logarithm Data Interpretation Data Tabulation -1 &2, Pie Charts - 1&2, Bar Graph – 1 &2, Line Graph – 1& 2, Data Sufficiency Reasoning Aptitude Number Series, Alphabet Series, Inserting of Missing Character, Number Sequence, Alpha Numeric Sequence, Time Sequence, Ranking Sequence, Arithmetical Reasoning, Quantitative Analysis, Problem on Ages, Clocks, Calendars, Cube Cutting, Cubes & Dices, Coding – Decoding, Sense of Direction, Blood Relations, Puzzles 1: Classification, Puzzles 2: Sitting Arrangement – Linear, Circular, Puzzles 3: Comparison, Puzzles 4: Sequential Order of Things, Puzzles 5: Condition & Grouping, Puzzles 6: Family Relations, Mathematical Operations & Symbol Notations, Syllogisms, Odd man out, Visual reasoning, membership

Suggested Book:

1. R.S Agrawal, Quantitative Aptitude for Competitive Examinations - Quantitative Aptitude.
2. Allwein, G., & Barwise, J. (Eds.). (2016). Logical reasoning with diagrams. 2nd Ed., Oxford University Press.
3. Dowden, B. H. (2019). Logical reasoning. 4th Ed., Sacramento eCA CA: California State University Sacramento.

CA139	Basics of Cloud & IoT	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Develop and deploy cloud application using popular cloud platforms.
- CLO 2. Write comprehensive case studies analyzing and contrasting different cloud computing solutions.
- CLO 3. Compare, contrast, and evaluate the key trade-offs between multiple approaches to cloud system design, and Identify appropriate design choices when solving real-world cloud computing problems.
- CLO 4. Design the compatible cloud models for different applications.
- CLO 5. Aware about IOT application areas and platform to become employable.
- CLO 6. Integration cloud with IOT as per industry requirements.
- CLO 7. Security requirements for IOT applications.

Syllabus:

Cloud Computing Overview, Cloud Computing History & Evolution, Components of Cloud Computing ,Requirements of Cloud Computing.Benefits & disadvantages of Cloud Computing, Cloud computing types: Deployment Models, Service Models: Understanding services and applications by type.Framework: The NIST Model, Cloud Cube Model, Capacity Planning: Defining baseline and metrics, Load testing, Network capacity, Scaling.Understanding Virtualization: Virtualization Technologies, Load balancing and Virtualization, Understanding Hypervisors, Security Concerns related to cloud, Securing cloud: Security mapping, securing data, Encryption.Using the mobile cloud: connecting to the cloud, Feature phones and the cloud, using smart phones with the cloud.Introduction to Internet of Things: Definition & Characteristics of IOT, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, Domain Specific IOTs: Home Automation, Environment, Cities, Energy, Retail, Agriculture, Logistics, Industry, Health & Lifestyle.IOT Platforms Design Methodology: Introduction, IOT Design Methodology steps, Case study on IOT system for Weather monitoring.IOT physical devices and Endpoints: Basic building blocks of an IOT device,

Raspberry Pi, Raspberry Pi interfaces, About the board, Internet of Things Security: Introduction, Overview of Governance, Privacy and Security Issues.

Suggested Books:

1. Velte Anthony, Velte Toby, Elsenpeter Robert, Cloud Computing, 1st Edition, 2017, McGraw Hill Professional.
2. FrancisdaCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, 2013, apress Publications.
3. Lakhwani, K., Gianey, H. K., Wireko, J. K., & Hiran, K. K. (2017) Internet of Things (IoT): Principles, paradigms and applications of IoT. 1st Ed., Bpb Publications.

CA139A	Introduction to Internet of Things	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Students would know the architectural overview of the IoT applications.
- CLO 2. Possess an ability and skill to design and develop hardware infrastructure of IoT application.
- CLO 3. They would be able to apply communication protocols for IoT application development.
- CLO 4. Possess an ability to push the data onto the cloud services.
- CLO 5. They would be able to analyze the sensor data and take necessary action associated with it.

Syllabus:

Introduction to Internet of Things (IoT), components of IoT, acquiring data, sensing and actuation, sensor networks, machine-to-machine communication, utilizing data, implementing IoT, IoT analytics, case studies.

Suggested Books:

1. Arshdeep Bahga and VijayMadiseti, "Internet of Things: A Hands-on Approach", 1st Ed., 2017, Universities Press.
2. Oliver Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 1st Ed., 2018, Wiley Edition
3. Lakhwani, K., Gianey, H. K., Wireko, J. K., & Hiran, K. K. (2017). Internet of Things (IoT): Principles, paradigms and applications of IoT. 5th Ed. Bpb Publications.

CA139B	Dynamic Programming	4-0-0	4
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Course Learning Outcomes:

- CLO 1. Analyze the asymptotic performance of algorithms.
- CLO 2. Write rigorous correctness proofs for algorithms.
- CLO 3. Demonstrate a familiarity with major algorithms and data structures.
- CLO 4. Apply important algorithmic design paradigms and methods of analysis.
- CLO 5. Synthesize efficient algorithm skills in common engineering design situations.

Syllabus:

Introduction to dynamic programming, optimal substructure & overlapping sub problems, Fibonacci numbers, coin change problem, binomial coefficient problem, tiling problem, longest common subsequence, 0-1 knapsack, word break problem, egg dropping puzzle, painting fence algorithm, dynamic programming on trees.

Suggested Books:

1. Lew, A., & Mauch, H. (2016). Dynamic programming: A computational tool. 2nd Ed. Springer
2. Springer. Powell, W. B. (2017). Approximate Dynamic Programming: Solving the curses of dimensionality 2nd Ed.. John Wiley & Sons.
3. Bertsekas, D. (2014). Dynamic programming and optimal control: Volume I Athena scientific.

YEAR IV – (SEMESTER VII)

CA401	Advanced Database Management System	3-0-0	3
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Course Learning Outcomes:

- CLO1:** To make student skilled with basic concepts of advanced database concepts of advanced database management system and understanding database concepts and structures.
- CLO2:** Students would be able to understand the role and importance of ADBMS with the help of live database example.
- CLO3:** Over this, entire course is designed to help students to understand data modelling and database development process, construct and normalize conceptual data models.
- CLO4:** Implement a relational database into a database management system. Use of database management systems such as Oracle, SQL and become proficient in using PL / SQL.
- CLO5:** Students will be able to design logic to automatically manage the database during any DML or DDL transaction and understand the issues related to database performance.

Syllabus:

Need of DBMS over traditional Data storage mechanisms, Basic DBMS terminologies; Architecture of a DBMS: Data Independence, DBMS Component Structure, DBMS USERS, various DBMS Data Models, Conceptual Model: Entity Relationship Model, Importance of ERD, Symbols (Entity: Types of Entities, weak Entity, Composite Entity, Strong Entity, Attribute: Types of Attribute, Relationship: Type of relationship, Connectivity, Cardinality). Normalization and its various forms, Functional Dependencies, Multivalued Dependencies, Join Dependencies Database Integrity: Domain, Entity, Referential Integrity Constraints Relational Languages : Relational Algebra, Relational Calculus, Query Execution, optimization and evaluation Plans. Transaction Management and Concurrency Control techniques, Database Recovery Management Concepts and methods. Introduction and Need of Database

Administration and activities of Database administration. Parallel Databases : Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems-Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism Distributed Database Concepts : Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing Multidimensional Databases and their uses in data analytics. Temporal Databases: Introduction to Temporality, Temporal relationships, temporal hierarchies. Spatial Databases: Spatial data types, spatial relationships, Topological Relationships, Spatial Data Structures and methods of storage. sBig Data : introduction: introduction to NOSQL Databases (Open Source only). Need and usage of XML Databases: XML Data Model – DTD – XML Schema

Suggested Reading(s):

1. Rob Coronel (2007), “Database Systems”, Seventh Edition, Gex Publications.
2. Bipin C Dessi (2017) ,“Introduction to Database System” ,Seventh Edition, Galgotia Publication
3. Gerald V.Post (2009) “Database Management Systems”, Second Edition,Tata Mc Graw Hill,

CA403	Advanced Data Structures and Algorithms Design	3-0-0	3
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Course Learning Outcomes:

CLO1: Learn the skills to measures of space and time complexities.

CLO2: Calculate the time complexities of algorithms.

CLO3: Learn various algorithm design techniques.

CLO4: Develop solutions to known problems of computer science using the algorithm techniques.

CLO5: Learn about the solvable/unsolvable P, NP hard problems.

Syllabus:

Introduction to Data Structures: Data Structures and its Types, Algorithms, Time Complexity, Recurrence, Probabilistic Analysis, Amortized Analysis, Competitive Analysis. Sorting Algorithms: Quick Sort, Heap Sort, Counting Sort, Bucket Sort, Multi-way Merge Sort. Recursion, Linked List, Queue, Stack, Heap, Tree. Hashing Techniques: Direct Address Tables, Hash Tables, Hash Functions, Open Addressing, Perfect Hashing. Advanced Data Structures: AVL Trees, Red-Black Trees, Splay Trees, B-trees, M-Way tree Binomial Heaps, Fibonacci heaps, Data Structures for Disjoint Sets. Graphs & Algorithms: Graphs Representation, Minimum Spanning Tree (MST), Single Source Shortest Paths, All Pairs Shortest Paths, Maximum Flow. String Matching: String, String Length, String Concatenation, String Copy, String-Matching, Brute Force algorithm, Rabin Karp algorithm, Knuth Morris-Pratt (KMP) algorithm, Boyer-Moore algorithm.

Suggested Reading:

1. 'Fundamentals of Computer Algorithms' by Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2nd Edition, Galgotia Publications.
2. 'Introduction to Algorithms' by Thomas Cormen, Charles Leiserson, Ronald Rivest, Clifford Stein, second edition, Prentice-Hall India

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3. 'Data Structures' by Schaums' Outlines Indian Adapted Edition 2006 by Seymour Lipschutz, Published By Tata McGraw-Hill Edition.
 4. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, Computational Geometry: Algorithms and Applications, Third Edition, Springer-Verlag, 2008.

CA405	Computer Organization and Architecture	3-0-0	3
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Course Learning Outcomes:

- CLO1:** Design trade-offs Basic fundamentals in digital logic & structure of a digital computer.
- CLO2:** Identify performance issues in processor and memory design of a digital computer.
- CLO3:** To Develop independent learning skills and be able to learn more about different computer architectures and hardware.
- CLO4:** To articulate design issues in the development of Multiprocessor organization & architecture.

Syllabus:

Digital Logic Design: Axioms and laws of Boolean algebra, Reduction of Boolean expressions, conversion between canonical forms, Karnaugh map (4 variable), Half Adder, full adder, 4-bit parallel parity bit generator, checker circuit, Decoder, Encoder, Multiplexer, IC RAM, ROM, Memory Organization, Sequential Circuits, State transistors, Flip-flop, RS, JK, D-Latch, Master slave. INSTRUCTION SET ARCHITECTURE Memory Locations and Addresses: Byte Addressability, Big-Endian and Little-Endian Assignments, Word Alignment, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Subroutines, Additional Instructions, dealing with 32-Bit Immediate Values. BASIC PROCESSING UNIT & PIPELINING Basic Processing Unit: Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control, CISC Style Processors. Pipelining: Basic Concept, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays, Pipeline Performance Evaluation. MEMORY ORGANIZATION Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, Memory Hierarchy, Cache Memories, Performance Considerations, Virtual Memory, Memory Management Requirements, Secondary Storage INPUT OUTPUT & PARALLEL PROCESSING Basic Input Output: Accessing I/O Devices, Interrupts, Input Output Organization: Bus Structure, Bus Operation, Arbitration, Interface,

Interconnection Standards. Parallel Processing: Hardware Multithreading, Vector (SIMD) Processing, Shared-Memory Multiprocessors, Cache Coherence, Message-Passing Multicomputers, Parallel Programming for Multiprocessors, Performance Modeling.

Suggested Reading(s):

1. M. Morris Mano, Computer System Architecture (3rd ed.), Prentice –Hall of India, 2007.
2. W. Stallings, Computer Organization and Architecture: Designing for Performance (7th ed.), Pearson Education, 2006
3. A.S. Tanenbaum, Structured Computer Organization (4th ed.), Prentice–Hall of India, 1999. 4. J.P.Hayes, Computer Architecture and Organization (2nd ed.), McGraw-Hill Book Company, 1988.

CA407	Society Project Based on Design Thinking	0-0-4	2
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Syllabus:

Introduction – Product Life Cycle - Design Ethics - Design Process - Four Step – Five Step - Twelve Step - Creativity and Innovation in Design Process - Design limitation. Introduction - Create Thinking - Generating Design Ideas - Lateral Thinking – Analogies – Brainstorming - Mind mapping - National Group Technique – Synectics - Development of work - Analytical Thinking - Group Activities Recommended. Introduction - Reverse Engineering Leads to New Understanding about Products - Reasons for Reverse Engineering - Reverse Engineering Process - Step by Step – Case Study. Introduction - Many Uses of Drawing - Communication through Drawing – Drawing Basis – Line - Shape/ Form – Value – Colour – Texture

Tasks to be done:

Task 1: Everyone is a Designer

- Understand class objectives & harness the designer mindset

Task 2: The Wallet/Bag Challenge and Podcast

- Gain a quick introduction to the design thinking methodology
- Go through all stages of the methodology through a simple design challenge
- Podcast: Observe, Listen and Engage with the surrounding environment and identify a design challenge.

Task 3: Teams & Problems

- Start Design Challenge and learn about teams & problems through this
- Foster team collaboration, find inspiration from the environment and learn how to identify problems

Task 4: Empathizing

- Continue Design Challenge and learn empathy
- Learn techniques on how to empathize with users
- Go to the field and interview people in their environments
- Submit Activity Card

Task 5: Ideating

- Continue Design Challenge and learn how to brainstorm effectively
- Encourage exploration and foster spaces for brainstorming
- Submit Activity Card

Task 6: Prototyping

- Continue Design Challenge and learn how to create effective prototypes
- Build tangible models and use them as communication tools
- Start giving constructive feedback to classmates and teammates
- Submit Activity Card

Task 7: Testing

1. Finish Design Challenge and iterate prototypes and ideas through user feedback
2. Evolve ideas and prototypes through user feedback and constructive criticism
3. Get peer feedback on individual and group performance
4. Submit Activity Card

Task 8:

5. Final Report Submission and Presentation

Suggested Book(s):

1. Cross, N. (2011). Design thinking: Understanding how designers think and work. 1st Ed. Berg .
2. Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H. Y. (2015). Design thinking for education: Conceptions and applications in teaching and learning. 1st Ed. Springer.
3. Stickdorn, M., Hormess, M. E., Lawrence, A., & Schneider, J. (2018). This is service design doing: applying service design thinking in the real world. " 1st Ed.O'Reilly Media, Inc."

AM110	Operation Research	3-0-0	3
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Course Learning Outcomes:

CLO1: To investigate and solve a variety of live problems of optimization using Simplex Method.

CLO2: To understand and apply the skills of theory and techniques of assignment problem to solve assign jobs to persons by minimizing cost and time.

CLO3: To solve real life complex transportation problems by computation technique for easy representation.

CLO4: To comprehend the relevance of game theory and project management within the context of computer science and finding solutions of live problems related to shortest path etc.

Syllabus:

Discrete Structures and Optimization Mathematical Logic: Propositional and Predicate Logic, Propositional Equivalences, Normal Forms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference. Sets and Relations: Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering. Counting, Mathematical Induction and Discrete Probability: Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion- Exclusion Principle, Mathematical Induction, Probability, Bayes' Theorem. Group Theory: Groups, Subgroups, Semi Groups, Product and Quotients of Algebraic Structures, Isomorphism, Homomorphism, Auto-smorphism, Rings, Integral Domains, Fields, Applications of Group Theory. Graph Theory: Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Bipartite Graphs, Trees and Rooted Trees, Prefix Codes, Tree Traversals, Spanning Trees and Cut-Sets. Boolean Algebra: Boolean Functions and its Representation, Simplifications of Boolean Functions. Optimization: Linear Programming - Mathematical Model, Graphical Solution, Simplex and Dual Simplex Method, Sensitive Analysis; Integer Programming, Transportation and Assignment Models, PERT-CPM: Diagram

Representation, Critical Path Calculations, Resource Levelling, Cost Consideration in Project Scheduling.

Suggested Reading(s):

1. “Operations Research Theory and Applications”, J K Sharma, Macmillan Publishers India Ltd.
2. “Introduction to Operations Research”, Frederick S. Hillier, Gerald J. Lieberman, Tata McGraw-Hill Education Private Limited, New Delhi.
3. “Introduction to Operations Research”, Hamdy A. Taha, Tata McGraw Hill Publishing Company Limited

YEAR IV – (SEMESTER VIII)

CA421	Rapid Application Development (Advance Java)	3-0-0	3
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Course Learning Outcomes:

- CLO 1.** Understand not only the fundamentals of the Java language, but also it's importance, uses, strengths and weaknesses
- CLO 2.** Understand what OO programming is and what the advantages of OO are in today's world for employability
- CLO 3.** Understand the basics of the Java language and how it relates to OO programming and the Object Model Learn to use Java multi-threading and exception handling features
- CLO 4.** Understand and use classes, inheritance and polymorphism, use collections, generics, autoboxing, and enumerations including new Java 6 features and capabilities
- CLO 5.** Use the JDBC API for database access, Use Java for networking and communication applications Work with annotations
- CLO 6.** Working with XML and Web Services in Java using JAXP, JAXB, and security
Optionally, learn to develop GUI applications using Swing

Syllabus:

J2EE and Web Development Java Platform, J2EE Architecture Types, Explore Java EE Containers, Types of Servers in J2EE Application, HTTP Protocols and API, Request Processing in Web Application, Web Application Structure, Web Containers and Web Architecture Models. Advance Networking Networking Basics, Introduction of Socket, Types of Socket, Socket API, TCP/IP client sockets, URL, TCP/IP server sockets, Datagrams, java.net package Socket, ServerSocket, InetAddress, URL, URLConnection, RMI Architecture, Client Server Application using RMI. JDBC Programming JDBC Architecture, Types of JDBC

Drivers, Introduction to major JDBC Classes and Interface, Creating simple JDBC Application, Types of Statement (Statement Interface, PreparedStatement, CallableStatement), Exploring ResultSet Operations, Batch Updates in JDBC, Creating CRUD Application, Using Rowsets Objects, Managing Database Transaction. Servlet API and Overview Servlet Introduction, Servlet Life Cycle, Types of Servlet, Servlet Configuration with Deployment Descriptor, Working with ServletContext and ServletConfig Object, Attributes in Servlet, Response and Redirection using Request Dispatcher and using sendRedirect Method Filter API, Manipulating Responses using Filter API, Session Tracking: using Cookies, HttpSession, Hidden Form Fields and URL Rewriting, Types of Servlet Event: ContextLevel and SessionLevel. Java Server Pages Introduction to JSP, Comparison with Servlet, JSP Architecture, JSP Life Cycle, JSP Scripting Elements, JSP Directives, JSP Action, JSP Implicit Objects, JSP Expression Language, JSP Standard Tag Libraries, JSP Custom Tag, JSP Session Management, JSP Exception Handling, JSP CRUD Application. Hibernate Introduction to Hibernate, Exploring Architecture of Hibernate, O/R Mapping with Hibernate, Hibernate Annotation, Hibernate Query Language, CRUD Operation using Hibernate API. Java Web Frameworks: Spring MVC Spring Introduction, Spring Architecture, Spring MVC Module, Life Cycle of Bean Factory, Explore: ConstructorInjection, Dependency Injection, Inner Beans, Aliases in Bean, Bean Scopes, Spring Annotations, Spring AOP Module, Spring DAO, Database Transaction Management, CRUD Operation using DAO and Spring API. Java Server Faces Features of JSF, JSP Architecture, JSF request processing Life cycle, JSF Elements, JSF Expression Language, JSF Standard Component, JSF Facelets Tag, JSF Converter Tag, JSF Validation Tag, JSF Database Access, JSF Prime Faces.

Suggested Reading(s):

1. Java the Complete Reference, ninth edition by Herbert Schild, Publisher: McGraw Hills
2. Head First EJB 3.0 by Kathy Sierra, Bert Bates, Publisher: O'Reilly Media
3. Head First Servlets and JSP by Bryan Basham, Kathy Sierra & Bert Bates, Publisher: O'Reilly Media

4. Just Hibernate, A Lightweight Introduction to the Hibernate Framework by
Madhusudhan Konda, Publisher: O'Reilly Media

CA423	Theory of Computation	3-0-0	3
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Course Learning Outcomes:

- CLO 1.** Able to design Finite Automata machines for given problems;
- CLO 2.** Able to analyze a given Finite Automata machine and find out its Language;
- CLO 3.** Able to design Pushdown Automata machine for given CF language(s);
- CLO 4.** Skilled to generate the strings/sentences of a given context-free languages using its grammar;
- CLO 5.** Able to design Turing machines for given any computational problem.

Syllabus:

Formal Language, Non-Computational Problems, Diagonal Argument, Russels's Paradox. Theory of Automata: Deterministic Finite Automaton (DFA), Non-Deterministic Finite Automaton (NFA), Equivalence of DFA and NFA, Mealy and Moore Models, Minimization of Finite Automata. Regular Sets and Regular Grammars: Regular Languages, Regular Grammars, Regular Expressions, Properties of Regular Language, Pumping Lemma, Non-Regular Languages, Lexical Analysis. Context Free Language: Properties of Context Free Language, Chomsky Classification of Languages, Context Free Grammar, Simplification of Context Free Grammar, Chomsky Normal Form, Greibach Normal Form. Push Down Automata: Ambiguity, Parse Tree Representation of Derivation Trees, Equivalence of PDA's and Pushdown Automaton (PDA), Non-Deterministic Pushdown Automaton (NPDA). Turing Machines (TM): Standard Turing Machine and its Variations; Universal Turing Machines, Models of Computation and Church-Turing Thesis. Recursive and Recursively-Enumerable Languages; Context Sensitive Languages, Unrestricted Grammars, Chomsky Hierarchy of Languages, Construction of TM for Simple Problems. Unsolvable Problems and Computational Complexity: Unsolvable Problem, Halting Problem, Post Correspondence Problem, Unsolvable Problems for Context-Free Languages, Measuring and Classifying Complexity, Tractable and Intractable Problems.

Suggested Reading(s):

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1. Introduction to Languages and the Theory of Computation by John Martin, Tata McGraw Hill, India
 2. J. E. Hopcroft and J. D. Ullman, 2003, Introduction to Automata Theory Languages and Computation by . 1st edition published by Narosa Publishing House.
 3. H. R. Lewis and C. H. Papadimitriou, 2011 Elements of the Theory of Computation by . Eastern economy edition published by Prentice Hall of India Pvt. Ltd.

CA424	Data Communication & Computer Networks	3-0-0	3
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Course Learning Outcomes:

- CLO 1.** Build an understanding of the fundamental concepts of data communication and computer networking required for employability.
- CLO 2.** Understand how errors detected and corrected that occur in transmission
- CLO 3.** How collisions to be handled when many stations share a single channel
- CLO 4.** Know about routing mechanisms and different routing protocols
- CLO 5.** Understand transport layer functions
- CLO 6.** Know about different application layer protocols

Syllabus:

Introduction to computer network- Topology; Base Band & Broad Band Topology; Guided & Unguided Media. Overview of Data & Signal Bits. Baud & Bit Rate. Modulation (AM, PM, FM); Multiplexing (TDM, FDM, STDM). Encoding (RZ, NRZ, BIPLOAR, MANCHESTER, DIFF. MANCHESTER). Digital To Analog – ASK, PSK, FSK, QPSK. Transmission methods – Synchronous & Asynchronous, Flow Control, Error Control, Error Detection methods. Goals of Layered protocols- Introduction to OSI, TCP/IP, IBM, SNA, ATM. Bit oriented (BSC) & Character oriented Protocol (SDLC, LAPB, LAPD, LLC) HDLC- frame format, station, states, configuration, access control. LAN Topology – Ethernet (IEEE 802.3), Token Bus (IEEE 802.4), Token Ring (IEEE 802.5) Introduction to WAN – DQDB (IEEE 802.6) & FDDI. Switching Technologies – Circuit, Message, and Packet. X.25, X.21, RS-232 C – frame format, channel, packet frames, facilities (In brief Only). ISDN- D channel, B-Channel, International Standards, NT1, NT2, TA, TE Devices. Introduction to leased lines, DSL, Digital Carriers. Bridging & Routing – Static & Dynamic (In Brief). IP, IP addressing, ICMP, ARP.RARP. Congestion Control, TCP, UDP. HTTP,FTP,Telnet,SMTP. Introduction to data security (private key, public key, ISO standards). Introduction to Mobile technology (Topology, FDM, TDM, CDMA), Satellite Communication (LEO, GEO, TDM).

Suggested Reading(s):

1. Forouzen , 'Data Communications and Networking' by, 3rd edition.2011
2. Stallings , 'Data Communication' ,4th Edition, TMH 2010
3. Dye, McDonald, Ruffi , 'Network Fundamentals- Track1' , Pearson Education,2013

CA425	Operating System Principals	3-0-0	3
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Course Learning Outcomes:

CLO01: Gain extensive knowledge on principles, types and advance concepts of operating systems.

CLO02: Recognize key mechanisms in design of operating systems modules for employability.

CLO03: Compare performance of processor scheduling algorithms.

CLO04: Practice with operating system concepts such as process management, concurrent processes and threads, memory management, virtual memory concepts, deadlocks.

CLO05: To identify various system security and protection issues.

CLO06: To learn the latest trends in building mobile OS.

Syllabus:

Introduction — Evolution of Operating Systems, Types of operating systems, Operating System Structures, Hardware and software structures needed for an operating system. Process Management: Processes—States & Life cycle of process, Schedulers, Context Switching, Process scheduling policies—Preemptive vs. Non-preemptive, CPU scheduling algorithms, Threads—States & Life cycle of thread, thread scheduling, Types of threads & Examples. Inter-process Communication (IPC) Mechanisms—Concurrent processes, Process synchronization, Critical Section, Peterson’s Solution, Classic IPC Problems, Semaphores, Concurrent programming, Monitors. Deadlock—Basic cause of deadlock, Conditions for deadlock, resource allocation graph, Wait for graph, Strategies for handling deadlocks, Starvation, Havender’s linear ordering principle, deadlock avoidance & detection, Safe state, Dijkstra’s Banker’s Algorithm. Memory Management: Main Memory, Static & Dynamic Partition schemes, multiple partitions schemes, Fragmentation, Compaction, Buddy Systems, Partition selection algorithms, deallocation strategy, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Virtual Memory: Demand Paging, Copy-on-Write, Page

Replacement Policies, Belady's Anomaly, Thrashing, Working set model. Storage (File and Device) Management: File-System Interface, File-System Implementation, Mass-Storage Structure, Disk Scheduling, RAID Structure, I/O Systems. Outline of : Multiprocessor Management, Protection & Security, Real-Time Operating Systems, and Multimedia Operating Systems, Case Studies: Windows XP/ Vista, Linux. Mobile Operating Systems: ARM and Intel architectures - Power Management - Mobile OS Architectures - Underlying OS - Kernel structure and native level programming – Runtime issues- Approaches to power management

Suggested Reading(s):

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, 2006, 'Operating System Concepts' by Sixth Edition, John Wiley & Sons (ASIA) Pvt. Ltd.
2. D.M. Dhamdhare , 2004 'System Programming & Operating Systems' , Second revised edition, Tata McGraw Hill
3. W. Stallings ,2011, 'Operating Systems' , Fifth edition, Prentice-Hall

CA429AA	Full Stack web development	2-0-4	4
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Course Learning outcomes:

- CLO 1.** Use their learned skills, knowledge and abilities to develop web sites for the internet
- CLO 2.** Apply basic design principles to present ideas, information, products, and services on websites
- CLO 3.** Apply basic programming principles to the construction of websites
- CLO 4.** Effectively manage website projects using available resources
- CLO 5.** Demonstrate communication skills, service management skills, and presentation skills
- CLO 6.** Complete job preparation tasks including writing resumes and cover letters, conducting job interviews and developing an ePortfolio
- CLO 7.** Apply employability skills including fundamental skills, personal management skills, and teamwork skills

Syllabus:

Introduction to Angular2 & Angular4 ,Introduction to Angular, Advantages of Angular, Angular1 vs. Angular2 vs. Angular4, Browsers Support Get Started with Angular2 & Angular4, Setting up an Angular App, Running an Angular App, Understanding Angular folder structure, Angular Initialization Process Angular Building Blocks: Components, Modules, Decorators , Understanding Component, Creating a Component, Understanding Modules, Understanding Decorators, Angular CLI, Introduction to CLI Creating new projecting new Building Project - ng build and ng serve Ng CLI options Creating components, services and directives etc. Data binding Understanding Data Binding Attribute Binding Two-way Data Binding Event Binding etc. Choosing Appropriate Data Binding Routing Understanding Routing Defining Routes Routing Building Blocks – Routes, Router Outlet and Router Link Directives Introduction to Directives -Built in Directives - ngIf, ngFor, ngSwitch etc. Creating Custom Directives Pipes Introduction to Pipes Angular Built-In Pipes Creating Custom Pipes Inheritance Introduction to Angular Inheritance Components Inheritance Advanced Components Nested Components Data sharing between nested components Components Life Cycle Hooks Services Introduction to Services Creating Services Data sharing using Services

Suggested Reading(s):

1. Mardan, A., Mardan, A., & Corrigan. (2018). Full Stack JavaScript (pp. 239-256). 1st Ed. Apress.
2. Hoque, S. (2020). Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node. js. 2nd Ed. Packt Publishing Ltd.
3. Gore, A. (2017). Full-Stack Vue. js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel. 1st Ed. Packt Publishing Ltd.

CA429BA	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	1-0-2	2
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Course Learning Outcomes:

CLO01: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies for enterprenureship.

CLO02: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.

CLO03: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.

CLO04:E-business is booming and so are the opportunities for graduates with an E-Business

Syllabus:

Introduction: An Introduction to Digital Marketing, Types of Digital Marketing, Career opportunities in Digital Marketing, Selection of Website topic. Domain Selection & Registration: What is domain name, How to register domain name, How to select domain name, Premium Domain names What is web hosting?, Types of web hosting: Linux & Windows OS, Web hosting packages, Web hosting hardware, Choosing a web hosting company What is web space and how much do I need? Data Transfer & Bandwidth, Virtual Servers & Shared Hosting, Dedicated Hosting and Business Hosting, Reseller Accounts. cPanel, WHM panel, Money back guarantees, Free trials. Creating a backup of web site, directory or hosting account? Create & Remove an Addon Domain? Park a domain? Redirect a web site or web page to another web site or web page? Create & Remove a Subdomain? Web Hosting Selection & Registration. Demonstration of Keyword researching tools, Market Samurai, Traffic Travis, Other online tools. Introduction, Key terms and concepts, Web design, Web development, Step-by-step guide to building a website in Wordpress. WP Installation and Dashboard : Posting, Editing Posts and

Tags And Categories, Links, Pages and Comments. Themes and Adding Themes, Widgets, Editors and Adding Plugins, Tools and Users, General and Writing, Use of Visual Composer & its elements : Reading and Discussion, Permalinks and Media, Use of Visual Composer & its elements Use of Visual Composer & its elements Contd.: Visual Composer & its elements All in One SEO pack installation and configuration and usage. Google Analytics plugin installation, WooCommerce, Default WooCommerce Pages, Products Adding Products, Categories & Images. Defining featured product Woo Commerce Settings & Shop Page Layouts, Shop Page Shortcodes & WooCommerce Widgets, Checkout Process. Adding products using woocommerce plugin Installation and usage of Slider Revolution plugin Creating Slider using slider revolution plugin contd.... Creating HOME Page, Displaying section wise products on HOME page, Setting up widget area bar information etc. Creating legal pages for eCommerce website i.e. Privacy Policy, Terms & conditions, Disclaimer and Refund policy page Content development guidelines for META Tags Creating META Tags, Defining META Tags on various pages, Defining image META tags etc. Writing blogs for the website. Making blogs SEO friendly using online content analysing tools e.g. www.wordcounter.net Tools of the trade & Social Book Marking, Directory submission Classified / B2B directories and Forum Postings Q&A, Image album postings etc. Various Online Tool for Content Marketing How to setup user login using social media login details Research & Selection of Affiliate Network Programs & products What is Google Adsense and How to apply for Adsense program to earn money from Pay Per Click model Digital and Social media Marketing Digital and Social media Marketing

Suggested Reading(s):

1. Evans, D., Bratton, S., & McKee, J. (2021). Social media marketing. 1st Ed. AG Printing & Publishing.
2. Tuten, T. L., & Solomon, M. R. (2017). 1st Ed. Social media marketing. Sage.
3. Zarrella, D. (2009). The social media marketing book. 3rd Ed." O'Reilly Media, Inc."

CA429BB	Search Engine Marketing (SEO & PPC), Web Analytics and Email Marketing & Management	1-0-2	2
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Course Learning Outcomes:

CLO01: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.

CLO02: Hands-on familiarity with the leading tools and techniques used in the customer-facing aspects of Digital Marketing & Internet Technologies.

CLO03: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.

CLO04: Skills of E-business is booming and so are the opportunities for graduates

Syllabus:

Search Engine On Page SEO factors, Placement of keywords Internet Business Promoter (IBP) SEO software installation, How to use IBP SEO Tool How to make Search Engine Friendly Page: Testing Pages for ON PAGE SEO factors using SEO analysis tools i.e. IBP SEO software. Traffic Travis SEO Analysis, On-Page Factors, Originality & Fresh Content, Writing for Humans, SEO Analysis, Images Optimization, Title, Desc, H1 and On page factors What are Off-Page Factors: Understanding Off Page SEO, Right and Wrong Ways to Link, What is an Authority Site? Planning the Off Page SEO Process, Site Audit, Off Page SEO Planning & Implementation, sitemaps & URL How to do competitors analysis. Factors for analysing competitors websites Search Engine Marketing (SEM)/ Pay Per Click Advertising (PPC): Introduction, What Is Pay-per-Click?, Key terms and concepts, Advertising in search, Difference between search & Display Campaign, Recent updates in Ads, Account structure in Ads Types of Google Ads campaigns. Understanding various types of Google Ads campaigns, Ads Account Limits, IP Address Exclusion, Guideline of Google ads, What is CTR, Impression, CPC The elements of a search ad, Targeting options, Bidding and ranking for search ads, Tracking, Use the Google Ads Editor to Manage Your Ads and Keywords. Search Engine Marketing (SEM)/ Pay Per Click Advertising (PPC)..: Planning and setting up your Ist search advertising campaign

The Benefits of PPC in the Purchase Phase, Set Up the Search and Content Networks, Keyword Research, Trademarks and Keywords Search Engine Marketing (SEM)/ Pay Per Click Advertising (PPC) Contd.: Negative Keywords, How Many Keywords can you have?, Creating the Ad Groups, Naming the Ad Groups, Writing the Ads Competitors' Bids, The Quality Score, The Ad Rank Score, Manual Bid Management, Automated Bid Management, What Is the Best Position for Your Ads? Creating reports for Google Ads using Report section Creating reports for Google Ads using Report section contd.... Web Analytics (Google Analytics): Introduction, Basic Analytics and Why Analytics?, Setting Up Google Analytics, What Do We Do With Them? - Analytics and AWStats, AWStats Dashboard, Summary, Days and Hours, Countries, Visits Duration, Pages-URL, Operating Systems and Browsers, Key Words and Key Phrases. - Analytics Settings, Website Profiles, Adding a Profile, Checking Status, Editing a Profile, Deleting a Profile, Access Management, - Adding a User, Setting User, Permissions, Deleting a User, Filtering Your Data, Understanding Goal Setting - Web Analytics (Google Analytics) Contd.: Why Set Goals?, Google Ads Integration, Why Google Analytics with Google Ads? - The Reporting Dashboards, Who Should Use This View, Absolute Unique Visitors, Visitor Loyalty, Keyword Specific Testing etc. Email Marketing: Introduction to Email Marketing, Key terms and concepts, Email Software and Tools. - Email strategy and planning, Advantages and challenges, Solving the SPAM problem, Rich media e-mails- Email Marketing - Step-by-step process, Tools of the trade (Mailchimp, Groupmail and Interspire Email Marketer etc.), - MailChimp Campaign Setup, Email List Building, Double Opt-in email list building and strategy making - Email Marketing Contd.: E-mail campaign planning, Objective setting, E-mail campaign budgeting, - Campaign design: targeting, offer, timing, creative, Campaign integration, Measurement & Testing - GroupMail email marketing software installation, configuration, SMTP configuration and setting up mail campaign INTERSPIRE email marketing software installation, configuration, SMTP configuration and setting up mail campaign - Web Forms Lead Importing, Integrating Landing Page Forms, Campaign Reports and Insights, Segmentation Strategy, Segmentation Lists - Auto-Responder Series, Triggering Auto – Responder Emails, AutoResponder follow up sequence setup

Suggested Reading(s):

1. Evans, D., Bratton, S., & McKee, J. (2021). Social media marketing. 1st Ed. AG Printing & Publishing.
2. Tuten, T. L., & Solomon, M. R. (2017). 1st Ed. Social media marketing. Sage.
3. Zarrella, D. (2009). The social media marketing book. 3rd Ed." O'Reilly Media, Inc."

CA429CA	Cloud Infrastructure & foundation	1-0-2	2
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Course Learning Outcomes:

CLO1: Understand the fundamental principles of distributed computing.

CLO2: Understand how the distributed computing environments known as Grids can be built from lower level services.

CLO3: Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.

CLO4: Analyze the performance of Cloud Computing for employability.

CLO5: Understand the concept of Cloud Security.

CLO6: Learn the Concept of Cloud Infrastructure Model.

Syllabus:

CLOUD FUNDAMENTALS Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications - Cloud computing Architecture – Cloud containers Web Service Architecture – Web Service APIs – Web service Authentication - Web service authentication methods - Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages 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. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat). Programming Models for Cloud Computing - Software Development in

Cloud - Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App. Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO).

Suggested Reading(s):

1. Velte Anthony, Velte Toby, Elsenpeter Robert, Cloud Computing, 1st Edition, 2017, McGraw Hill Professional.
2. FrancisdaCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, 2013, apress Publications.
3. Lakhwani, K., Gianey, H. K., Wireko, J. K., & Hiran, K. K. (2020). Internet of Things (IoT): Principles, paradigms and applications of IoT. 1st Ed., Bpb Publications.

CA429CB	IoT and Cloud Computing	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Understand the various concept of the IoT and their technologies.
- CLO 2.** Develop the IoT application using different hardware platforms
- CLO 3.** Implement the various IoT Protocols for employability
- CLO 4.** Understand the basic principles of cloud computing.
- CLO 5.** Develop and deploy the IoT application into cloud environment

Syllabus:

Introduction to IoT: Sensing, Actuation, Basics of Networking: Communication Protocols: Sensor Networks: Sensor Networks: Machine-to-Machine Communications Interoperability in IoT, Introduction to Arduino Programming: Integration of Sensors and Actuators with Arduino: Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT SDN for IoT (contd), Data Handling and Analytics, Cloud Computing Cloud Computing(contd), Sensor-Cloud Fog Computing, Smart Cities and Smart Homes Connected Vehicles, Smart Grid, Industrial IoT Industrial IoT (contd), Case Study: Agriculture, Healthcare, Activity Monitoring

Suggested Reading(s):

1. “Velte Anthony, Velte Toby, Elsenpeter Robert, Cloud Computing, 1st Edition, 2017, McGraw Hill Professional.
2. FrancisdaCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, 2013, apress Publications.
3. Lakhwani, K., Gianey, H. K., Wireko, J. K., & Hiran, K. K. (2020). Internet of Things (IoT): Principles, paradigms and applications of IoT. 1st Ed., Bpb Publications.

CA429DA	Design Thinking and Fundamentals	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Examine Design Thinking concepts and principles
- CLO 2.** Practice the methods, processes, and tools of Design Thinking
- CLO 3.** Apply the Design Thinking approach and model to real world situations
- CLO 4.** Analytical skills for role of primary and secondary research in the discovery stage of Design Thinking

Syllabus:

Introduction to design thinking, history of design thinking, wicked problems, case studies in design thinking, design thinking process, implementing the process in driving innovation, design thinking in social innovations Tools of design thinking – persona, customer journey map, AS-IS, TO-BE Processes, product lockdown workshops An exercise in design thinking – implementing design thinking for making the process of a user better. Student to choose one industry segment to implement design thinking process. Design thinking case studies in retail, design thinking case studies in banking, design thinking case studies in management decisions Design thinking process and implementing it for a digital product

Suggested Reading(s):

1. Cross, N. (2011). Design thinking: Understanding how designers think and work. 1st Ed. Berg .
2. Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H. Y. (2015). Design thinking for education: Conceptions and applications in teaching and learning. 1st Ed. Springer.
3. Stickdorn, M., Hormess, M. E., Lawrence, A., & Schneider, J. (2018). This is service design doing: applying service design thinking in the real world. " 1st Ed.O'Reilly Media, Inc."

CA429DB	UX Design & Digitalization	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Understand the importance of the user experience
- CLO 2.** Apply the user experience design process
- CLO 3.** Develop empathy for users through user research methods
- CLO 4.** Discover and analyse user needs
- CLO 5.** Organize information and design the Information architecture
- CLO 6.** Learn skills for design principles in interface, navigation, visual, and interaction design
- CLO 7.** Ideate, create, and validate prototypes
- CLO 8.** Apply usability test techniques

Syllabus:

Understand the evolution of UX design as an industry practice and learning about UX industry experts. Understanding UX design processes and methodologies – user centred design, 5S model. Job roles and responsibilities in the UX industry. UX industry trends. Deep-dive in UX methodologies, case studies in UX design, heuristic evaluation, understanding product UX lifecycle. Project on UX design implementation with industry relevant problem statement. Understand how technology and digitalization is transforming different industry segments – BFSI, manufacturing, retail, automotive, media, FMCG, logistics, oil & gas. Learn how to understand industry specific problems and user needs and design experiences for different industries. Research and design for all industry segments using a toolkit. Digitalization for the bottom of the pyramid. Localization of experience. Project on UX design process and industry trends

Suggested Reading(s):

1. Cross, N. (2011). Design thinking: Understanding how designers think and work. 1st Ed. Berg .
2. Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H. Y. (2015). Design thinking for education: Conceptions and applications in teaching and learning. 1st Ed. Springer.

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3. Stickdorn, M., Hormess, M. E., Lawrence, A., & Schneider, J. (2018). This is service design doing: applying service design thinking in the real world. " 1st Ed.O'Reilly Media, Inc."

CA429EA	Object Oriented Database Design With UML	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** The importance of modeling in the software development life cycle
- CLO 2.** Skills for the UML notation and symbols
- CLO 3.** The object-oriented approach to analyzing and designing systems and software solutions
- CLO 4.** How to Employ the UML notation to create effective and efficient system designs

Syllabus:

INTRODUCTION: Principles of OOD; programming Paradigms; benefits of OOD&P, applications of OOD; Classes and objects; access qualifiers; instance creation; constructors, parameterized constructors, overloaded constructors, constructors with default arguments, copy constructors, static class members and static objects. FUNCTIONS and OPERATORS: Function prototyping, function components, passing parameters, inline functions, default arguments, overloaded function; array of objects, pointers to objects, dynamic allocation operators, dynamic objects; Operator overloading, overloading unary and binary operator, overloading the operator using friend function, stream operator overloading, data conversion. INHERITANCE: Defining derived classes, single inheritance, protected data with private inheritance, multiple inheritance, multi-level inheritance, hierarchical inheritance, hybrid inheritance, multipath inheritance, constructors in derived and base class, abstract classes, virtual function and dynamic polymorphism, virtual destructor. EXCEPTION HANDLING: Principle of exception handling, exception handling mechanism, multiple catch, nested try, re/throwing the exception. OBJECT ORIENTED DESIGN: Requirements modeling, business modeling, component based development; Rational Unified Process (RUP), process overview, phases and iterations, static structure of the process, core workflows; UML history, building blocks of UML, structural modeling, behavioral modeling; Use Case Diagrams, Modeling Ordered Interactions: Sequence Diagrams; case studies.

Suggested Reading(s):

1. Ali Bahrami, 2017, “Object Oriented System Development”, International Edition , McGraw-Hill.
2. Booch G., 2007 “Object oriented analysis and design”, 3rd edition Addison- Wesley Publishing Company.
3. Rambaugh J, Blaha M, Premeriani, 2003 W., Eddy F and Lorezen W., “Object Oriented Modeling and Design”, 2nd Ed. PHI

CA429EB	Database Administration	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Design, model and install any database management systems by using Oracle database as sample.
- CLO 2.** Plan, design, construct, control and manage database instances, database network environment, storage structures, user security, database backup and recovery, database maintenance
- CLO 3.** Define and devise transaction management, concurrency control, crash recovery components
- CLO 4.** Examine and perform data base administration roles and operations by using Oracle database system as a sample.
- CLO 5.** Skills to Compare and contrast by examining the database systems and new trends in data storage, data retrieval and maintenance techniques.

Syllabus :

Implement Transaction Control and Data Control Language Transactional Control: Commit, Save point, Rollback DCL commands : Grant and Revoke. Explain types of Locks Test the locks on database Types of locks :i. Row level locks ii. Table level locks iii. Shared lock iv. Exclusive lock v. Deadlock Practice using various Database Objects Synonym : Create synonym Sequences:Create and alter sequences Index :Unique and composite Describe different types views and test it on a database Views :Create/Replace, Update and alter views PL / SQL and Triggers Basics of PL / SQL Data types Advantages Control Structures Conditional Iterative Sequential Implement Concepts of exception handling Exceptions:Predefined Exceptions, User defined exceptions Implement procedure, function, cursor in Package Cursors Static (Implicit & Explicit),Dynamic Procedures & Functions Packages :Package specification, Package body, Advantages of package Write, code, test and debug various types of triggers Fundamentals of Database Triggers Creating Triggers Types of Triggers : Before, after for each row, for each statement Database Design And Implementation Information System and organization Database design and implementation Database Application Life Cycle3.2 Conceptual Database application i. Design ii. Retrieve transaction

iii. Update Transaction iv. Mixed Transaction Logical and Physical Database Design i. Response Time ii. Space Utilization iii. Transaction Throughput Transaction Processing Analyze various concurrency control methods Transaction concepts Concurrency Methods for Concurrency control i. Locking Methods ii. Timestamp methods iii. Optimistic methods Database Administrator Implement user creation and execute authentication mechanism Types of Oracle Database Users User Creation and management Tasks of a Database Administrator Submitting Commands and SQL to the Database About Database Administrator Security and Privileges Database Administrator Authentication Creating and Maintaining a Password File Data Utilities

Suggested Reading(s):

1. Rob Coronel (2007), “Database Systems”, Seventh Edition, Gex Publications.
2. Bipin C Dessi (2017) ,“Introduction to Database System” ,Seventh Edition, Galgotia Publication
3. Gerald V.Post (2009) “Database Management Systems”, Second Edition,Tata Mc Graw Hill,

CA429FA	Research Methodology	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Students will be able to select appropriate quantitative methodologies for use in a study to be performed in the spring. These methodologies include, but are not limited to, experimental, survey and content analysis.
- CLO 2.** Students will be able to learn basic skills and approaches to qualitative research. These methodologies include, but are not limited to, case studies, indepth interviews and focus groups.
- CLO 3.** Students will be able to identify and critique articles based on different research methods
- CLO 4.** Students will be able to construct a questionnaire relying on several types of questions

Syllabus:

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process Problem Identification & Formulation – Research Question – Investigation Question –Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance Research Design: Concept and Importance in Research – Features of a good research design –Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample –

Practical considerations in sampling and sample size. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Suggested Reading(s):

1. Schutt, R. K. (2012). Investigating the Social World: The Process and Practice of Research (7th edition). Los Angeles: Sage.
2. Poindexter, P. M., & McCombs, M. E. (2000). Research in Mass Communication: A Practical Guide 1st Ed.. Bedford/St. Martin's.
3. Nayak, J. K., & Singh, P. (2021). Fundamentals of research methodology problems and prospects. 3rd Ed. SSDN Publishers & Distributors..

CA429FB	Statistical Data Analysis using R	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Understand the fundamental syntax of R through readings, practice exercises, demonstrations, and writing R code.
- CLO 2.** Apply critical programming language concepts such as data types, iteration, control structures, functions, and boolean operators by writing R programs and through examples
- CLO 3.** Skills to import a variety of data formats into R using RStudio
- CLO 4.** Prepare or tidy data for in preparation for analysis
- CLO 5.** Query data using SQL and R
- CLO 6.** Analyze a data set in R and present findings using the appropriate R packages
- CLO 7.** Visualize data attributes using ggplot2 and other R packages.

Syllabus:

Introduction: Overview and History of R, Software Installation, R Studio, Basic Features of R, Limitations of R, R Interface, Getting Help, Data Types, R Objects, Comments. Arrays, Matrices and Data Frames, Subsetting, Reading and Writing Data Control Structures: If, While, For Loops, Next, Break, R Functions, Basic Data Manipulation. Accessing R Packages, Dates and Times, lapply, tapply, split, mapply, apply, Coding Standards. Introduction to Scoping Rules, Debugging Tools, Simulation, R Profiler

Suggested Reading(s):

1. Wickham, H. & Golemund, G. (2018). for Data Science. International Ed. O'Reilly:
2. Crawley, M. J. (2012). The R book. 6th Ed. John Wiley & Sons.
3. Borcard, D., Gillet, F., & Legendre, P. (2011). Numerical ecology with R (Vol. 2, p. 688). New York: Springer.

CA429GA	Accounting and Financial Management	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Know and apply accounting and finance theory
- CLO 2.** Explain and apply skills for international accounting standards
- CLO 3.** Critically evaluate financial statement information
- CLO 4.** Evaluate and compare different investments

Syllabus:

Financial Accounting – An Introduction: Meaning of Accountancy, book-keeping and Accounting, Accounting Process, Objectives for accounting, Differences between book-keeping and accounting, Users of accounting information, Limitations of Accounting, Basic terminologies Accounting Concepts, Principles, Bases and Policies Structure: Accounting Concepts, Principles, Policies and Standards, Types of accounting concepts, Accounting Principles, Accounting Policies, Accounting Standards. Double Entry Accounting: Meaning of double entry accounting, Classification of accounts under Traditional approach, Classification of accounts under Accounting Equation approach, Comparison of traditional approach with Modern approach equal approach, Accounting Trail, Transactions and events, Meaning and roles of debit and credit, accounting equation Secondary Books: Secondary books, Purchases Book/Purchases Day book, Sales Book or Sales Day book, Bills receivable book-Bills payable book, Cash book, Posting to Ledger accounts- Posting to Ledger Trial Balance: Meaning, Objectives of preparing a trial balance, Methods of preparing a trial balance, Preparation of Trial balance, Adjusting Entries, Errors and their rectification, Errors disclosed by Trial Balance, Errors not disclosed by Trial Balance, Steps to locate the errors Final Accounts: Adjustments before preparing final accounts, Depreciation, Bad Debts and accounting treatment of bad debts, Provision for doubtful debts, Reserves for Discount on Debtors, Reserve for Discount on Creditors, Closing Stock, Trading Account, Profit and Loss Account Balance Sheet. Introduction to Management Accounting: Meaning of Management accounting, The Role of Management Accounting, Management Accounting Framework, Functions of Management Accounting, Tools of

Management Accounting, The Balanced Scorecard, Cost Management System, Value Added Concept , Merits of Management Accounting, Demerits of Management Accounting , Distinction between Management Accounting and Financial Accounting Funds Flow Analysis: Meaning of Funds Flow Statement, Ascertainment of flow of funds, Technique of preparing funds flow statement, Schedule of Changes in Working Capital, Adjusted Profit and Loss account, Funds Flow Statement Flow Analysis: Meaning of Cash Flow Statement, Purpose of Cash Flow Statement, Preparation of Cash Flow Statement , Format of Cash Flow Statement (AS3: Revised Method) , Cash Flow from Operating Activities, Cash Flow Statement under Direct Method, Different between Cash Flow Analysis and Fund Flow Analysis, Uses of Cash Flow Statement Understanding Cost: Meaning of Cost, Objective of Costing, Methods of Costing, Technique of Costing, Classification of Cost, Elements of Cost, Statement of Cost Sheet, Solved Problems. Marginal Costing and Break Even Analysis: Concept of Marginal Costing, Characteristics of Marginal Costing, Difference between Absorption Costing and Marginal Costing, Marginal Cost, Contribution , Cost Volume Profit (CVP) Analysis, Break Even Chart, Break Even Point , Profit Volume ratio or MCSR, Target profit, Margin of Safety, Application of Marginal cost, Limitations of Marginal cost, Solved Problems Decisions Involving Alternative Choices: Decision Making, Types of Costs, Types of Choices Decisions, Make or Buy Decisions, Addition / Discontinuance of a Product line, Sell or Process Further, Operate or Shut down, Exploring New Markets, Maintaining a desired level of profit. Budgetary Control: Meaning of a Budget, Budgetary control, Objectives of budgetary control, Merits of budgetary control, Essential features of Budgetary Control , Steps in budgetary Control, Types of Budgets, Cast Budget , Flexible Budget, Limitation of Budget Control Standard Costing: Definition of Standard Costing, Meaning, Difference between Standard cost and Budgetary Control, Establishment of standards, Variance analysis, Material cost variance, Material price variance, Material usage variance, Material Mix variance, Material Yield variance, Direct labor variance, Labor Efficiency Variance, Labor Rate variance, Labor mix variance, Labor Yield Variance.

Suggested Reading(s):

1. Peterson, S. J. (2013). Construction accounting and financial management (Vol. 2). Upper Saddle River, NJ: Pearson.
2. McLaney, E., & Atrill, P. (2016). Accounting and finance: an introduction. 2nd Ed. Prentice Hall.
3. Ryan, B. (2004). Finance and accounting for business. 2nd Ed. Cengage Learning Business Press.

CA429GB	Managerial Economics	1-0-2	2
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Course Learning Outcomes:

CLO 1. To introduce the economic concepts

CLO 2. To familiarize with the students the importance of economic approaches in managerial decision making

CLO 3. To understand the applications and skills of economic theories in business decisions

Syllabus:

Meaning and Importance of Managerial Economics: Introduction, Meaning, Scope of Managerial Economics , Importance of the study of Managerial Economics, Two Major Functions of a Managerial Economist Demand Analysis: Introduction, Meaning and Law of Demand, Elasticity of Demand, Demand Forecasting: Introduction, Meaning and Forecasting, Level of Demand Forecasting, Criteria for Good Demand Forecasting, Methods or Techniques of Demand Forecasting, Survey Methods, Statistical Methods, Demand Forecasting for a New Products Supply & Market Equilibrium: Introduction, Meaning of Supply and Law of Supply, Exceptions to the Law of Supply, Changes or Shifts in Supply. Elasticity of supply, Factors Determining Elasticity of Supply, Practical Importance, Market Equilibrium and Changes in Market Equilibrium Production Analysis: Introduction, Meaning of Production and Production Function, Cost of Production Cost Analysis- Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run. Objectives of Firm- Introduction, Profit Maximization Model, Economist Theory of the Firm, Cyert and March's Behavior Theory, Marris' Growth Maximisation Model, Baumol's Static and Dynamic Models, Williamson's Managerial Discretionary Theory Revenue Analysis and Pricing Policies- Introduction, Revenue: Meaning and Types, Relationship between Revenues and Price Elasticity of Demand, Pricing Policies, Objectives of Pricing Policies, Pricing Methods Price Determination under Perfect Competition- Introduction, Market and Market Structure, Perfect Competition, Price-Output Determination under Perfect Competition, Short-run Industry Equilibrium under Perfect Competition, Short-run

Firm Equilibrium under Perfect Competition, Long-run Industry Equilibrium under Perfect Competition, Long-run Firm Equilibrium under Perfect Competition Pricing Under Imperfect Competition- Introduction, Monopoly, Price Discrimination under Monopoly, Bilateral Monopoly, Monopolistic Competition, Oligopoly, Collusive Oligopoly and Price Leadership, Duopoly, Industry Analysis Macro Economics and some of its measures- Introduction, Basic Concepts, Macroeconomic Ratios, Index Numbers, National Income Deflators Consumption Function and Investment Function- Introduction, Consumption Function, Investment Function, Marginal efficiency of capital and business expectations, Multiplier, Accelerator Stabilization Policies-Introduction, Economic Stability, Instruments of economic Stability, Monetary Policy, Fiscal Policy, Physical Policy or Direct Controls. Business Cycle- Introduction, Meaning and Features, Theories of Business Cycles, Measures to Control Business Cycles, Business Cycles and Business Decisions Inflation and Deflation: Inflation - Meaning and Kinds, Measures to Control Inflation, Deflation

Suggested Reading(s):

1. Yogesh Maheswari, 2005, Managerial Economics, 3rd Ed. Phi Learning, New delhi,
2. Moyer & Harris ,2003 Managerial Economics,2nd Ed. Tata Mcgraw-Hill, New Delhi,
3. Geetika, Ghosh & Choudhury,2005, Managerial Economics, 2nd Ed.Cengage Learning, New delhi,

CA429HA	Cyber security & Cyber Forensics	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Analyze and resolve security issues in networks and computer systems to secure an IT infrastructure.
- CLO 2.** Design, develop, test and evaluate secure software .
- CLO 3.** Develop policies and procedures to manage enterprise security risks.
- CLO 4.** Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.
- CLO 5.** Learn Skills to interpret and forensically investigate security incidents.

Syllabus:

Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems associated with Computer Crimes, Realms of Cyber world, brief history of the internet, contaminants and destruction of data, unauthorized access, computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet, Cyber psychology, Social Engineering. Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling, analysis and advanced tools, forensic technology and practices, Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis. Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation, email investigation, email tracking, IP tracking, email recovery, search and seizure of computer systems, password cracking Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts, Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences, social media analysis, data retrieval, Email analysis from mobile phones. Cyber Crime and computer crime Introduction to Digital Forensics, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web

technology, cryptography, emerging digital crimes and modules. Basics of Computer Computer organisation, components of computer- input and output devices, CPU, Memory hierarchy, types of memory, storage devices, system softwares, application softwares, basics of computer languages. Computer Forensics Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, computer artifacts, Internet Artifacts, OS Artifacts and their forensic applications Forensic Tools and Processing of Electronic Evidence Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images, damaged SIM and data recovery, multimedia evidence, retrieving deleted data: desktops, laptops and mobiles, retrieving data from slack space, renamed file, ghosting, compressed files.

Suggested Reading(s):

1. Eoghan Casey, 2011, Digital Evidence and Computer Crime , Edition 3, Academic Press
2. MarjieBritz2011 Computer Forensics and Cyber Crime: An Introduction , Edition 2, prentice Hall
3. David Benton and Frank Grindstaff,2006, Practical guide to Computer Forensics, 2nd Ed. Surge Publishing

CA429HB	Digital Security and Advanced Cryptography	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Students should be able to: understand basic principles and results of the theory of secure communication;
- CLO 2.** Know principles and problems of basic cryptosystems for encryption (both secret and public key), digital signing and authentication
- CLO 3.** Know methods to create core cryptographic protocols primitives;
- CLO 4.** Practically use simple cryptosystems skills
- CLO 5.** Know how the real protocols enabling secure communication over internet, various tools and techniques to protect as well as attack a computer network.

Syllabus:

Systems Vulnerability Scanning Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra Review of the prerequisite course CSCI-462/662 Cryptography Private-key cryptosystems; Advanced Encryption Standard (AES) Overview of modular arithmetic, discrete logarithms, and primality/factoring Public-key cryptosystems; ElGamal cryptosystem Basic signature schemes Algebra and number theory Rings of polynomials Existence and finding primitive roots, Blum integers Galois fields $GF(p^k)$ Primes; Agrawal, Kayal, Saxena P-time algorithm for recognizing primes Elliptic curves Discrete logarithm based cryptosystems and signatures Elliptic Curve Cryptosystem (ECC) Digital Signature Standard (DSS) Selection of other signature schemes Overview of discrete logarithm algorithms Ethical aspects of public-key cryptosystems and signatures Hashing, emerging SHA-3 standard Interactive protocols Touch of complexity theory Interactive proof systems; 0-

knowledge proof systems 0-knowledge authentication Electronic cash; Chaum and Brands schemes Private information retrieval Selected topics AES news SHA-3 news Private/public/group/share key generation and management Digital watermarking, digital fingerprinting Steganography Selected topics in quantum computing Quantum computers Shor's algorithm, future demise of RSA Quantum cryptography Quantum key distribution and reconciliation

Suggested Reading(s):

1. D. R. Stinson: ,2003, Cryptography: Theory and Practice (Discrete Mathematics and Its Applications), 3e, CRC Press.
2. B. Schneier: ,2006,Applied cryptography: protocols, algorithms, and source code in C, 2e, John Wiley & Sons.
3. Bernard Menezes:,2011, Network Security & Cryptography, 1st Edition, Cengage Learning, Delhi

CA427A	Data Mining & Data Warehousing	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Study data warehouse principles and its working skills
- CLO 2.** Learn Data mining concepts and understand Association Rule Mining
- CLO 3.** Study Classification Algorithms
- CLO 4.** Gain knowledge of how data is grouped using clustering techniques.

Syllabus:

Data Warehousing Definition, Usage and Trends, DBMS Vs. Data Warehouse, Data Marts, Metadata, Data Mining Definition & Application, DBMS Vs. Data Mining, KDD Versus Data Mining, Data Mining Techniques, Business Intelligence Introduction, Cycle of a Business Intelligence Analysis Data Preprocessing: Need, Data Cleaning, Integration & Transformation Data Warehouse Process & Architecture, OLAP and OLTP Definitions, Difference Between OLAP and OLTP, Dimensional Analysis, Multidimensional Data Model, Data Cubes, Drill-Down and Roll-Up – Slice and Dice or Rotation, Operations, Types of OLAP, ROLAP Vs. MOLAP, Schemas for Multidimensional Database: Stars, Snowflakes and Fact Constellations Relation between BI and DW, the Business Intelligence User Types, Standard Reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, Dimensional Analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards Association Rule Mining, Single-Dimensional Boolean Association Rules Apriori Algorithm, FP Growth, Multi-Level Association Rules from Transaction Databases Classification and Prediction, Concepts of Decision Tree Induction and Bayesian Classification, Cluster Analysis, Categorization of Methods, Partitioning Methods, K-Means Algorithm, Outlier Analysis, Hierarchical Methods Emerging Technologies - Machine Learning, Big Data: Introduction, Importance, Four Vs Data Mining for Business Applications Like Fraud Detection, Market Segmentation, Retail Industry, Telecommunications Industry, Banking & Finance and CRM etc. Spatial Databases, Multimedia Databases, Time Series and Sequence Data, Text Databases, Web Mining Concepts.

Suggested Reading(s):

1. Jiawei Han, Micheline Kamber, 2006, Data Mining- Concepts and Techniques- 2nd Ed. Morgan Kaufmann Publishers, Elsevier.
2. Ning Tan, Vipin Kumar, Michael Steinbach 2009, Introduction to Data Mining, 2nd Ed., Pearson Education.

CA427B	Parallel and Distributed Computing	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Analyze and critically discuss research papers both in writing and in class
- CLO 2.** Formulate and evaluate a hypothesis by proposing, implementing and testing a project
- CLO 3.** Relate one's project to prior research via a review of related literature
- CLO 4.** Learn skills to write a coherent, complete paper describing and evaluating a project
- CLO 5.** Orally present a clear and accessible summary of a research work
- CLO 6.** Understand the fundamental questions in parallel and distributed computing and analyze different solutions to these questions
- CLO 7.** Understand different parallel and distributed programming paradigms and algorithms, and gain practice in implementing and testing solutions using these.

Syllabus:

Introduction to High Performance Computing Overview of high performance computing and Java Framework, Concurrent techniques, The benefits of parallel programming, The benefits of distributed programming, The basic layers of Concurrent techniques, Categories of computers Parallel Computer System Architecture Overview of Parallel Computing, Central processing unit design, Instruction set architecture and design, some general parallel terminology Microprocessor technologies Overview of Microprocessors, Silicon technology, Intel multi core technology Parallel Computer memory architecture Parallel Computer memory architectures, SMPs, MPPS and parallel processing Parallel and Distributed Programming Model: Parallel and Distributed Programming Models, Shared memory model, Threads models, Message passing model, Data Parallel model, Hybrid Programming Model, Flynn's Programming model, Embarrassingly parallel computation, Pipeline computations. Designing Parallel and Distributed Programs: Automatic vs Manual Parallelization, Understand the problem and the programme, Partitioning, Communications, Synchronization, Data dependencies, Load balancing, Granularity Parallel input and output, Limits and costs of parallel programming, Performance analysis and tuning. Client/Server based distributed programming through socket: TCP/IP layers and protocols, Transport layer protocol, TCP vs UDP, Introduction to Java socket programming, The

socket class ,The server socket class, The datagram packet class, The datagram socket class, The Inet address class Middleware based distributed Programming Overview of middleware, remote method invocation ,Common object request broker architecture. Introduction to cloud computing What is cloud computing, cloud components, web application framework, cloud web services, service oriented architectures towards to cloud computing.

Suggested Reading(s):

1. El-Rewini, H., & Lewis, T. G. (1998). Distributed and parallel computing. 2nd Ed. Manning Publications
2. Zomaya, A. Y., & Diab, H. B. (2005). Dependable Computing Systems: Paradigms, Performance Issues, and Applications 3rd Ed.(Wiley Series on Parallel and Distributed Computing). Wiley-Interscience.
3. Basu, S. K. (2016). Parallel and Distributed Computing: Architectures and Algorithms. 3rd Ed. PHI Learning Pvt. Ltd..

CA427C	Digital Image Processing	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Students understand how images are digitally represented and learn how to perform image processing, e.g. logic and arithmetic operations, convolution, and filtering
- CLO 2.** Students are able to implement low-level edge and corner detection algorithms to discard redundant and preserve useful information
- CLO 3.** Students are able to learn skills of a projective pinhole camera by applying techniques such as perspective projection, rigid body motion and homogeneous coordinates. Students are able to discover the intrinsic and extrinsic camera parameters using linear least squares on a set of
- CLO 4.** Students are able to extract 3D information from images and recover world positions through triangulation. They understand fundamental concepts in multiple view geometry, such as the correspondence problem, the essential/fundamental matrix, and the epipolar geometry

Syllabus:

Introduction and Digital Image Fundamentals, Human visual system, Image as a 2D data, Image representation – Gray scale and Color images, image sampling and quantization Image enhancement in Spatial domain: Basic gray level Transformations, Histogram Processing Techniques, Spatial Filtering, Low pass filtering, High pass filtering Filtering in the Frequency Domain: Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering Image Restoration and Reconstruction: Noise Models, Noise Reduction, Inverse Filtering, MMSE (Wiener) Filtering Color Image Processing: Color Fundamentals, Color Models, Pseudo color image processing Image Compression: Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, LZW coding, JPEG Compression standard Morphological Image Processing: Erosion, dilation, opening, closing, Basic Morphological Algorithms: hole filling, connected components, thinning, skeletons Image Segmentation: point, line and edge detection, Thresholding, Regions

Based segmentation, Edge linking and boundary detection, Hough transform Object Recognition and Case studies Object Recognition- patterns and pattern classes, recognition based on decision – theoretic methods, structural methods, case studies – image analysis Application of Image processing in process industries

Suggested Reading(s):

1. Solomon, C., & Breckon, T. (2011). Fundamentals of Digital Image Processing: A practical approach with examples in Matlab. 3rd Ed. John Wiley & Sons.
2. Tyagi, V. (2018). Understanding digital image processing. 6th Ed. CRC Press.
3. Sundararajan, D. (2017). Digital image processing: a signal processing and algorithmic approach. 3rd Ed. Springer.

CA427D	Software Project Management	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Understand Project Management principles while developing software.
- CLO 2.** Gain extensive knowledge about the basic project management concepts, framework and the process models
- CLO 3.** Obtain adequate knowledge about software process models and software effort estimation techniques
- CLO 4.** Learn skills to estimate the risks involved in various project activities
- CLO 5.** Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles
- CLO 6.** Learn staff selection process and the issues related to people management

Syllabus:

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning. Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model. Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning – Risk Management – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules. Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract

Management.Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.

Suggested Reading(s):

1. Hughes, B. (2004). MikeCotterell “Software Project Management”. Third Edition, Tata, McGraw Hill.
2. Ramesh, G. (2002). Managing global software projects. 2nd Ed. Tata McGraw-Hill Education.
3. Royce, W. (2015). Software project management. 5th Ed. Pearson Education India..

CA427E	Organizational Behavior	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Identify and define organizational behavior concepts and learn the skills
- CLO 2.** Apply those concepts to improve you understanding of your own work attitudes and behaviors
- CLO 3.** Apply those concepts to improve the functioning of an organizational unit

Syllabus:

Introduction to organization, organization and managers, manager' roles and skills, behaviour at work, introduction to organization behaviour, major behavioural science disciplines contributing to OB, challenges and opportunities managers have in applying OB concepts, OB model (including motivation models) and levels of OB model Introduction to individual behaviour, values, attitudes, job satisfaction, personality, perception and individual decision making, learning, motivation at work, managing emotions and stress (Meaning-Definition Stress and job performance relationship Approaches to stress management (Coping with stress) Interpersonal Behaviour, Johari Window, Transactional Analysis – ego states, types of transactions, life positions, applications of T.A., managerial interpersonal styles.. Introduction to group behaviour, foundations of group behaviour, concept of group and group dynamics, types of groups, formal and informal groups, theories of group formation, group norms, group cohesiveness, group decision making, intergroup behaviour, concept of team vs. group, types of teams, building and managing effective teams, leadership theories and styles, power and politics, conflict and negotiation. Foundations of organization structure, organization design, organization culture, organization change, managing across cultures, human resource management policies and practices, diversity at work.

Suggested Reading(s):

1. Robbins, S. P/ Judge, T. A/ Sanghi, S.,2002 Organizational Behavior, 2nd Ed. Pearson Publication
2. Aswathappa, K.,2003 Organisational Behaviour– Text and Problem,3rd Ed. Himalaya Publication

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3. Pardeshi, P. C., 2005 Organizational Behaviour & Principles & Practice Of Management,
4th Ed. Nirali publication

CA427F	Agile Methods for Software Development	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Realize the importance of interacting with business stakeholders in determining the requirements for a software system
- CLO 2.** Perform iterative software development processes: how to plan them, how to execute them
- CLO 3.** Point out the impact of social aspects on software development success
- CLO 4.** Develop techniques and tools for improving team collaboration and software qualityrequire for employability
- CLO 5.** Perform Software process improvement as an ongoing task for development teams
- CLO 6.** Show how agile approaches can be scaled up to the enterprise level

Syllabus:

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices. Agile Information Systems – Agile Decision Making - Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation. Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile

Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

Suggested Reading(s):

1. David J. Anderson and Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003
2. Hazza and Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009
3. Cockburn, A. (2006). Agile software development: the cooperative game. 3rd Ed. Pearson Education.

CA427G	Web Services	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Understand the principles of SOA required for employability
- CLO 2.** Efficiently use market leading environment tools to create and consume web services
- CLO 3.** Identify and select the appropriate framework components in creation of webservice solution
- CLO 4.** Apply OOP principles to creation of web service solutions

Syllabus:

Evolution and Emergence of Web Services – Evolution of distributed computing. Core distributed computing technologies – client/server, CORBA, JAVA RMI, Micro Soft DCOM, MOM, Challenges in Distributed Computing, Introduction to Web Services – The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services. Web Service Architecture – Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services. Brief Over View of XML – XML Document structure, XML namespaces, Defining structure in XML documents, Reuse of XML schemes, Document navigation and transformation. SOAP : Simple Object Access Protocol, Inter-application communication and wire protocols, SOAP as a messaging protocol, Structure of a SOAP message, SOAP envelope, Encoding, Service Oriented Architectures, SOA revisited, Service roles in a SOA, Reliable messaging, Describing Web Services – WSDL introduction, non functional service description, WSDL1.1 Vs WSDL 2.0, WSDL document, WSDL elements, WSDL binding, WSDL tools, WSDL port type, limitations of WSDL. Registering and Discovering Services : The role of service registries, Service discovery, Universal Description, Discovery, and Integration, UDDI Architecture, UDDI Data Model, Interfaces, UDDI Implementation,.

Suggested Reading(s):

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1. Michael P. Papazoglou ,2005, Web Services & SOA Principles and Technology, Second Edition,
 2. R. Nagappan, R. Skoczylas, R.P. Sriganesh ,2006, Developing Java Web Services, , 3rd Ed. Wiley India
 3. S. Chatterjee, J. Webber , 2009,Developing Enterprise Web Services, 3rd Ed., Pearson Education

CA427H	Cyber Law and IT Security	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Make Learner Conversant With The Social And Intellectual Property Issues Emerging From ‘Cyberspace
- CLO 2.** Explore The Legal And Policy Developments In Various Countries To Regulate Cyberspace
- CLO 3.** Develop The Understanding Of Relationship Between Commerce And Cyberspace;
- CLO 4.** Give Learners In Depth Knowledge Of Information Technology Act And Legal Frame Work Of Right To Privacy, Data Security And Data Protection
- CLO 5.** Make Study On Various Case Studies On Real Time Crimes

Syllabus:

Emergence of Cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access. Information technology Act : Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of DigitalSignature Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication. Cyber law and related Legislation : Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution , Online Dispute Resolution (ODR). Electronic Business and legal issues: Evolution and development in Ecommerce, paper vs paper less contracts E-Commerce models- B2B, B2C,E security. Application area: Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends. Case Study On Cyber

Crimes: Harassment Via E-Mails, Email Spoofing (Online A Method Of Sending E-Mail Using A False Name Or E-Mail Address To Make It Appear That The E-Mail Comes From Somebody Other Than The True Sender, Cyber Pornography (Exm.MMS),Cyber-Stalking

Suggested Reading(s):

1. K.Kumar,2011,” Cyber Laws: Intellectual property & E Commerce,Security”,1st Edition, Dominant Publisher
2. Rodney D. Ryder, 2007,“ Guide To Cyber Laws”, Second Edition, Wadhwa And Company, New Delhi,
3. NIIT ,2002,Information Security policy &implementation Issues,2nd Ed. , PHI

YEAR V – (SEMESTER IX)

CA431	Computer Graphics and Multimedia	3-0-0	3
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Course Learning Outcomes:

- CLO 1:** Explain the applications, areas, and graphic pipeline, display and hardcopy technologies.
- CLO 2:** Apply and compare the algorithms for drawing 2D images also explain aliasing, anti aliasing and half toning techniques.
- CLO 3:** Discuss OpenGL application programming Interface and apply it for 2D & 3D computer graphics.
- CLO 4:** Analyze and apply skills of clipping algorithms and transformation on 2D images.
- CLO 5:** Solve the problems on viewing transformations and explain the projection and hidden surface removal algorithms.
- CLO 6:** Explain basic ray tracing algorithm, shading, shadows, curves and surfaces and also solve the problems of curves.

Syllabus:

Graphics Introduction, Application of Graphics, Elements of Graphics Workstation, Pixel, Frame, Buffer, Resolution, Graphics Display Devices: Raster Scan System, Random Scan System, Refresh CRT, Color CRT, LCD Led Monitor and Plasma Panel, Hard Copy Devices: Printers & Plotters, Input Devices : Mouse, Trackball, Light Pen, Scanner, Digital Camera Drawing Geometry: Point-Plotting, Coordinate System, Point Plotting, Line Drawing-Line Segments, Line Drawing Algorithm: DDA Algorithm, Bresenham's Line Algorithm, Circle Drawing, Ellipse Drawing, Polygon Representation Rectangle, Filling- Filled Area Primitives, Scan Line Polygon Fill Algorithm, Flood Fill Algorithm, Boundary Fill Algorithm 2D Geometric Transformation: Translation, Rotation, Scaling, Geometric Transformation, Coordinate Transform and Composite Transformation, 2D Viewing Transformation & Clipping: World

Coordinate System (WCS), Normalized Device Coordinate System, Point Clipping, Line Segment Clipping, Cohen–Sutherland Line Clipping 3D Geometric Transformation 3D Geometric Transformation: Translation, Rotation, Scaling, Composite Transformation, 3D Display Methods – Parallel Projection, Perspective Projection Curve Representation, Bezier and B-Spline Methods Multimedia Basics, Multimedia Applications, Multimedia: Text – Font, Faces, Animating Text, Hypertext. Sound: MIDI, Digital Audio Basics, File Formats Image: Bitmap, Vector Drawing, Color Palette, Image File Formats (BMP, JPG), Video – Broadcast Video Standards (NTSC, PAL), Integrating Computer and Television, Compression and Decompression (JPEG, MPEG) Animation: Principle of Animation, Cell Animation, Kinematics, Morphing, Multimedia Fundamentals: Introduction, Multimedia & Hypermedia, WWW, Multimedia software tools, Multimedia Authoring and Tools, Graphics and Image Data Representation, Color Models in images & video, Fundamental Concepts in Video, Basics of digital Audio. Multimedia Data Compression: Lossless Compression Algorithms (Basics of Information Theory, Run length coding, variable length coding, lossless image compression), Lossy Compression Algorithms (distortion measure, quantization, Discrete Cosine transform), Basic Image Compression standard: JPEG, Basic Video Compression standard: MPEG (MPEG:1:4).

Suggested Reading(s):

1. Edward Angel, 2009, Interactive Computer Graphics A Top:Down Approach with OpenGL, 5th Edition, Pearson,
2. David F. Rogers, 1995, Procedural Elements for Computer Graphics, 2nd Ed. McGraw Hill.
3. Edward Angel, 2000, Interactive Computer Graphics, 2nd Ed. Addison:Wesley
4. Mason Woo et al, 1997, OpenGL Programming Guide, Reprint Edition Addison:Wesley,

CA433	Compiler Design	3-0-0	3
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Course Learning Outcomes:

- CLO 1:** Specify and analyze the lexical, syntactic and semantic structures of advanced language features
- CLO 2:** Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation
- CLO 3:** Apply skill to write a scanner, parser, and semantic analyser without the aid of automatic generators
- CLO 4:** Turn fully processed source code for a novel language into machine code for a novel computer
- CLO 5:** Describe techniques for intermediate code and machine code optimisation
- CLO 6:** Design the structures and support required for compiling advanced language features.

Syllabus:

Introduction to Compiler and Compilation Process, Typical Compiler Structure, Programming Language, One Pass & Multi Pass Compilers, Bootstrapping, Various Phases of Compiler. Lexical Analyzer: Introduction to Lexical Analyzer, Input, Buffering, Recognition of Tokens, Idea About LEX: a Lexical Analyzer Generator. Syntax Analysis : CFG's, Need and Role of the Parser, Parsing Techniques: Top Down and Bottom UP Parsing, General Strategies: Recursive Descent Parser, Predictive Parser: LL(1) Parser, Shift Reduce Parser, LR Parsers: (LR,SLR,LALR), Error Handling and Recovery in Syntax Analyzer. Syntax Directed Definitions, Construction of Syntax Trees, Top Down Translation, Specification of a Type Checker, Different Intermediate Forms, Syntax Directed Translation Mechanisms and Attributed Intermediate Code Forms Using Postfix Notation and Three Address Code, Representing TAC Using Triples and Quadruples, Translation of Assignment Statement, Boolean Expression and Control Structures. Symbol Table Organization: Symbol Tables Contents, Data Structures for Symbol Tables, Storage Memory Allocation – Static & Dynamic Memory Allocation,

Compilation Control Transfer, Procedure Calls, Conditional Execution, Iteration Control Construct. Code Generator: Issues in the Design of a Code Generator, Intermediate Code Generation, Declarations Statements, Assignment Statements, Boolean Expression, Case Statements, Back Patching, Procedure Calls, Code Generation, the Target Machine, Run:Time Storage Management, Basic Blocks and Flow Graphs, Register Allocation and Assignment, the Dag Representation of Basic Blocks, Generating Code from DAGS. Code Optimization: Introduction to Optimization, Transformations, Local Optimization, Program Flow Analysis, Global Optimization. Principal Sources of Optimization, Dead Code Elimination, Loop Optimization, Peephole Optimization, Idea About Global Data Flow Analysis, Common Sub Expression Removal, Code Motion, Strength Reduction.

Suggested Reading(s):

1. Alfred V. Aho, Jeffrey D. Ullman (2001), Principles of compiler design, Indian student edition,
2. Pearson Education, New Delhi, India.
3. Kenneth C. Louden (1997), Compiler Construction– Principles and Practice, 1st edition, PWS Publishing.
4. K. L. P Mishra, N. Chandrashekar (2003), Theory of computer science- Automata Languages and computation, 2nd edition, Prentice Hall of India, New Delhi, India.

CA434	Software Engineering Design Testing and Quality Assurance	3-0-0	3
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Course Learning Outcomes:

CLO01: Infer various software models concepts for making the software.

CLO02: Analyze requirements for software development and to determine the entities involved in the system and their relationship to one another.

CLO03: To make sure that the result meets the business and user requirements Software testing plays an instrumental role

CLO04: To satisfy the BRS that is Business Requirement Specification and SRS that is System Requirement Specifications and finally gain the confidence of the customers by providing them a quality product.

CLO05: To create test cases and learn the skills for employability.

Syllabus:

Design and Analysis Aspects: Architectural Design – Cohesion and coupling, Abstraction, Data flow Oriented Design, Distributed Systems Architecture, Application Architectures, Object Oriented Design, Real:time Software Design, User Interface Design and Usability Engineering. Software Development: Rapid Software Development, Software Reuse: Design Patterns, Component Based Software Engineering (CBSE), Critical Systems Development, Software Evolution. Software Testing Process, Objectives, Testing Techniques, Software Testing Life Cycle, Concept of Testing, Types of Errors, Stubs and Drivers Verification and Validation, Different Types of Verification & Validations Mechanisms, Concepts of Software Reviews, Code Inspection and Code Walkthrough, Testing of Component Based Software System, Energy Efficient Testing, Mobile Application Testing. Software Testing Methods, Testing Fundamentals, Test Case Design, White Box Testing and its Types, Black Box Testing and its Types, Software Testing Strategies, Strategic Approach to Software Testing, UNIT Testing, Integration Testing, Validation Testing, System Testing, Test Planning, Budgeting and Scheduling. Software Testing Metrics, Concept and Developing Testing Metrics, Different

Types of Metrics, Complexity Metrics, Defect Management, Definition of Defects, Defect Management Process, Defect Reporting, Metrics Related to Defects, Using Defects for Process Improvement. Software Quality, Factors Affecting Software Quality, Quality Models, Software Quality Estimation, Quality Metrics, Quality Assurance, SQA Activities, Software Reviews, Formal Technical Reviews, Quality Control Quality Management, and, SQA Plan. Quality Improvement, Pareto Diagrams, CauseEffect Diagrams, Scatter Diagrams, Run Charts, Total Quality Management, Statistical Quality Assurance, Software Reliability, the ISO 9001 Quality Standard, Six Sigma, Informal Reviews. Quality Costs, Quality Cost Measurement, Utilizing Quality Costs for Decision:Making. Manual Vs Automatic Testing, Basics of Automated Testing, Drawback of Manual Testing, Advantages of Automation of Testing, Factors for Automation Testing, Types Automation of Testing Tools, Introduction to QTP, QTPIDE, Basic Components in QTP, QTP Framework, Write Scripts, Introduction to Selenium, and Rational Robot.

Suggested Reading(s):

1. Pressman, R. S. (2005). Software engineering: a practitioner's approach. McGraw Hill.
2. Ian Sommerville Software Engineering (2014), Sixth Edition, Adison-Wesley Pub. Co.
3. Pankaj Jalote (2011)An Integrated Approach to Software Engineering by, Third Edition Wiley.

CA437	Intellectual Property Rights	0-2-0	1
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Course Learning Outcomes:

CLO1: To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.

CLO 2: To disseminate knowledge on patents, patent regime in India and abroad and registration aspects

CLO 3: To disseminate knowledge on copyrights and its related rights and registration aspects

CLO 4: To disseminate knowledge on trademarks and registration aspects for employability

CLO 5: To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects

CLO 6: To aware about current trends in IPR and Govt. steps in fostering IPR

Syllabus:

Module: Introduction and Historical Background Introduction: The Concept of Property: Its Definition, Its Features, and Classification – Intellectual Property as Creations of the Human Mind – Justifying Intellectual Property : Arguments for and Against It – Types of IPRs: Patent, Copyright, Trademark, Trade Secret, Industrial Design, Geographical Indication, Semiconductor Integrated Circuit Layout Design, Plant Variety & Farmer's Rights; Genetic Resources and Traditional Knowledge Historical Background: Evolution of IPRs through Various International Agreements, Treaties, & Conventions: From Paris Convention (1883) To WTOTRIPS Agreement (1995) – Global IPR Organizations: WIPO (1967) and WTO (1995) Self:Learning Topics: Relevance of Intellectual Property in Today's Knowledge Economy Module: Patents: Introduction to Patent: What is a Patent? – Conditions for Grant of Patent – Patentable Inventions and Inventions Not Patentable – Process and Product Patents – Patent Specifications – The Process for Obtaining a Patent in India and Abroad – PCT Patent – Post:Grant Opposition, Revocation and Compulsory Licensing – Rights Granted to a Patentee – Patent Infringement & Its Remedies – Patent Search and Databases – e:filing of Patent Application Emergence of

Technology Patents: Patenting the Inventions of Information Technology: Patenting Computer Programs and Software – Software Patents vs Software Copyrights: Lessons for India – Patenting of Biotechnology Inventions (or Patenting Life) Self:Learning Topics: Biotech Patents in India Module: Copyrights Introduction to Copyright: Nature of Copyright – Copyright as a Property, Statutory Right, Idea versus Expression – Requirements for Copyrights – Idea/Expression Dichotomy: Merging of the Idea with Expression, Originality & Fixation Various Works Protectable Under Copyrights – Authorship and Ownership – Registration of Copyrights Term of the Copyright – Copyright Infringement, Its Remedies & Penalties. Copyrights in the Digital Age Internet and Copyright – Copyrights in Computer Software – Copyrights for Electronic Database – Digital Copyright Protection in India Self:Learning Topics: Fair Use – Instances of Fair Use: Using Copyrighted Works in Education and Library Module: Trademarks and Trade Secrets Trademarks: Introduction – The Rationale and Functions of a Trademark – Different Types of Trademarks – Categories of Trademark Distinctiveness – Recognizing a Good Trademark – What Cannot be Registered as a Trademark? – Registration & Renewal of a Trademark – Rights Granted by Trademark Registration – Different Classes of Trademark Infringement – Acts of Trademark Infringement & Remedies Trade Secrets: Trade Secret and its Characteristics: Kinds and Examples of Trade Secrets: Protection of Trade Secrets: Patents and Trade Secrets Self:Learning Topics: Origin of Trademarks System in India – Misappropriation of Trade Secrets Module: Designs and Geographical Indications Design: Defining a Design – Essentials of a Design – Registration & Term of Designs – Copyright in Registered Designs – Conditions for Registration of Industrial Designs – Procedure for Registration of Industrial Designs – Infringement of Industrial Designs and Remedies Against Infringement – The Hague Agreement Geographical Indications: Introduction: Concept of Geographical Indications: Kinds of Geographical Indications – Registration of GIs – Benefits of Registering GIs – Infringement of a Registered GI and Remedies Thereof Self:Learning Topics: IPRs for Semiconductor Integrated Circuit Layout Design Module: Harnessing Intellectual Property for National Development India's New National IPR Policy, 2016: Vision Statement, Mission Statement and Objectives – IPR Administration System in India – Govt of India Initiatives & Schemes towards Promoting IPR Self:Learning Topics: Managing of Intellectual Property in Organizations

Suggested Reading(s):

1. May, C., & Sell, S. K. (2006). Intellectual property rights: A critical history (p. 37). Boulder: 3rd Ed. Lynne Rienner Publishers.
2. Cullet, P. (2005). Intellectual property protection and sustainable development. LexisNexis, 4th Ed. Butterworths.
3. Swanson, T. (Ed.). (1998). Intellectual property rights and biodiversity conservation: an interdisciplinary analysis of the values of medicinal plants. 2nd Ed. Cambridge University Press.

CA439AA	Advanced Web Technologies: I(MongoDB, Express, Angular, React, Node)	2-0-4	4
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Course Learning Outcomes:

- CLO 1:** Define the fundamental ideas and standards underlying Web Service Technology.
- CLO 2:** Define the fundamental principles for cloud applications.
- CLO 3:** Discuss concepts at the frontier of industrial practice and emerging standards.
- CLO 4:** Differentiate the major frameworks allowing to develop web services and cloud applications and assess their suitability for specific usage scenarios.
- CLO 5:** Explain the link between the concepts of services and business processes and discuss and critique related standards.
- CLO 6:** Develop skills of business processes using the Workflow foundation .
- CLO 7:** Develop and deploy web services and cloud applications using appropriate Microsoft technologies.

Syllabus:

Angular Forms and Controls Introduction to Angular Forms Types of Angular Forms: Template Driven and Model Driven Template Driven vs. Model Driven Template Driven Form Creating Template driven Form Angular form input controls Angular form validation Angular form and controls properties Model Driven Form Creating Model Driven Form Angular form input controls Angular form validation Angular form and controls properties Introduction to Node.js Introduction to Node.js History of Node.js Introduction to io.js What is Node.js Foundation? V8 JavaScript Engine Why Server:side JavaScript? Getting started with Node.js Node.js Architecture JavaScript Event Loop Node.js vs. others Server:Side Frameworks Node.js Application Area Who Use Node.js Advantages of Node.js Limitations of Node.js JavaScript with Node.js Writing Asynchronous Code Blocking vs Non:Blocking Code Modules Understanding Modules Built:In Modules Creating Module Exporting Module Importing Modules Node.js CLI and NPM Understanding CLI Node's Package Manager: NPM Local Packages and Global Packages Installing, Updating and Removing Modules using NPM Understanding package.json file Node.js Package and Publishing Creating a Node Package Publishing Package Using published package Buffers Creating buffer Buffer decoding Streams

Creating streams Streams types Readable Stream Writable Stream Stream Pipe Events
Understanding Events Event Emitter class Emitting Event Listening Event

Suggested Reading(s):

1. Papazoglou, 2012, Web Services: Principles and Technology (2nd edition); Prentice Hall.
2. Alonso, Casati, Kuno and Machiraju, 2009 Web Services: Concepts, Architectures and Applications; 3rd Ed. Springer.
3. Cerami, 2008 Web Services Essentials; 2nd Ed. O'Reilly.

CA439BA	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	1-0-2	2
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Course Learning Outcomes:

CLO01: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.

CLO02: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies for entrepreneurship.

CLO03: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.

Syllabus:

Social Media Marketing (SMM) : Introduction, Key terms and concepts, Social media channels & Social networks.: What is Facebook Marketing, Overview & Why Facebook?: Content creation, Location and social media, Rules of engagement, Get to know the admin panel, Creating Business Page: Advantages and challenges. How to connect with people by planning your Facebook page and understanding how it is structured to make the maximum use of it.: Facebook Marketing Strategies for Fan Page, Introduction to Fan Page Marketing Strategies.: All Connections, Invite Potential Followers, Distributer Pages For Your Content, Competitions: Rules & Steps – Facebook Inner Marketing Strategies structure, Psychology of Successful Posts, Time For Hooked Headlines, How To Create Network Effect, Notification Challenge – Facebook Group Marketing Strategies, Introduction To Facebook Groups, Start Your Group, Fundamental Group Marketing Setup, Group Monetization, Group Up! – Live Streaming Professional, Introduction to Live Streaming, How To Go Live, Live Stream Planning, Live Stream Monetization, Tips to Master Live Acting, Live Stream Mission – Facebook Ads & Promotions: Introduction to Facebook Ads Manager.: Facebook Ads & Promotions – Set Your Billing, Define Saved Audience, Create Ads: Reach: Facebook Ads & Promotions – Create Ads: Engagement Posts, Define your Targeted Customers: Facebook

Retargeting, Introduction to Retargeting: Create Pixel, Pixel Installation, Pixel Status & Checker, Pixel Custom Audience.: Lookalike & Custom Audience, Conversion Ad & Custom Conversion, Start Retargeting. – Event Marketing, Introduction to Events, Event Setup, Marketing your Event: Facebook Shop setup, Introduction to Facebook Shop, Shop and product setup, Payment option setup etc. How to analyse Facebook reporting and insight Instagram Marketing – Introduction – Instagram Marketing: Overview, What is Instagram?, Basics of Instagram, Advantages of Using Instagram : Instagram Marketing – Account Setup and inviting more users to window shop, You can promote your brand, You can attract fans and boost sales Instagram Marketing – Business Strategy, Engage your customers, Build content, Always hashtag, Connect to other forms of social media; Ideas to Flip: up Instagram, Use sponsored ads and posts, Post according to an editorial calendar, Partner with Instagram influencers: Instagram Marketing: Activity Review, Instagram Marketing: Fine Tuning Content, Instagram Marketing: Tools and Apps, Paid Advertising & Reporting LinkedIn Marketing – Introduction to LinkedIn, why does my business need LinkedIn? How to Optimize your Profile? Expand Your Network of Influencers; Creating a Profile, Make a professional header, Keep connections informed of your status, Showcase your skills, credentials, and experience, Changing your profile settings.: LinkedIn Marketing – Page Setup and promotion, What is a group?, Finding groups, Joining groups and Engaging in Groups LinkedIn Marketing – Paid Advertising, Getting Started with Text Ads, Targeting, New Audience Targeting, Bid Strategy, Campaign Manager, Sponsored Groups and Display Ads Measure The Impact And Optimize, Unlock The Power Of LinkedIn's Partner Program and Reporting Twitter Marketing – Twitter Marketing: Overview, What is Twitter?, How Can I Use Twitter for Marketing?, Twitter Terminology Twitter Marketing – Twitter Marketing: Account and Profile, Creating a Twitter Account, Tips on Selecting a Username, Twitter Account Profile & Twitter Account Profile Elements Twitter Marketing – Twitter Marketing: The Followers, Components of Twitter, Considerations to Follow Others on Twitter & Image & Video Posts; Twitter Marketing – Sharing Images on Twitter, Tagging People in Twitter, Twitter Video Posts, Sharing Videos on Twitter & Recording a Video on Twitter; Twitter Marketing: Hashtags, Considerations of Using Hashtags in Twitter, Types of Twitter Hashtags & Twitter Marketing – Retweet Twitter Marketing: Useful Features, URL Shorteners in Twitter, Posting Links in a Tweet & Implementing Twitter

Cards: Twitter Marketing: Native Analytics, Automation, Managing Conversions & Reputation Management Pinterest Marketing – Basics, Working Principle of Pinterest, What is Pinterest Used For? What is Pinning? What are Pinterest Boards? Pinterest Marketing – Types of Pinterest Accounts, Pinterest Terminology, Setting up a Pinterest Account & Pinterest as a Social Network; Pinterest Marketing – Interface, Changing a Pinterest Profile, Types of Pinterest Boards, Categorizing on Pinterest Boards & Best Practices for Pinnable Image; Pinterest Marketing: Rich Pins, Promote Your Pins, What are Promoted Pins? & Tracking the Traffic; Pinterest Marketing: Planning a Campaign, Drive Traffic, Why does Customer Loyalty Matter? & Generate Customer Loyalty; YouTube Marketing – In introduction, Salient Features of YouTube, Creating an Account and The YouTube Advantage; YouTube Marketing: Create Creative Video, Creating a Channel, Channel Description Box and Setup Channel Background; YouTube Marketing: Channel Branding, Create Video Thumbnails, Create Video Playlists & Video Sharing Sharing Unlisted and Private Videos, White Hat SEO for Videos, Choosing a Video Title & Add Video Annotation; YouTube Marketing: Promoting a Video, Fan Finder, Handling Comments, Manage Negative Comments & Monetize Your Video; YouTube Marketing: Marketing Tricks, Safety Settings, Videos Admin, Video Transcripts and Video Call Button; YouTube Marketing: Partner Program, Analytics and Real:Time Reports

Suggested Reading(s):

1. Venakataramana Rolla (2009), “Digital Marketing Practice guide for SMB: SEO, SEM and SMM”, CreateSpace Independent Publishing Platform, 1st edition.
2. Damian Ryan Kogan (2017) “Understanding Digital Marketing: Marketing strategies for Engaging the Digital Generation”, 3rd edition.
3. Shivani Karwal,(2014) “Digital Marketing Handbook: A Guide to search Engine Optimization, Pay Per Click Marketing, Email Marketing and Content Marketing”, Create Space Independent Publishing Platform, 1st edition.

CA439BB	Affiliate Marketing and Online Reputation Management (ORM)	1-0-2	2
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Course Learning Outcomes:

CLO01: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.

CLO02: Hands-on familiarity with the leading tools and techniques used in the customer-facing aspects of Digital Marketing & Internet Technologies for employability.

CLO03: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.

Syllabus:

Introduction to Affiliate Marketing: Overview of Affiliate Marketing, Basics of Affiliate Marketing and Its Role in Internet Marketing, Preparing to Begin Affiliate Marketing Affiliate Marketing and the Major Players, Types of Affiliate Sites That Work Best for Monetization, Integrating Affiliate Marketing Into Your Marketing Mix, Traditional Affiliate Networks vs. CPA Networks Finding a Niche and Doing Your Research, Gearing Up for Your Marketing Push Content: What Works and How to Create It, Selecting the Right Networks to Work With. Adding Paid Sponsoring Placement, AdSense and Links, Determining Costs and Creating a Business Plan, Tracking Tools, Obtaining and Placing Tracking Code Are You Delivering the Content Your Audience Wants?, Using Video, Blogs, Email and Social Media to Broadcast, Methods for Delivering a Variety of Content; Applying to Programs and How to Get Approved, Building Better Landing Pages, Selling Affiliate Marketing as a Viable Channel to Executives; Understanding Search: SEO/SEM and Their Role in Affiliate Marketing, Creating Content for Your Affiliate Marketing Site; Getting the Most From What You Are Delivering, Measuring the Effectiveness of Your Campaigns, Driving Traffic Using Natural and Paid Search, Negotiating a Better Deal or Higher Commissions Leveraging Your Affiliate Channel Into Other Areas of Your Business, Tools for Optimizing Your Site, Network Reporting Forums,

Websites, Conferences and Message Boards, Leveraging Social Media; Engaging Your Audience, Dealing With a Network Representative or Affiliate Manager; Generating Revenue Through a Membership Site or List Building, Blending Online and Offline Campaigns; Tools for Monitoring What People Are Saying About Your Brand and Website, How to Promote Your Efforts; Legal Best Practices and Ethical Considerations, Use of Collected Data and Respecting Privacy Concerns; Trademark Bidding, Understanding Affiliate Marketing Terms of Service Agreements; Search Engine Techniques: Black Hat vs. White Hat, Collecting Data and Ensuring Privacy, Website Protection, Assessing Potential Risks and Challenges How Super:Affiliates Choose Programs to Promote, Building Trust, Influence and Engagement With Customers Coupons and Deals, Methods to Make the Networks Work Harder for You Successful Affiliate Marketing, Affiliate Marketing Through Email Marketing Online Publisher Perspective, ShareASale Affiliate Network & Coupons and Deals Mobile Marketing: Introduction, Key terms and concepts, The role of mobile in personal communication, Mobile messaging channels, Location and mobile Mobile Marketing Mobile Marketing Technology & Reach, Anywhere anytime access and Advertisements should be personalized What is Mobile Marketing Strategy? Identify Your Target Audience, Define the Value of Your Offerings and What is Mobile Marketing Policy? Mobile Marketing: SMS Campaign, What is SMS Campaign?, How does SMS Campaign Work? and Benefits of SMS Campaign Mobile Website Marketing Strategies, How does Mobile Website Work?, Mobile Apps Marketing Strategies & Mobile Advertising Ecosystem Mobile Social Media Marketing, Mobile E:Mail Marketing, How does M:Commerce Work? and Understanding Mobile Users Online Reputation Management: Understanding ORM scenario How to deal with criticism online Understanding tools for monitoring online reputation Step by Step guide to overcome negative online reputation

Suggested Reading(s):

1. Venakataramana Rolla (2009), “Digital Marketing Practice guide for SMB: SEO, SEM and SMM”, CreateSpace Independent Publishing Platform, 1st edition.
2. Damian Ryan Kogan (2017) “Understanding Digital Marketing: Marketing strategies for Engaging the Digital Generation”, 3rd edition.

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3. Shivani Karwal,(2014) “Digital Marketing Handbook: A Guide to search Engine Optimization, Pay Per Click Marketing, Email Marketing and Content Marketing”, Create Space Independent Publishing Platform, 1st edition.

CA439CA	Cloud Computing with AWS	1-0-2	2
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Course Learning Outcomes:

CLO 1: Understand the concepts, characteristics, delivery models and benefits of cloud computing

CLO 2: Understand the key security and compliance challenges of cloud computing

CLO 3: Understand the key technical and organisational challenges for entrepreneurship

CLO 4: Understand the different characteristics of public, private and hybrid cloud deployment models.

Syllabus:

Fundamentals of Cloud Computing, Introduction to Cloud Computing, Cloud Environment Architecture Cloud Computing Models Infrastructure & Networking Introduction to Amazon Web Services AWS Global Infrastructure Introduction to Network Switches & Virtual Private Cloud VPC & Subnets Internet Gateways, VPC Peering & NAT Gateways IP Addressing in AWS Understanding AWS Security Groups Launching our first EC2 instance EC2 instance types & Pricing Model storage Introduction to Block & Object storage mechanism Introduction to Elastic Block Store: EBS EBS Snapshots EBS Volume Types Instance Store Volumes Introduction to Simple Storage Service (S3) Features of S3 Elastic Load Balancers: Understanding High Availability Configuration ELB Configuration Elasticity Auto Scaling Identity & Access Management Understanding the IAM Policies IAM User, IAM Policy and IAM Role Relational Databases Introduction to Relational Databases Creating our first database structure in MySQL Getting started with DynamoDB Domain Name System Introduction to DNS Understanding DNS Records Introduction to Route53 Aws Lambda and API Getting started with AWS Lambda Introduction to API Understanding working of API Building our API with API Gateway Building Scalable Applications Introduction to Message Brokers Understanding SQS Understanding Simple Notification Service (SNS) Cloud Security Tools and technologies to secure the data in Private and Public Cloud Architecture. Security Concerns, Legal issues and Aspects, Multi:tenancy issues

Suggested Reading(s):

1. Velte Anthony, Velte Toby, Elsenpeter Robert, Cloud Computing, 1st Edition, 2017, McGraw Hill Professional.
2. FrancisdaCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, 2013, apress Publications.
3. Lakhwani, K., Gianey, H. K., Wireko, J. K., & Hiran, K. K. (2020). Internet of Things (IoT): Principles, paradigms and applications of IoT. 1st Ed., Bpb Publications.

CA439CB	Distributed System and Cloud Architecture	1-0-2	2
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Course Learning Outcomes:

- CLO 1:** A thorough understanding of the fundamentals of cloud computing for employability
- CLO 2:** Gain proficiency in programming paradigms and run time systems developed for the cloud.
- CLO 3:** Acquire the ability to analyze, design, and develop algorithms for solving several distributed systems problems.
- CLO 4:** Explore a wide range of system design alternatives for various aspects of cloud-native application development and understand their tradeoffs.

Syllabus:

Introduction to Cloud Computing, Virtualization, Hotspot Mitigation for Virtual Machine Migration Server Virtualization, Software Defined Network, Geo:distributed Cloud Data Centers Leader Election in Rings (Classical Distributed Algorithms), Leader Election (Ring LE & Bully LE Algorithm), Design of Zookeeper, Time and Clock Synchronization in Cloud Data Centers, Global State and Snapshot Recording Algorithms, Distributed Mutual Exclusion, Consensus in Cloud Computing and Paxos, Byzantine Agreement, Failures & Recovery Approaches in Distributed Systems, Design of Key:Value Stores, Design of HBase, Peer to Peer Systems in Cloud Computing, MapReduce, Introduction to Spark, Introduction to Kafka

Suggested Reading(s):

1. Velt Anthony, Velt Toby, Elsenpeter Robert, Cloud Computing, 1st Edition, 2017, McGraw Hill Professional.
2. FrancisdaCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, 2013, apress Publications.
3. Lakhwani, K., Gianey, H. K., Wireko, J. K., & Hiran, K. K. (2020). Internet of Things (IoT): Principles, paradigms and applications of IoT. 1st Ed., Bpb Publications.

CA439DA	Empathy & Its Tools	1-0-2	2
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Course Learning Outcomes:

- CLO 1:** Describe the intellectual, scientific, and historical origins of the concept of empathy.
- CLO 2:** Use knowledge derived from reading and on-the-ground experience to identify and solve problems in the community.
- CLO 3:** Identify and discuss one's own experiences of empathy (or lack of empathy) in a variety of settings and among people with different backgrounds.
- CLO 4:** Articulate multiple perspectives on a variety of global issues for entrepreneurship .
- CLO 5:** Collaborate effectively and respectfully with peers and community members.
- CLO 6:** Heighten concern for individuals from different backgrounds .

Syllabus:

Learn how to understand users, techniques to empathize with users and identify key user problems. Learn how to gain insights from empathy and define problems statements. Empathy tools – techniques for getting empathy insights through interviews empathy maps, emotional mapping, observation, Understand the users, user's interaction with the environment, people and culture, UX and societies, creating ethnography mood boards, user scenarios, storyboard, ethnography and user research, understanding research problems, data gathering techniques Perform field study to understand people design Project submissions empathy mapping

Suggested Reading(s):

1. Cross, N. (2011). Design thinking: Understanding how designers think and work. 1st Ed. Berg .
2. Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H. Y. (2015). Design thinking for education: Conceptions and applications in teaching and learning. 1st Ed. Springer.
3. Stickdorn, M., Hormess, M. E., Lawrence, A., & Schneider, J. (2018). This is service design doing: applying service design thinking in the real world. " 1st Ed.O'Reilly Media, Inc."

CA439DB	User Interface Design	1-0-2	2
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Course Learning Outcomes:

CLO 1: Analyze application structures to organize content clearly.

CLO 2: Construct Navigation that enables users to easily accomplish tasks for employability

CLO 3: Design page layouts that support findability of hierarchical content and task completion

CLO 4: Determine how to display data to meet user needs

CLO 5: Support contextually obvious user actions.

CLO 6: Structure UI designs with feedback and help patterns.

Syllabus:

Analyze application structures to organize content clearly.

Activity 1: Card Sorting

Project 1: Research / Sketch / Analyze 3 products

2: Construct Navigation that enables users to easily accomplish tasks.

Lecture: Wayfinding

Group Activity: Document and analyze wayfinding design around ACC campus

Lecture: Wireframing and Annotations

Lecture: Flow Charts / How to Make Sense of Any Mess

Activity: Document and analyze user flows of Project 1 products

Project 2: Research / Sketch / Student Tracking App Nav

3: Design page layouts that support findability of hierarchical content and task. completion.

Project 3: Research / Sketch / Student Tracking App (con't.) layout

4. Determine how to display data to meet user needs.

Lecture: Lists of things

Activity: Find and analyze use cases and characteristics of lists.

Project 4: Research / Sketch / Craigslist or Reddit redesign

Search sort and filter (Mobile Pattern Gallery Chp 4)

Lecture: Telling a story with data (Cerner and Hans Rosling videos)

Project 5: Research / Design Data Visualization

5. Create contextually obvious interactions.

Project 6: Research Actions and Commands / Sketch / Grocery Store Website

6. Configure forms with focused inputs.

Project 7: Research Forms and Controls / Sketch / ACC enrollment flow

7. Structure UI designs with feedback and help patterns.

Feedback and Affordances (Mobile Pattern Gallery Chp 8)

Help (Mobile Pattern Gallery Chp 9)

Project 8: Research / Sketch / ACC enrollment flow (con't.)

Project 9: UX Project

Suggested Reading(s):

1. Cross, N. (2011). Design thinking: Understanding how designers think and work. 1st Ed. Berg .
2. Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H. Y. (2015). Design thinking for education: Conceptions and applications in teaching and learning. 1st Ed. Springer.
3. Stickdorn, M., Hormess, M. E., Lawrence, A., & Schneider, J. (2018). This is service design doing: applying service design thinking in the real world. " 1st Ed.O'Reilly Media, Inc."

CA439EA	Database Technologies & Essentials	1-0-2	2
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Course Learning Outcomes:

CLO 1: Use the basic concepts of Database Systems in Database design

CLO 2: Apply SQL queries to interact with Database

CLO 3: Design a Database using ER Modelling for employability

CLO 4: Apply normalization on database design to eliminate anomalies

CLO 5: Analyze database transactions and can control them by applying ACID properties.

Syllabus:

INTRODUCTION: Introduction and applications of DBMS, Purpose of data base, Data, Independence, Database System architecture- Levels, Mappings, Database, users and DBA
 DATABASE DESIGN: Database Design Process, ER Diagrams - Entities, Attributes, Relationships, Constraints, keys, extended ER features, Generalization, Specialization, Aggregation, Conceptual design with the E-Rmodel.
 THE RELATIONAL MODEL: Introduction to the relational model, Integrity constraints over relations, Enforcing integrity constraints, Querying relational data, Logical database design: E-R to relational, Introduction to views, Destroying/altering tables and views.
 RELATIONAL ALGEBRA AND CALCULUS: Preliminaries, relational algebra operators, relational calculus - Tuple and domain relational calculus, expressive power of algebra and calculus.
 SQL: Basics of SQL, DDL, DML, DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. transaction control commands – Commit, Rollback, Save point, cursors, stored procedures, Triggers
 SCHEMA REFINEMENT AND NORMAL FORMS: Introduction to schema refinement, functional dependencies, reasoning about FDs. Normal forms: 1NF, 2NF, 3NF, BCNF, properties of decompositions, normalization, schema refinement in database design, case studies.
 TRANSACTIONS MANAGEMENT: Transaction concept, transaction state, implementation of atomicity and durability, concurrent

executions, Serializability, recoverability, implementation of isolation, transaction definition in SQL, testing for Serializability. CONCURRENCY CONTROL AND RECOVERY SYSTEM: Concurrency control, lock based protocols, time-stamp based protocols, validation based protocols, multiple granularities. Recovery system - failure classification, storage structure, recovery and atomicity, log- based recovery, shadow paging, buffer management, failure with loss of non-volatile storage, advanced recovery techniques, remote backup systems. OVERVIEW OF STORAGE AND INDEXING: Tree structured indexing - intuition for tree indexes, indexed sequential access method (ISAM), B- Trees - a dynamic tree structure.

Suggested Reading(s):

1. Rob Coronel (2007), “Database Systems”, Seventh Edition, Gex Publications.
2. Bipin C Dessi (2017) ,“Introduction to Database System” ,Seventh Edition, Galgotia Publication
3. Gerald V.Post (2009) “Database Management Systems”, Second Edition,Tata Mc Graw Hill,

CA439EB	Database Administration-II	1-0-2	2
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Course Learning Outcomes:

- CLO 1:** Design, model and install any database management systems by using Oracle database as sample.
- CLO 2:** Plan, design, construct, control and manage database instances, database network environment, storage structures, user security, database backup and recovery, database maintenance.
- CLO 3:** Define and devise transaction management, concurrency control, crash recovery components for employability
- CLO 4:** Examine and perform data base administration roles and operations by using Oracle database system as a sample

Syllabus:

Introduction Exploring the Oracle Database Architecture, Connecting to a server, Oracle Database Server Architecture, Instance: Database Configurations, Memory structures- Shared Pool, MS – Buffer Cache, MS-Redo Log Buffer, MS- Large Pool, MS- Java Pool/Streams Pool, MS-PGA Transactions, Properties (ACID Rules) , Life Cycle Concurrency control, Why do we need concurrency control?, Types of concurrency control mechanisms, Basic samples Crash Recovery Components, Undo and Redo operations, Examples for different component behaviors, Process Structures, Background processes -Database Writer Pr, BP- Log Writer Process(LWR), BP-Checkpoint Process (CKPT), BP-System Monitor Process(SMON), BP-Process Monitor Process(PMON), BP-Recoverer Process, BP-Archiver Process(ARCn), Process Startup Sequence, Database Storage Architecture, Logical and physical storage structures, Segments, Extents and Blocks, Table spaces and Data files, SYSTEM and SYSAUX Table spaces, ASM storage components, Interacting with an Oracle Database Managing the Database instance, Database initialization parameters modificatio, Stages of database startup, Database shutdown modes and options, Alert log, Using Trace Files, Dynamic performance views, Data Dictionary views, Data dictionary from SQL Expert,Managing the ASM instance, Benefits of using ASM,

ASM instance processes and parameters, Interaction between database instances and ASM, ASM instance dynamic performance views, ASM system privileges, ASM disk groups, ASM disks, Allocation units, ASM files, Extent Maps , Striping granularity, Fine-Grained Striping, ASM Failure groups, Stripe and mirror example, Failure example, Managing disk groups, Adding disk to disk groups, Alter commands , ASM disk group compatibility , Disk Group Attributes,ASM Fast Mirror Resync Overview Configuring the Oracle Network environment, Creating additional listeners, Creating Oracle Net Service aliases, Configuring connect-time failover, Controlling the Oracle Net Listener, Using tnsping to test Oracle Net connectivity, Shared servers versus dedicated servers,Managing Database Storage Structures, Storage of table row data in blocks, Oracle-Managed Files (OMF), Enlarging the database, Administering User security, Create and manage database user accounts: Authenticate users Assign default storage areas (table spaces) , Administer authentication, Grant and revoke privileges (system & object privileges), Create and manage roles, Predefined roles, Create and manage profiles:Implement standard password security features, Control resource usage by users, Supplied password verification Function, Assigning quotas to users, Principle of least privilege, Protect privileged Accounts,Managing Data Concurrency, Locking mechanism, Oracle data concurrency management, Enque mechanism, Monitoring and resolving locking conflicts Managing Undo Dat,DML and undo data generation

Suggested Reading(s):

1. Rob Coronel (2007), “Database Systems”, Seventh Edition, Gex Publications.
2. Bipin C Dessi (2017) ,“Introduction to Database System” ,Seventh Edition, Galgotia Publication
3. Gerald V.Post (2009) “Database Management Systems”, Second Edition,Tata Mc Graw Hill,

CA439FB	Advanced Research Methodology	1-0-2	2
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Course Learning Outcomes:

CLO 1: Demonstrate articulation of research as both a systematic methodology and a systemic thinking process.

CLO 2: Demonstrate and understand the skills of inference and the use of research terms in describing educational practice on a spectrum from action research through experimental design

Syllabus:

Dispositions Principle : Productive dispositions positively affect learners, professional growth, and the learning environment. Equity Principle : All learners deserve high expectations and support. Process Principle : Learning is a lifelong process of development and growth. Ownership Principle : Professionals are committed to, and assume responsibility for, the future of their disciplines. Support Principle : Successful engagement in the process of learning requires collaboration among multiple partners. Impact Principle : Effective practice yields evidence of learning. Technology Principle : Technology facilitates teaching, learning, community- building, and resource acquisition. Standards Principle : Evidence-based standards systematically guide professional preparation and development.

Suggested Reading(s):

1. Schutt, R. K. (2012). Investigating the Social World: The Process and Practice of Research (7th edition). Los Angeles: Sage.
2. Poindexter, P. M., & McCombs, M. E. (2000). Research in Mass Communication: A Practical Guide 1st Ed.. Bedford/St. Martin's.
3. Nayak, J. K., & Singh, P. (2021). Fundamentals of research methodology problems and prospects. 3rd Ed. SSDN Publishers & Distributors.

CA439GA	E-Commerce and E-Governance, ERP	1-0-2	2
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Course Learning Outcomes:

CLO 1: Define E-Marketplaces and list their components

CLO 2: List the Major types of Electronic Markets and describe their features

CLO 3: Describe the types of Intermediaries in EC and their roles in entrepreneurship

CLO 4: Describe electronic Catalogs, Shopping carts, and search Engines

CLO 5: Describe the various types of Auctions and list their characteristics

Syllabus:

Introduction to E-Business and E-Commerce: Define the e-Commerce and e-Business, Define e-Commerce Types of EC transactions. Define e-Business Models. Internet Marketing and e-Tailing. Elements of e-Business Models. Explain the benefits and limitations of e-Commerce. E-Marketplaces: Structures, Mechanisms, Economics, & impacts: Define e-Marketplace and Describe their Functions. Explain e-Marketplace types and their features. Describe the various types of auctions and list their characteristics. Discuss the benefits, limitations and impacts of auctions. E-Commerce in the wireless environment. Competition in the DE and impact on industry. E-Business applications, E-Procurement and EPayment Systems: Integration and e-Business suits. ERP, e-SCM, CRM, E-Payment. E-Procurement definition, processes, methods and benefits. Discuss the categories and users of smart cards. Describe payment methods in B2B EC. The Impact of E-Business on Different Fields and Industries: E-Tourism · Employment and Job Market Online Online Real Estate. Online Publishing and e-Books. Banking and Personal Finance Online. On-Demand Delivery Systems and E-Grocers. Online Delivery of Digital Products. E-Learning and Online Education: Define electronic learning. Discuss the benefits and drawbacks of e-Learning. The e-Learning Industry. Discuss e-Content development and tools. Describe the major technologies used in e-Learning. Discuss the different approaches for e-Learning delivery. How e-Learning can be evaluated. E-Government: Definition of e-Governments · Implementation. E-Government Services. Challenges and Opportunities. E-Government Benefits, Case Study. Launching Online Business and E-Commerce

Projects: Understand the requirements for starting an online business from different perspectives. Describe the funding options available to startup businesses. Understand the processes associated with managing Web site development. Know the techniques of search engine optimization. Evaluate Web sites on design criteria.

Suggested Reading(s):

1. Turban, E. et al 2008, Electronic Commerce: A Managerial Perspective, 3rd Ed., Prentice Hall.
2. Dave Chaffey, 2006, Electronic Business and Electronic Commerce Management, 2nd edition, Prentice Hall
3. Horton and Horton, 2003 e-Learning Tools and Technologies, 2nd Ed., Wiley Publishing.

CA439GB	Management Information Systems	1-0-2	2
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Course Learning Outcomes:

- CLO 1:** Relate the basic concepts and technologies used in the field of management information systems
- CLO 2:** Learn skills to compare the processes of developing and implementing information systems
- CLO 3:** Outline the role of the ethical, social, and security issues of information systems.
- CLO 4:** Translate the role of information systems in organizations, the strategic management processes, with the implications for the management.
- CLO 5:** Apply the understanding of how various information systems like DBMS work together to accomplish the information objectives of an organization

Syllabus:

The meaning and use MIS, System View of Business, Process of MIS, Development of MIS within the organization, Management Process, Information Needs, System Approach in Planning Organizing and Controlling MIS. Planning, Implementation and Controlling of Management Information System. Fundamentals of Data Processing, Computer Operation of Manual Information System, Components of Computer Systems, Flow Chart, Conversion of Manual to Computer Based Systems, Computer Systems Software, Application Software, Telecommunication Modem. Managerial Decision Making, characteristics and components of Decision Support System. System Design: System design consideration, input/output design, forms design, file organization and database, data management, file design, program design, control and security.

Suggested Reading(s):

1. Jawadekar, W.S., 2009, "Management Information Systems", 5th Ed. Tata McGraw Hill Private Limited, New Delhi,

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2. Kenneth C. Laudon and Jane P. Laudon:2003 “Management Information Systems” 9/e,
Pearson Education, New Delhi.
 3. Mahadeo Jaiswal, Monika Mital: 2008, “Management Information System”, 3rd Ed.
Oxford University Press, New Delhi

CA439HA	Secure Software Development	1-0-2	2
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Course Learning Outcomes:

- CLO 1:** Explain the role of security throughout the Software Development Life Cycle process
- CLO2: Determine** software application security vulnerabilities and analyze attack consequences
- CLO 3 :** Apply secure design principles for developing attack resistant software for employability
- CLO 4 :** Analyze insecure software, utilizing automated code review tools with static analysis and symbolic execution
- CLO 5 :** Compare tools and techniques for testing software resilience.

Syllabus:

Basics - Introduction to GNU Tool chain, Linux environment and VI editor, Tokens of C - Keywords, Data-Types, Variables, Constants, Operators, Identifiers, Storage Class Specifiers, Control Flow Statements, GNU Make utility, Arrays, Multidimensional arrays, Data Input & Output, Strings, Loops - for, while etc., Functions and Recursion Advanced - Pointers - Intro, Pointer Arithmetic, Pointers and Arrays, Pointers and Functions, Pointers and Strings, Structures, Unions, Enum, Typedef, Bit field operators and pointers with structures, Preprocessors, C and Assembly, Files, I/O, Variable No. of arguments, Command Line arguments, Error handling and debugging with GNU GDB, Memory layout, Calling Conventions - cdecl, std, fastcall, Format string problems, Stack Overflow, Buffer Overflow, Integer Overflows, Introduction to various C standards, Secure Coding in C - SEI CERT C coding standard SDLC: Introduction to Secure SDLC, Threats, Vulnerability & Attack, What is software Security, Why threat modelling? How to threat model? STRIDE and mitigation techniques, Data Flow Diagrams & STRIDE, Microsoft Threat Modeling Tool, Attack Surface Analyser, Attack trees and Abuse cases

Suggested Reading(s):

1. Jason Grembi. 2006, Secure Software Development: A Security Programmer's Guide, 2nd Ed. Cengage, 2006
2. Gray 2008, McGraw: Software Security – Building Security In, Reprint Ed. Addison Wesley, 2008
3. Julia H. Allen, Sean Barnum, Robert J. Ellison, 2009 Software Security Engineering: A Guide for Project Managers McGraw, and Nancy Mead. 3rd Ed. Addison-Wesley

CA439HB	Malware Analysis and Reverse Engineering	1-0-2	2
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Course Learning Outcomes:

- CLO 1:** Be able to understand the cyber security challenges raised from malicious software attacks
- CLO 2:** Learn skills to analyze the security risks, threats and potential vulnerabilities on enterprise networks environment
- CLO 3:** Be able to carry out independent analysis of modern malware samples using behavioral, code analysis and memory forensic techniques
- CLO 4:** Be able to apply the learned techniques to protect, reduce the security risks and avoid malicious software attacks on computer systems or networks
- CLO 5:** Be able to research independently and use learned skills and tools to investigate malicious software attacks and implement or update a cyber protection plan

Syllabus:

Malware Analysis Primer, Basic Static Techniques ,How to access VM for labs, Malware Analysis in Virtual Machines, Basic Dynamic Analysis, Proposed Group Project (Malware), Complete in Class Lab1a, A Crash Course in x86 Disassembly, IDA Pro, Recognizing C Code Constructs in Assembly, Analysing Malicious Windows Programs, Debugging OllyDbg Malware Behaviour, Covert malware Lunning, Malware methodology -Basic analysis - Advanced static analysis -Advanced Dynamic analysis -Anonymous and stealthy analysis - Malware classification and functionality -Anti Reverse-engineering -Malware lab

Suggested Reading(s):

1. Chris Eagle 2011, The IDA Pro Book: The Unofficial Guide to the World's Most Popular Disassembler.
2. Gray 2008, McGraw: Software Security – Building Security In, Reprint Ed. Addison Wesley, 2008
3. Julia H. Allen, Sean Barnum, Robert J. Ellison, 2009 Software Security Engineering: A Guide for Project Managers McGraw, and Nancy Mead. 3rd Ed. Addison-Wesley

CA436A	Artificial Intelligence and Neural Networks	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Know the main provisions neuromathematics skills
- CLO 2.** Know the main types of neural networks;
- CLO 3.** Know and apply the methods of training neural networks;
- CLO 4.** Know the application of artificial neural networks;
- CLO 5.** To be able to formalize the problem, to solve it by using a neural network.

Syllabus:

Overview of the course, Knowledge based systems, Pattern Classification, Machine Learning, and Artificial Neural Network, Neurons and its significance, Mathematical modeling of neurons and its importance in the neural network, Supervised and unsupervised learning schemes: Hebbian learning, Perceptron-learning, Delta-learning, Winner take all, Outstar learning, Gradient descent algorithm, Widrow-Hoff, Correlation, Boltzmann, Single-layer perceptron, Support vector Classification, Multi-layer perception, Back-propagation training, Radial Basis Function, Hopfield network, Competitive network, MAXNET, Adaptive Resonance Theory (ART), K- mean clustering algorithm, Counter-propagation network, Self-organizing map (SOM), Speech processing/recognition, Speaker identification, Communication, Pattern/Image Classification, Power and Control systems.

Suggested Book:

1. K. Mehrotra, C. K. Mohan, and S. Ranka, 2009 Elements of Artificial Neural Networks (2nd Edition), Penram International Publishing Private Limited Ltd, Mumbai,
2. R. J. Schalkoff, 2011 Artificial Neural Networks, 4th Ed. McGraw Hill Education, New York, USA, 2011.
3. Yegnanarayana, 1998, Artificial Neural Networks, 2nd Ed. Prentice Hall India Learning Private Limitedpublishers, Mumbai, India,

CA436B	Human Resource Management	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Describe and explain the development of human resources management.
- CLO 2.** Evaluate current methods of job analysis, recruitment, selection, training/development, performance appraisal, promotion, and separation.
- CLO 3.** Discuss management's ethical, socially responsible, and legally required actions.
- CLO 4.** Assess methods of compensation and benefits planning for employability.
- CLO 5.** Examine the role of strategic human resource planning in support of organizational mission and objectives.

Syllabus:

Managing Human Resources Today, Managing Equal Opportunity and Diversity, Human Resource Strategy and Analysis, Job Analysis and Talent Management, Personnel Planning and Recruiting, Selecting Employees, Training and Developing Employees, Performance Management and Appraisal, Managing Careers, Developing Compensation Plans, Pay for Performance and Employee Benefits, Maintaining Positive Employee Relations, Labor Relations and Collective Bargaining, Improving Occupational Safety, Health, and Risk Management, Managing HR Globally, Managing Human Resources in Small and Entrepreneurial Firms.

Suggested Book:

1. Dessler, G. 2006 Fundamentals of Human Resource Management (4th Edition, Pearson)
2. Belcourt, Monica, Bohlander, G. and Singh, P. 2011 Managing Human Resources: 7th Canadian Edition. Nelson Education
3. Bernardin, H. J., & Russell, J. E. (2006). Human resource management (p. 736). 3rd Ed. New York: Tata McGraw-Hill.

CA436C	Block Chain Technologies	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Explain design principles of Bitcoin and Ethereum.
- CLO 2.** Learn and Explain skills of Nakamoto consensus.
- CLO 3.** Explain the Simplified Payment Verification protocol.
- CLO 4.** List and describe differences between proof-of-work and proof-of-stake consensus.
- CLO 5.** Interact with a blockchain system by sending and reading transactions.
- CLO 6.** Design, build, and deploy a distributed application.
- CLO 7.** Evaluate security, privacy, and efficiency of a given blockchain system.

Syllabus:

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof. Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain. Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin, Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.

Suggested Book:

1. Bashir, I. (2017). Mastering blockchain. 2nd Ed. Packt Publishing Ltd.
2. da Rosa Righi, R., Alberti, A. M., & Singh, M. (2020). Blockchain Technology for Industry 4.0. 3rd Ed. Springer Singapore.

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3. Julie, E. G., Nayahi, J. J. V., & Jhanjhi, N. Z. (Eds.). (2020). Blockchain Technology: Fundamentals, Applications, and Case Studies. 4th Ed. CRC Press.

CA436D	Open Source Technologies	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Understand the difference between open source software and commercial software.
- CLO 2.** Identify, install and run Linux operating system.
- CLO 3.** Install and manage applications for employability.
- CLO 4.** Identify, install open source web technologies Apache, MySql, PHP.
- CLO 5.** Develop web applications using LAMP.
- CLO 6.** Write session control PHP code for a website.

Syllabus:

Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Where I can use Linux? Linux Kernel – Linux Distributions. Introduction to Linux Essential Commands - Filesystem Concept - Standard Files 1. The Linux Security Model - Vi Editor - Partitions creation - Shell Introduction 2. String Processing - Investigating and Managing Processes - Network Clients - Installing Application. Apache Explained - Starting, Stopping, and Restarting Apache - Modifying the Default Configuration - Securing Apache - Set User and Group - Consider Allowing Access to Local Documentation - Don't Allow public html Web sites - Apache control with .htaccess. Introduction to MYSQL - The Show Databases and Table - The USE command - Create Database and Tables - Describe Table - Select, Insert, Update, and Delete statement - Some Administrative detail - Table Joins - Loading and Dumping a Database. Introduction- General Syntactic Characteristics - PHP Scripting - Commenting your code - Primitives, Operations and Expressions - PHP Variables - Operations and Expressions Control Statement - Array - Functions - Basic Form Processing - File and Folder Access - Cookies - Sessions - Database Access with PHP - MySQL - MySQL Functions - Inserting Records - Selecting Records - Deleting Records - Update Records.

Suggested Book:

1. Giarratano & Riley, 2012 'Expert Systems Principles and Programming', 2nd Ed. Course Technology INC
2. Raj K. Bansal, Goel, Sharma, 2009, "MATLAB and its applications in Engineering", 2nd Ed., Pearson Education
3. W. Jason Gilmore, 2008, "Beginning PHP and MySQL", 1st Ed. Apress Publishing.
4. Lynn Beighley and Michael Morrison, 2007, "Head First PHP & MySQL", 2nd Ed. O'Reilly Media Publications

CA436E	Cryptography and Network Security	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Understand the most common type of information and network threat sources.
- CLO 2.** Understand the Public-Key Infrastructure for employability.
- CLO 3.** Understand security protocols for protecting data on networks.
- CLO 4.** Understand the information and network security issues and apply the related concepts for protection and communication privacy.
- CLO 5.** Understand application security using smart- cards.
- CLO 6.** Understand the operation of e-payments, micro- payments and related security issues protocols.

Syllabus:

Planning for Security: Introduction, Information Security Policy, Standards, and Practices; The Information Security Blue Print; Contingency plan and a model for contingency plan Security Technology: Introduction; Physical design; Firewalls; Protecting Remote Connections Intrusion Detection Systems (IDS); Honey Pots, Honey Nets, and Padded cell systems; Scanning and Analysis Tools. Cryptography: Introduction; A short History of Cryptography; Principles of Cryptography; Cryptography Tools; Attacks on Cryptosystems. Introduction to Network Security, Authentication Applications: Attacks, services, and Mechanisms; Security Attacks; Security Services; A model for Internetwork Security; Internet Standards and RFCs Kerberos, X.509 Directory Authentication Service. Electronic Mail Security: Pretty Good Privacy (PGP); S/MIME IP Security: IP Security Overview; IP Security Architecture; Authentication Header; Encapsulating Security Payload; Combining Security Associations; Key Management. Web Security: Web security requirements; Secure Socket layer (SSL) and Transport layer Security (TLS); Secure Electronic Transaction (SET).

Suggested Book:

1. Forouzan, B. A., & Mukhopadhyay, D. (2015). Cryptography and network security (Vol. 12). New York, NY, USA:: Mc Graw Hill Education (India) Private Limited.

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2. Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.
 3. Daras, N. J., & Rassias, M. T. (Eds.). (2015). Computation, cryptography, and network security (pp. 253-287). New York: Springer.

CA436F	Deep Learning	1-0-2	2
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Course Learning Outcomes:

CLO 1. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.

CLO 2. Implement deep learning algorithms and skills to solve real-world problems.

Syllabus:

Introduction: Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques. Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network. Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization. Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy. Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network. Probabilistic Neural Network: Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders. Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing. Deep Learning Tools: Caffe, Theano, Torch.

Suggested Book:

1. Goodfellow, I., Bengio, Y., and Courville, 2016, A., Deep Learning, 2nd Ed. MIT Press
2. Bishop, C. ,M., 2016, Pattern Recognition and Machine Learning, 3rd Ed. Springer
3. Giarratano & Riley, 2012 'Expert Systems Principles and Programming', 2nd Ed. Course Technology INC

CA436G	Data Science	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Describe the various areas where data science is applied
- CLO 2.** Identify the data types, relation between data and visualization technique for data
- CLO 3.** Explain probability, distribution, sampling, Estimation
- CLO 4.** Learn skills to solve regression and classification problem .

Syllabus:

Introduction to Business Analytics, Why Analytics Business Analytics: The Science of Data-Driven Decision Making Descriptive Analytics Predictive Analytics Prescriptive Analytics Descriptive, Predictive and Prescriptive Analytics Techniques-Big Data Analytics Web and Social Media Analytics Machine Learning Algorithms Framework for Data-Driven Decision Making Analytics Capability Building Roadmap for Analytics Capability Building -Challenges in Data-Driven Decision Making and Future Descriptive Analytics Introduction to Descriptive Analytics Data Types and Scales Types of Data Measurement Scales Population and Sample Percentile, Decile and Quartile-Measures of Variation Measures of Shape – Skewness and Kurtosis Introduction to Probability Introduction to Probability Theory Probability Theory – Terminology Fundamental Concepts in Probability – Axioms of Probabil Application of Simple Probability Rules – Association Rule Le Bayes’ Theorem Random Variables Probability Density Function (PDF) and Cumulative DistribContinuous Random Variable Binomial Distribution Poisson Distribution Geometric Distribution Parameters of Continuous Distributions Uniform Distribution Exponential Distribution Chi-Square Distribution Student’s t-Distribution F-Distribution Sampling and Estimation Introduction to Sampling Population Parameters and Sample Statistic Sampling Probabilistic Sampling Non-Probability Sampling Sampling Distribution Central Limit Theorem (CLT) Sample Size Estimation for Mean of the Population Estimation of Population Parameters Method of Moments Estimation of Parameters Using Method of Moments Estimation of Parameters Using Maximum Likelihood Estim simple Linear Regression Introduction to Simple Linear Regression History of Regression–Francis Galton’s

Regression Model Simple Linear Regression Model Building Estimation of Parameters Using Ordinary Least Squares Interpretation of Simple Linear Regression Coefficients Validation of the Simple Linear Regression Model Outlier Analysis Confidence Interval for Regression Coefficients b_0 and b Confidence Interval for the Expected Value of Y for a Given X Prediction Interval for the Value of Y for a Given X Logistic Regression Introduction – Classification Problems Introduction to Binary Logistic Regression Estimation of Parameters in Logistic Regression Interpretation of Logistic Regression Parameters Logistic Regression Model Diagnostics Classification Table, Sensitivity, and Specificity Optimal Cut-Off Probability Variable Selection in Logistic Regression Application of Logistic Regression in Credit Rating Gain Chart and Lift Chart Decision Trees Decision Trees: Introduction Chi-Square Automatic Interaction Detection (CHAID) Classification and Regression Tree Cost-Based Splitting Criteria Ensemble Method Random Forest

Suggested Book:

1. Van Der Aalst, W. (2016). Process mining: data science in action 2nd Ed. Heidelberg: Springer.
2. Nelson, R., & Staggers, N. (2016). Health informatics: An Inter-professional approach. 2nd Ed. Elsevier Health Sciences.
3. Zhou, Z. H. (2021). Machine learning. 1st Ed. Springer Nature..

CA436H	Big Data Analytics	1-0-2	2
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Course Learning Outcomes:

- CLO 1. Identify Big Data and its Business Implications
- CLO 2. List the components of Hadoop and Hadoop Eco-System
- CLO 3. Access and Process Data on Distributed File System
- CLO 4. Manage Job Execution in Hadoop Environment
- CLO 5. Develop Big Data Solutions using Hadoop Eco System
- CLO 6. Analyze Infosphere BigInsights Big Data Recommendations
- CLO 7. Apply Machine Learning Techniques using R for employability

Syllabus:

Introduction to big data and hadoop Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.Hadoop Eco System Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction Data Analytics with R Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

Suggested Book:

1. Ankam, V. (2016). Big data analytics. 3rd Ed. Packt Publishing Ltd.
2. Sedkaoui, S. (2018). Data analytics and big data. 3rd Ed. John Wiley & Sons.

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3. Bahga, A., & Madisetti, V. (2016). Big data science & analytics: A hands-on approach. 2nd Ed. VPT.

CA436I	Natural Language Processing & Fuzzy Logics	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Apply the principles and Process of Human Languages such as English and other Indian Languages using computers
- CLO 2.** Realize semantics and pragmatics of English language for text processing
- CLO 3.** Create CORPUS linguistics based on digestive approach (Text Corpus method)
- CLO 4.** Check a current methods for statistical approaches to machine translation for research skills
- CLO 5.** Perform POS tagging for a given natural language and Select a suitable language modelling technique based on the structure of the language
- CLO 6.** Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology
- CLO 7.** Develop a Statistical Methods for Real World Applications and explore deep learning based NLP

Syllabus:

INTRODUCTION :Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM –Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance **WORD LEVEL ANALYSIS** Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in pos tagging – Hidden Markov and Maximum Entropy models. **SYNTACTIC ANALYSIS** 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 cfigs – Feature structures, Unification of feature structures. **SEMANTICS AND PRAGMATICS** 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, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods. BASIC CONCEPTS of Speech Processing :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: 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. SPEECH MODELING :Hidden Markov Models: Markov Processes, hmms – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-Estimation, Implementation Issues

Suggested Book:

1. Breck Baldwin, 2015 Language Processing with Java and LingPipe Cookbook, 3rd Ed. Atlantic Publisher
2. Nitin Indurkha and Fred J. Damerau, 2010 andbook of Natural Language Processing, Second Edition, Chapmanand Hall/CRC Press
3. Jurafsky, David, and James H. Martin. 2000 Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Upper Saddle River, NJ: Prentice-Hall
4. Christopher D., and Hinrich Schütze. 1999, Foundations of Statistical Natural Language Processing. Cambridge, MA: MIT Press,

CA436J	Machine Learning Using Python	1-0-2	2
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Course Learning Outcomes:

- CLO 1.** Recognize the characteristics of machine learning strategies
- CLO 2.** Apply various supervised learning methods to appropriate problems
- CLO 3.** Identify and integrate more than one technique to enhance the performance of learning skills
- CLO 4.** Create probabilistic and unsupervised learning models for handling unknown pattern
- CLO 5.** Analyze the co-occurrence of data to find interesting frequent patterns
- CLO 6.** Preprocess the data before applying to any real-world problem and can evaluate its performance

Syllabus:

INTRODUCTION – Well defined learning problems, Designing a Learning System, Issues in Machine Learning; THE CONCEPT LEARNING TASK - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias DECISION TREE LEARNING - Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning; ARTIFICIAL NEURAL NETWORKS – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of backpropagation rule Backpropagation algorithm convergence, Generalization; Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm; Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning Genetic Algorithms: an illustrative example, Hypothesis space search, Genetic Programming, Models of

Evolution and Learning; Learning first order rules-sequential covering algorithms General to specific beam search-FOIL; REINFORCEMENT LEARNING -The Learning Task, Q Learning

Suggested Book:

1. Ethem Alpaydin, 2014 "Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition
2. Bonaccorso, G. (2017). Machine learning algorithms. Packt Publishing Ltd.
3. Bishop, C. M., & Nasrabadi, N. M. (2006). Pattern recognition and machine learning (Vol. 4, No. 4, p. 738). New York: springer.
4. Raschka, S., & Mirjalili, V. (2019). Python machine learning: Machine learning and deep learning with Python, scikit-learn, and TensorFlow 2. Packt Publishing Ltd.

YEAR V – (SEMESTER X)

CA440B	Industrial Project		30
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Guidelines for the Project

The Integrated BCA-MCAs Programme is designed with the Objective to Prepare the Students to Take up Positions in IT Industries as Programmer, Systems Designers, Software Engineers, and Project Managers etc. The Curricula are designed to Provide Students Comprehensive Knowledge Covering the Skills and Core Areas of Computer Science in Theory and Practical's. With the Same Objective Six Months Major Project is Part of Curricula in Last Semester of Integrated BCA-MCA. In the Major Project Students are supposed to Develop Quality Software Solutions by Applying Theoretical and Practical Knowledge of Various Courses Learnt.

The Project Work Constitutes a Major component in the Course it Needs to Be Carried out with due Care, and Should Be Executed with Seriousness by the Students with Essential Foundation, Principles, and Practices to Develop Effective ways to Solve Computing Problems.

Objective

The Objective of the Project is to help the Student Develop the Ability to Apply Theoretical and Practical Tools / Techniques to Solve Real Life Problems Related to Industry, Academic Institutions and Research Laboratories. After Completion of this Project Work, The Student Should be able to Describe the Systems Development Life Cycle (SDLC) in their Project:

- Evaluate Systems Requirements.
- Evaluate a Problem Definition.
- Collect Information to Determine Requirements.
- Perform and Evaluate Feasibility Studies Like Cost-Benefit Analysis, Technical Feasibility, Time Feasibility and Operational Feasibility for the Project.
- Work on Data Collection Methods for Fact Finding.

- Construct and Evaluate Data Flow Diagrams.
- Construct and Evaluate Data Dictionaries/ Decision Trees/ Decision Table.
- Create and Evaluate Graphical Tools as Systems Flow Charts, Entity-Relationship (ER) Diagrams and State Transition Diagrams.
- Decide the S/W Requirement Specifications and H/W Requirement Specifications.
- Plan the Systems Design Phase of the SDLC.
- Distinguish Between Logical and Physical Design Requirements.
- Design and Evaluate System Outputs.
- Design and Evaluate Systems Inputs.
- Design and Evaluate Validity Checks for Input Data.
- Design and Evaluate User Interfaces for Input.
- Estimate Storage Requirements.
- Decide and Describe Various Data Structures.
- Perform Coding for the Project.
- Documentation Requirements and Prepare Documentation.
- Perform Various Testing Techniques/Strategies.
- Able to Generate Various Reports in Project.
- Able To Deploy The Project On Machine/Lab/Real Time Environment
- Brief the Maintenance Procedures.
- To Decide the Future Scope and Further Enhancement of the System.
- Plan For Appendices (If Any) to be Placed in Support with the Project Report Documentation

Type of Project

The Majority of the Students are expected to Work on Real-Life Project Preferably in Some Industry/ Research and Development Laboratories / Educational Institution / Software Company. Students are Encouraged to Work in the Various Areas of Computer Applications Listed Below. However, it is not mandatory for a Student to Work on a Real-Life Project. The Student can formulate a Project Problem with the Help of Her/his Supervisor and if Approved, the Student Commence Working on it.

Project Proposal Formulation

The Project Proposal should be Prepared in Consultation with Supervisor. Approval of the Project Proposal is Mandatory to Continue and Submit the Project Work. The Project Proposal Should Clearly State the Project Objectives and the Environment of the Proposed Project to be undertaken.

The Project Proposal Should Contain Complete Details In The Following Form:

1. Title of the Project
2. Introduction and Objectives of the Project
3. Project Category (RDBMS/OOPS/Networking/Multimedia/Artificial Intelligence/Expert Systems/ Cloud/ Security/ Data Analytics etc.)
4. Analysis (DFDs, ER Diagrams, Class Diagrams, Time Line etc. as per the Project Requirements).
5. A complete Structure which Includes:
 - Number of Modules and their Description to Provide an Estimation of the Student's Effort on the Project.
 - Data Structures as per the Project Requirements for all the Modules
 - Process Logic of Each Module
 - Reports Generation.
6. Tools / Platform, Hardware and Software Requirement Specifications
7. Security Mechanisms
8. Project Team Members (If any)
9. Organization/ Company Details with Profile of Supervisor (If project is carried out outside the Department)

Project Work Guidelines

- The Project Work Should Normally Include Software Development.
- Preferably, not more than one Student is permitted to Work on a Project. However, in Case a Project is Comprehensive enough that requires one human–year or More Time for its Completion, then as per Requirements at most two Students may Work on the Same Project. If 2 Students have been allowed to Work on a Project, The Project Synopsis and Project Reports by them Must Include only respective Modules undertaken / worked upon individually. Each Student Must Submit a Separate Project Proposal and a Separate Project Reports Related to her/his Modules. Completely identical Project Synopses and/or Project Reports are Not Allowed. Only Introductory and Possibly Concluding Remarks may be similar or common. Each Student has to undergo all the Phases
- The Project may be done in the University Campus or in n Approved Sponsoring Organization in View of the Proposed Topic.
- A Candidate is required to present the Progress of the Project Work during the Semester as per the Schedule provided by the MCA Project coordinator, under the Guidance of the Supervisor.

PROJECT REPORT FORMULATION

Good quality white executive bond paper A4 size should be used for typing and duplication. Care should be taken to avoid smudging while duplicating the copies.

Page Specification: Leftmargin-3.0cms, Right Margin- 2.0 cm, Top Margin 2.54 cm, Bottom Margin 2.54 cm, Line Spacing – Single, Font Size – 12 for Normal Text, 14 for Headings,16 for Chapter Heading, Page numbers - All Text Pages as well as Program Source code listing should be numbered at the bottom of the pages. Employ MS-Word or Open Source Software.

The project report should contain the following:

1. Front Page – Colored

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2. The Approved Performa and Synopsis.
 3. Certificate from the Supervisor with her/his signature and date.
 4. Certificate from company/industry in their letter head (if project is carried out outside the department)
 5. Certificate of Originality/ Self Certificate
 6. The Project Report documentation should include the following topics (as per the project requirements).
 - Acknowledgement
 - Table of Contents / Index with page numbering
 - Introduction / Objectives of the project
 - System Analysis
 - Feasibility Study
 - Software and Hardware Requirement Specifications
 - System Design
 - Coding
 - Validation checks
 - Implementation and Maintenance
 - Testing (Testing techniques and Testing strategies used along with the test data and the errors listed for each test case).
 - System Security measures (Implementation of security for the s/w developed)
 - Reports, Tables Figures should be properly numbered/labeled
 - Screen Shots of Projects
 - Conclusion
 - Future scope and further enhancement of the Project
 - Bibliography/ References
 - Appendices (if required)

Two Copies of the Original Project Report in Bound Form are to be submitted. Each Student is required to Prepare Individual Copy of Project Report in CD and Submit along with His/hers Project Report in MS-Word as well as PDF. The Same Must Contain the Report, Results, Screenshots, Errors, Databases, Source Codes (Wherever it is not feasible Explicit Approval from the Supervisor Must be obtained). Soft Copy of Labeled and Signed Project CD Should be in a thick Envelope Pasted Inside of the Back Cover of the Project Report.

PROJECT EVALUATION

The Project Report is evaluated for Total of 500 Marks. The Evaluation is done in Following Five Heads of 100 Marks Each. Normally The Evaluation Shall be Done by the Same Examiners for Each of these Five Heads. For Passing the Examination a Total of 50% in all these Heads Together but in Two Separate Heads as Internal (200 Marks) and External (300 Marks)

Evaluation shall be Essential.

- Project Analysis & Planning
- Project Design & Development
- Project Testing & Validation
- Project Documentation
- Project Presentation & Viva

8. REGISTRATION FOR NEXT SEMESTER

8.1 All students are eligible to register for next semester irrespective of number of backlogs unless a criterion is specified for any particular course.

8.2 A student is not permitted to register in a term if:

- (i) He/She has dues outstanding to the University, hostel, or any recognized authority or body of the University,
- (ii) His/Her grade sheet in the preceding term is withheld, or
- (iii) He/She has been specifically debarred or asked to stay away from that term

8.3 Late registration may be granted in case a student fails to register on the stipulated date. Students failing to register on the specified day of registration will be allowed to register only after permission from Dean of School and after paying the stipulated late fee. Any student who fails to register will not be allowed to attend classes.

8.4 The registration of the student may be cancelled, if at the later stage, it is found that the student is not eligible for registration due to following reasons:

- (i) If the registration of a student in a course is not found to be in accordance with the regulations, his/her registration in that course will be cancelled and the grade obtained, if any, will not be considered for final award.
- (ii) The registration of a student in a course or complete set of Courses in a term can be cancelled by the concerned authority when he/she is found guilty in cases of unfair means, breach of discipline, etc. or when he/she persistently and deliberately does not pay his/her dues.
- (iii) Absence for a period of four or more weeks at a stretch during a term shall result in automatic cancellation of the registration of a student from all the courses in that term.

8.5 A student who is duly registered in a term is considered to be on the rolls of the university. After registration, if he withdraws from the term, or has been given prior permission to temporarily withdraw from the University for the term, or has been asked to stay away by an appropriate authority of the University will be considered to be on the rolls of the University for that term. While such a student retains the nominal advantage of being on the rolls of the

University; the loss of time from studies and its consequences cannot be helped by the University.

8.6 If for any valid reason a student is unable to register in a term, he must seek prior permission of Dean of School to drop the term. If such permission has not been requested or after a request the permission has been denied, his/her name would be struck off the rolls of the University and he/she would no longer be a student of the University. His/Her case will be automatically processed and the file will be closed. However, if such a student, after his name has been struck off the rolls of the University, is permitted to come back, his case can be considered at the sole discretion of the competent authority of the University with the provision that all his previous records as a former student are revived under the current academic and administrative structure, regulations and schedule of fees.

9 PEDAGOGICAL ASPECTS

The structural layout of the program and its courses requires that each course be divided in lecture, tutorial and practical sessions. Duration of each session as given in the column against the course in the course scheme is 55 minutes.

Lecture sessions: Lectures are delivered by traditional – chalk board method, supplemented by modern Information Communication technology (ICT) methods and using all pedagogical tools. The students are encouraged to ask questions and involve in group discussion to the extent allowed by the teacher. In some subjects where case study based methodology is adopted, the lectures are supplemented by discussions on case studies.

Tutorial Sessions: The tutorial sessions are small groups of students interacting with the teacher, solving application oriented analytical problems. The tutorial sessions are very interactive and inculcate problem solving skills in the students.

Lab / Practical Sessions: During lab / practical sessions, the students work on prescribed list of experiments and do what they have learnt in the Lecture / Tutorial sessions.

Integrated Projects: In each semester, the students identify their team mates (at the most 4 in each team) and work on a unique integrated project allotted to them by faculty / group of faculty members. The projects are allotted to them either at the start of each semester or at a later stage

(but not later than Sessional test I) in the semester. Integrated projects are designed by the faculty keeping in mind the courses the students have studied so far and are currently studying. Thus, the project statements are made such a way that the students while working on these projects apply the concepts learned so far and the deliverables are multi-faceted. The students work on the Integrated Project during their lab hours.

10 ASSESSMENT AND EVALUATION

In case of theoretical courses/subjects, the evaluations will be based on teacher assessment, quizzes, sessional tests and end term examinations.

In case of the practical subjects (Laboratory/workshops/field works), the evaluation will be based on continuous assessments and end term exams/viva.

The evaluation of the project work/training will be based on the seminars, projects reports and end term viva by the expert committee.

Examinations

To assess the students attainments in the subjects (Theory, Laboratory, Sessionals), Seminars, project work etc., the system of continuous assessment is adopted by the University. In conformity to this, there will be sessional exams, quizzes, assignments, seminars and End term exams, in addition to the other continuous evaluation components.

A student may be debarred from appearing in the end term examinations for following reasons:

- (a) Disciplinary action taken against him/her.
- (b) Attendance criteria are not fulfilled.

In case any debarred student appears in the examinations by default, his/her results will be treated as null and void.

The evaluation will be continuous and the weightage of various components are as given in Table 1 (For Theory courses) and in Table 2 (for Practical Courses).

Evaluation components for Theory Courses

Components	Weightage
Internal Evaluation Component (IEC) (Test/Assignments/MCQ/Open Book Test/Case Study)	20%
Sessional Tests (STs)	30%
End Term Examination	50%
Total	100%

There are three Sessional Tests (STs) for all theory papers and the average of best two is considered. The End Term examination for practical courses includes conduct of experiment and an oral examination (viva voce).

Evaluation Components for Practical Courses

Components	Weightage
Lab Performance / File work	40%
Internal Viva – Voce	20%
End Term	40%
Total	100%

The medium of examination is English.

11 LETTER AWARD GRADING SCHEME

11.1

The list of letter and non-letter grades, their applicability and connotation are given below:

(a) Letter Grades

% Marks Range of Total	Grade	Qualitative Meaning	Grade Point
80 – 100	O	Outstanding	10
70 – 79	A+	Excellent	9
60 – 69	A	Very Good	8
55 – 59	B+	Good	7
50 – 54	B	Above Average	6
45 – 49	C	Average	5
40 – 44	P	Pass	4
0 – 39	F	Fail	0
	Ab	Absent	

(b) Non-letter Grades:

Noncredit courses will be graded as Excellent, Good, Fair or Poor.

11.2 The Grade I (Incomplete) may be awarded in the following conditions:

- (i) Where a case of unfair means is pending, a 'Grade I' is awarded till the case is finalized
- (ii) Where a case of indiscipline is pending, a 'Grade I' is awarded till the case is finalized
- (iii) In cases of unfair means and indiscipline where the results for a particular examination are declared null and void
- (i) In cases, where the student does not complete his course work because of some reason viz, shortage of attendance / is absent in the end term examination.

11.3 The Cumulative Grade Point Average (CGPA) denotes the overall performance of a student in all courses in which he/she is awarded letter grades. It is the weighted average of the grade points of all the letter grades received by the student from the time since his entry into the University.

Calculation of CGPA:

The CGPA (calculated on a 10 point scale) would be used to describe the overall performance of a student (from of admission till the point of reckoning) in all courses for which LETTER GRADES will be awarded. SGPA will indicate the performance of student for any particular semester. Formulas for calculation of SGPA and CGPA have been provided as below:

$$SGPA_i = \frac{\sum_{j=1}^n C_{ij} G_j}{\sum_{j=1}^n C_{ij}} \quad CGPA = \frac{\sum_{i=1}^N SGPA_i * \sum_{j=1}^n C_{ij}}{\sum_{i=1}^N \left(\sum_{j=1}^n C_{ij} \right)}$$

Where n = number of subjects in the semester; N = number of semesters; SGPA_i = SGPA for the ith Semester; C_{ij} = number of credits for the jth course in ith semester; and G_j = Grade point corresponding to the grade obtained in the jth course.

Example to Understand the Calculation of SGPA

Suppose a student is registered in four courses ‘W’, ‘X’, ‘Y’ and ‘Z’ in a particular semester as mentioned below in the Column - I of the table. Column - II in the table below depicts the number of credits, which those courses carried. At the end of the semester, student was awarded with the grades as mentioned in Column – III in the table given below. Column – IV indicates the corresponding grade weight. Column – V and Column – VI indicate essentially the Credit value and Grade Points for every course completed by a student in that particular semester.

Courses in which student registered (Col. I)	Credits (Col. II)	Letter Grade (Col. III)	Grade Value (Col. IV)	Credit Value (Col. V)	Grade Points (Col. VI)
Course W	3	B	6	3 x 6	18
Course X	3	A	8	3 x 8	24
Course Y	3	O	10	3 x 10	30
Course Z	2	O	10	2 x 10	20
Total	11			Total	92

Thus, the total SGPA of the student would be =

$$SGPA = \frac{\text{Total grade pts.}}{\text{Total no. of credits}} = \frac{92}{11} = 8.36$$

Suppose the SGPA of the student in two successive terms is 7.0 and 8.0 with respective course credits being 12 and 11, then the

$$CGPA = \frac{7 \times 12 + 8 \times 11}{12 + 11} = \frac{84 + 88}{23} = 7.48$$

12 PROMOTION RULES

Any bonafide student, who appears for the examination conducted by the University, shall be promoted to the next higher semester and shall carry forward all course(s) / subject(s) in which he/she is declared fail. The student shall have to pass all papers within stipulated maximum

duration as prescribed by the University to qualify for the award of degree. Further, any specific condition stipulated for a particular course, by the concerned regulatory body, shall be enforced.

13 ELIGIBILITY TO AWARD THE DEGREE

13.1 A student is deemed to have fulfilled the requirement of graduation for a degree (single or dual degree) or a higher level degree when he has:

- (i) Cleared all Courses prescribed for the program.
- (ii) Earned the minimum credits required for the program as described in the Academic Programme Guide.
- (iii) Obtained the minimum CGPA of 4.5 for the award of degree in UG programs; and
- (iv) Satisfied all requirements of these regulations.

Minimum credits to be earned for award of degree in Integrated BCA-MCA

Course / Year	Bachelor of Computer Applications (For Semester Track)	For Co-op Track
Year I	48	48
Year II	48	48
Year III	44	44
Year IV	43	43
Year V	43	43
Total	226	226

13.2 A student is deemed to have become eligible for the degree if:

He/she satisfy all rules of evaluation. However, in case of a student having outstanding dues against him to be paid to the University, Hostel or any other recognized organ of the University, His degree will be withheld until the said dues are cleared.

13.3 Under extreme exceptional circumstances where gross violation of graduation is detected at later stage the Academic Council may recommend to the Governing Body, the recall of a degree already awarded.

Appendix: A Mapping of CLO with PO

Course Code	Course Name	CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CA101	Introduction to Information Technology	CLO 1. Understand the computing basics, network applications, human computer interactions. Evaluate the fundamentals of computers, IT and the various related technologies to enhance IT related skills.	H	H		M	H		M	H		H
		CLO 2. Appreciate the benefits of different number systems and be able to perform appropriate computations on different number systems as well as able to understand computer codes.		M	H	M		M	H		H	M

		CLO 3. Enhance calculation skills using binary arithmetic. Evaluate the Boolean expressions and reduce those to simplified forms.	M	H	M		M	M	M	H		H
		CLO 4. Learn Skills of designing digital circuits using the logic gates. Comprehend the need, benefits and functions of operating systems in computers.		M	M	H		H			H	H

		CLO 5. Realize the significance of open source movement and the various licenses available under open source paradigm. To understand basic concepts of Microprocessors.	H	M			H		H	M		
CA103	PC Assembly and Troubleshooting	CLO 1. Identify the main components for the PC to enable new startup.		H		H	H	H		M	M	
		CLO 2. Learn about power supplies and the skills to troubleshoot various power-related problems.	M	H	M				M			H

		CLO 3. Have an idea about the processor generations used in PCs starting from the first Intel generations to current CPU families.		H	M		H		M		M	H
		CLO 4. Familiarize themselves with PC memories such as RAM and ROM devices. This includes RAM types, RAM upgrading, ROM BIOS, and the CMOS chip.	M	H		H		H		H	H	

		<p>CLO 5. Know about motherboards and the various technologies connected to main boards such as Chipsets, Buses, and various BIOS types. Terms such as PCI, ISA, AGP, MCA, POST, Bootstrap loader, IDE controllers, Regulators, Heat sinks, and others will be familiar to the students to become entrepreneurs.</p>		M	H	M		M	H		H	M
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AM107	Foundation Course In Mathematics	CLO 1. Student will construct and analyze the graphs of trigonometry functions. Students will apply the concepts of trigonometry to any angle in a rectangular co-ordinate plane.	M	H	M		M	M	M	H		H
		CLO 2. Describe how circle, parabola, ellipse and hyperbola form the sections of cone and derive the standard equations of conics.		M	M	H		H			H	H

		CLO 3. Understand the respective application areas such as maxima-minima and area of a plane region through an overview of differentiation and integration respectively.	H	M			H		H	M		
		CLO 4. Enhance mathematical skills to solve computer related problems.		H		H	H	H		M	M	
		CLO 5. Develop Skills to correlate programming problems with mathematics.	M	H	M				M			H
CA105	Programming Concepts	CLO 1. Understand the requirement of program in software development		H	M		H		M		M	H

		CLO 2. Develop the logic building ability for given problem	H	H		M	H		M	H		H
		CLO 3. Understand the program constructs and its related activities to improve logical skills		M	H	M		M	H		H	M
		CLO 4. Convert a given logic into a Pseudo code and flowcharts to improve logical skills.	M	H	M		M	M	M	H		H
		CLO 5. Able to convert given algorithm to its corresponding code and enhance coding skills.		M	M	H		H			H	H

ES101	Environmental Sciences	CLO 6. Describe about all the natural resources, various ecosystems and energy resources, environmental pollution, waste management, biodiversity and human population.	H	M			H		H	M		
		CLO 1. Design, identify and analyze both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming) environmental problems.		H		H	H	H		M	M	

		CLO 2. Analyze the societal and environmental impacts of energy with respect to meet the growing energy needs for sustainable growth.	M	H	M				M			H
		CLO 3. Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world		H	M		H		M		M	H
		CLO 4. Understand the real world issues to improve skills related to pollution.	M	H		H		H		H	H	
CA107	Introduction to Programming Languages	CLO 1. Develop the logic by understanding the semantics and syntax of C to enhance employability		M	H	M		M	H		H	M

		CLO 2. Use break, continue and go to in looping constructs.	M	H	M		M	M	M	H		H
		CLO 3. Manipulate tabular data (i.e. Arrays)		M	M	H		H			H	H
		CLO 4. Use the user defined data types (structures and unions).	H	M			H		H	M		
		CLO 5. Modularize their complex problems using derived and user defined data types (data structures).		H		H	H	H		M	M	
		CLO 6. Able to write C programs , increasing coding skills to gain employability	M	H	M				M			H

CA142	Networking Fundamentals	CLO 1. Describe and analyses the hardware, software, components of a network and the interrelations required for employability.		H	M		H		M		M	H
		CLO 2. Explain networking protocols and their hierarchical relationship hardware and software. Compare protocol models and select appropriate protocols for a particular design.	M	H		H		H		H	H	

		<p>CLO 3. Manage multiple operating systems, systems software, network services and security. Evaluate and compare systems software and emerging industry technologies.</p>		M	H	M		M	H		H	M
		<p>CLO 4. Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.</p>	M	H	M		M	M	M	H		H

		<p>CLO 5. Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security. Analyze performance of enterprise network systems.</p>		M	M	H		H			H	H
		<p>CLO 6. Effectivel y communicate technical information verbally, in writing, and in presentations to improve employability.</p>	H	M			H		H	M		

AM108	Basics of Statistical Mathematics	CLO 1. Possess an ability to solve the problems of data interpretation using measures of central tendency, measures of Variation and concepts of correlation and regression.		H		H	H	H		M	M	
		CLO 2. Introduce and form matrices for present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.	M	H	M				M			H

		CLO 3. To analyze and correlate many real life problems mathematically and thus find the appropriate solution for them using theory of probability.		H	M		H		M		M	H
		CLO 4. To improve skills on calculating standard measures such as mean , median mode		H	M		H		M		M	H
		CLO 5. Able to gain skills to correlate Programming with Mathematics	M	H		H		H		H	H	

CA112	Software Engineering	CLO 1. How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment.		M	H	M		M	H		H	M
		CLO 2. To develop skills in one or more significant application domains.	M	H	M		M	M	M	H		H
		CLO 3. Work as an individual and as part of a multidisciplinary team to develop and deliver quality software.		M	M	H		H			H	H

		CLO 4. Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle.	H	M			H		H	M		
		CLO 5. Demonstrate the skill to use the techniques and tools necessary for engineering practice		H		H	H	H		M	M	
HR101	Human Values & Professional Ethics	CLO 1. Understand basic concepts of human values and value education.	M	H	M				M			H
		CLO 2. Understand importance of personal development and creation of a positive personality.		H	M		H		M		M	H

		CLO 3. Understand importance of value education towards national and global development.	M	H		H		H		H	H	
		CLO 4. Identify constitutional or national values, social, professional, religious and aesthetic values.		M	M	H		H			H	H
		CLO 5. Understand about national Integration and international cooperation.	H	M			H		H	M		
		CLO 6. Acquire basic working knowledge of human rights and institutions engaged in protection of these rights.		H		H	H	H		M	M	

CA113	Fundamentals of Object Oriented Programming	CLO 1. Develop the logic by understanding the semantics and syntax of C++	M	H	M				M			H
		CLO 2. Modularize their complex problems using derived and user defined data types (data structures).		H	M		H		M		M	H
		CLO 3. Declare constructor to initialize variables.	H	H		M	H		M	H		H
		CLO 4. Understand the concept of reusability of a code using inheritance and improve employability skills.		M	H	M		M	H		H	M
		CLO 5. Use the overloading of functions and operators in program domain.	M	H	M		M	M	M	H		H

		CLO 6. To be able to convert a real life problem in C++ code and enhance employability probability.		M	M	H		H			H	H
CA115	Relational Database Management System	CLO 1. Understand the concept of Relational models, architecture for DBMS, EF Codd's rules, normalization, managing concurrent transactions, recovery and security of database.	H	H		M	H		M	H		H
		CLO 2. Implement ER model to identify the entities and attributes involved in the database to improve employability chances.		M	H	M		M	H		H	M

		CLO 3. Implement normalization to have a non-redundant anomaly free database to improve employability.	M	H	M		M	M	M	H		H
		CLO 4. Develop a normalized and secured database having backup (Implementation of the recovery techniques) and enhance employability.		M	M	H		H			H	H
		CLO 5. Analyze the difference between RDBMS and other database storing techniques.	H	M			H		H	M		
CA144	Artificial Intelligence	CLO 1. Use the basic concepts of Artificial Intelligence		H		H	H	H		M	M	

		CLO 2. Understand the role of knowledge representation, problem solving, and learning in intelligent-system engineering.	M	H	M				M			H
		CLO 3. Represent knowledge using propositional calculus and predicate calculus. Use inference rules to produce predicate calculus expression.		H	M		H		M		M	H
		CLO 4. Solve problems using search techniques: depth-first, breadth-first, forward chaining, backward chaining, best-first and heuristic search	M	H		H		H		H	H	

		CLO 5. Develop intelligent systems by assembling solutions to concrete computational problems.		M	H	M		M	H		H	M
		CLO 6. Learn structured knowledge through weak and strong Filler techniques like semantic networks, frame systems, scripts and conceptual dependencies.	M	H	M		M	M	M	H		H
		CLO 7. Use and learn Expert system architecture and its development.		M	M	H		H			H	H
AM109	Discrete Mathematics	CLO 1.To investigate and solve a variety of live problems related to sets, Relations and Functions.	H	H		M	H		M	H		H

		CLO 2. To understand and apply the theory and techniques of Lattice, Logic and Boolean algebra		M	H	M		M	H		H	M
		CLO 3. To gain skills related to Graph Theory and its relevance within the context of computer science and	M	H	M		M	M	M	H		H
		CLO 4. Enhance skills to findg solutions of live problems related to shortest path etc.		M	M	H		H			H	H
		CLO 5. Gain skills to solve real life problems using combinatory.	H	M			H		H	M		

DM101	Disaster Management	CLO 1. Understand the classification, causes and impacts of disasters including basic concepts and definitions of terminologies.	M	H	M				M			H
		CLO 2. Describe the principles of disaster management, various parts of disaster cycle and community based approaches of disaster risk reduction.		H	M		H		M		M	H
		CLO 3. Classify the hazard and vulnerability profile of India, enlistment of Acts and policies related with disaster management along with the role of institutions	M	H		H		H		H	H	

CA121	Data Structures	CLO 1. Define basic static and dynamic data structures and relevant standard algorithms for them: arrays, stack, queue, dynamically linked lists, trees.		M	H	M		M	H		H	M
		CLO 2. Handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures	M	H	M		M	M	M	H		H
		CLO 3. Select basic data structures and algorithms for autonomous realization of simple programs or program parts required to work in industry.		M	M	H		H			H	H

		CLO 4. Know the importance of memory management through dynamic memory allocation and make use of memory efficient data structure like linked list.		M	M	H		H			H	H
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		<p>CLO 5. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.</p>	H	H		M	H		M	H		H
		<p>CLO 6. Ability to sensibly select appropriate data structures and algorithms for problems enhance employability.</p>		M	H	M		M	H		H	M

CA123	Client Side Scripting	CLO 1. Understand the purpose of client side scripting to design and develop websites	M	H	M		M	M	M	H		H
		CLO 2. Decide when to use offline and hosted jQuery and DOM .		M	M	H		H			H	H
		CLO 3. Utilize the full strength of jQuery using chaining.	H	M			H		H	M		
		CLO 4. Apply different iteration on the wrapper set.		H		H	H	H		M	M	
		CLO 5. Implement different filters on wrapper set will be achievable by the students.	M	H	M				M			H
		CLO 6. Explore core jQuery features which would help in designing GUI.		H	M		H		M		M	H

		CLO 7. Gain skills to start their own website design and development work.		H		H	H	H		M	M	
CA125	Introduction to Java Programming	CLO 1. Create Java applications that leverage the object-oriented features of the java language, such as encapsulation, inheritance and polymorphism	M	H	M				M			H
		CLO 2. Enable the students to understand about interface and its uses to achieve the multiple inheritances.		H	M		H		M		M	H

		CLO 3. Create user exception and handle using exception handling techniques required for industry employability.		H	M		H		M		M	H
		CLO 4. Create an applet which can be executed on web browser through which student can gain insight of interactive web development.	M	H		H		H		H	H	
		CLO 5. Enable the student to understand the concept of window based programming by making use of AWT components.		M	H	M		M	H		H	M

CA119	Operating System Concepts	CLO 1. Student should be able to identify the different types of Operating System and their components.	M	H	M		M	M	M	H		H
		CLO 2. Design and implementation of new system calls and gain skills to work in open source operating system.		M	M	H		H			H	H
		CLO 3. Implementation of existing resource management algorithms in Linux operating system .		H		H	H	H		M	M	
		CLO 4. To identify various system security and protection issues and gain necessary skills.	M	H	M				M			H

		CLO 5. To completely administer the system using various Operating systems (Windows and Ubuntu) for managing its resources.		H	M		H		M		M	H
CS501	Cyber Security	CLO 1. Understand the Information Technology Act of India (ITA).		H	M		H		M		M	H
		CLO 2. Protect themselves from various Cybercrimes.	M	H		H		H		H	H	
		CLO 3. Understand the various kind of vulnerabilities.		M	H	M		M	H		H	M
		CLO 4. Defend the personal data from botnets.	M	H	M		M	M	M	H		H
		CLO 5. Understand the frauds used through handheld devices such as mobile phone and PDA.		M	M	H		H			H	H

		CLO 6. Importance of ACI (Authentication, Confidentiality and Integrity) in Cyber.		M	H	M		M	H		H	M
		CLO 7. Explore the importance of IPR.	M	H	M		M	M	M	H		H
		CLO 8. Discover the various cons and pros of the social media		M	M	H		H			H	H
CA140	Logical Reasoning	CLO 1. To improve answers during the Aptitude test and develop an all-around personality with a mature outlook.	M	H	M				M			H
		CLO 2. To enhance their logical thinking, verbal reasoning and numerical reasoning.		H	M		H		M		M	H

		CLO 3. To take part effectively and confidently not only in campus placements programs but also in other exams like CAT, GMAT, SSC, Bank Po, UPSC etc.		H	M		H		M		M	H
CA135	Advanced Java	CLO 1. Demonstrate basic concepts of OOPs using JAVA programming language to become employable.	M	H		H		H		H	H	
		CLO 2. Explain collection framework and easy way to use data structure in java.		M	H	M		M	H		H	M
		CLO 3. Define AWT package to create various components of web page.	M	H	M		M	M	M	H		H

		CLO 4. Understand swing package and its various components.		M	M	H		H			H	H
		CLO 5. Implement various events classes, event listener and adaptor classes.		H		H	H	H		M	M	
		CLO 6. Understand basic steps to perform connectivity of MySQL and Java technology as per industry requirements.	M	H	M				M			H
		CLO 7. Create small applications that interact with database and web.		H	M		H		M		M	H
CA139	Basics of Cloud & IoT	CLO 1. Develop and deploy cloud application using popular cloud platforms.		H	M		H		M		M	H

		CLO 2. Write comprehensive case studies analyzing and contrasting different cloud computing solutions.	M	H		H		H		H	H	
		CLO 3. Compare, contrast, and evaluate the key trade-offs between multiple approaches to cloud system design, and Identify appropriate design choices when solving real-world cloud computing problems.		M	H	M		M	H		H	M
		CLO 4. Design the compatible cloud models for different applications.	M	H	M		M	M	M	H		H

		CLO 5. Aware about IOT application areas and platform to become employable.		M	M	H		H			H	H
		CLO 6. Integration cloud with IOT as per industry requirements.		M	H	M		M	H		H	M
		CLO 7. Security requirements for IOT applications.	M	H	M		M	M	M	H		H
CA138	Programming Practicum	CLO 1. Understanding the data types, operators, and control structures of C.		M	M	H		H			H	H
		CLO 2. Understand the behavior, working of pointers and strings	M	H	M		M	M	M	H		H
		CLO 3. Understand the various concepts of OOPS and its benefits		M	M	H		H			H	H

		CLO 4. Decide when to use static, constant and normal objects		H		H	H	H		M	M	
		CLO 5. Utilize the full strength of static polymorphism using function and operator overloading.	M	H	M				M			H
		CLO 6. Gain skills to apply different various type conversions and dynamic memory allocation		H	M		H		M		M	H
		CLO 7. Implement runtime polymorphism in different scenarios and inheritance		H	M		H		M		M	H
		CLO 8. Improve skills to search and sort data using algorithms.	M	H		H		H		H	H	
CA149	Basics of Data Sciences	CLO 1. Obtain, clean/process, and transform data		M	H	M		M	H		H	M

		CLO 2. Analyze and interpret data using an ethically responsible approach	M	H	M		M	M	M	H		H
		CLO 3. Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues		M	M	H		H			H	H
CA401	Advanced Database Management System	CLO 1. To make student skilled with basic concepts of advanced database concepts of advanced database management system and understanding database concepts and structures.		M	H	M		M	H		H	M

		CLO 2. Students would be able to understand the role and importance of ADBMS with the help of live database example.	M	H	M		M	M	M	H		H
		CLO 3. Over this, entire course is designed to help students to understand data modelling and database development process, construct and normalize conceptual data models.	H	H		H	H	H		H	H	H

		CLO 4. Implement a relational database into a database management system. Use of database management systems such as Oracle, SQL and become proficient in using PL / SQL.	H	H	H	H	M		H			H
		CLO 5. Students will be able to design logic to automatically manage the database during any DML or DDL transaction and understand the issues related to database performance.	H	H		M		H		M		H
CA403	Advanced Data Structures and Algorithms Design	CLO 1. Learn the skills to measures of space and time complexities.	H	H	M		H	H			H	H

		CLO 2. Calculate the time complexities of algorithms.	H	H		H	H			M	H	
		CLO 3. Learn various algorithm design techniques.		H	H	H	M	H		H	M	
		CLO 4. Develop solutions to known problems of computer science using the algorithm techniques.	H	M		M	H		H	H	H	H
		CLO 5. Learn about the solvable/unsolvable P, NP hard problems.	H					H	H	M	H	
CA405	Computer Organization and Architecture	CLO 1. Design trade-offs Basic fundamentals in digital logic & structure of a digital computer.	H	M		H			M	H	H	
		CLO 2. Identify performance issues in processor and memory design of a digital computer.	H	H		H	H	H		H	H	H

		CLO 3. To Develop independent learning skills and be able to learn more about different computer architectures and hardware.	H	H	H	H	M		H	H	H	H
		CLO 4. To articulate design issues in the development of Multiprocessor organization & architecture.	H	H	H	M		H	H	M	H	H
AM110	Operation Research	CLO 1.To investigate and solve a variety of live problems of optimization using Simplex Method.	H	H	M		H	H	H	M	H	H

		CLO 2. To understand and apply the skills of theory and techniques of assignment problem to solve assign jobs to persons by minimizing cost and time.	H	H		H	H		H	M	H	
		CLO 3. To solve real life complex transportation problems by computation technique for easy representation.		H	H	H	M	H		H	M	

		CLO 4. To comprehend the relevance of game theory and project management within the context of computer science and finding solutions of live problems related to shortest path etc.	H	M		M	H		H	H	H	H
CA421	Rapid Application Development (Advance Java)	CLO 1. Understand not only the fundamentals of the Java language, but also it's importance, uses, strengths and weaknesses	H	M		M	H		H	H	H	H
		CLO 2. Understand what OO programming is and what the advantages of OO are in today's world for employability	H					H	H	M	H	

		CLO 3. Understand the basics of the Java language and how it relates to OO programming and the Object Model Learn to use Java multi-threading and exception handling features	H	M		H			M	H	H	
		CLO 4. Understand and use classes, inheritance and polymorphism, use collections, generics, autoboxing, and enumerations including new Java 6 features and capabilities	H	H		H	H	H		H	H	H

		CLO 5. Use the JDBC API for database access, Use Java for networking and communication applications Work with annotations	H	H	H	H	M		H	H	H	H
		CLO 6. Working with XML and Web Services in Java using JAXP, JAXB, and security Optionally, learn to develop GUI applications using Swing	H	M		M	H		H	H	H	H
CA423	Theory of Computation	CLO 1.Able to design Finite Automata machines for given problems;	H					H	H	M	H	
		CLO 2. Able to analyze a given Finite Automata machine and find out its Language;	H	M		H			M	H	H	

		CLO 3. Able to design Pushdown Automata machine for given CF language(s)	H	H	H	H	M		H	H	H	H
		CLO 4. Skilled to generate the strings/sentences of a given context-free languages using its grammar.	H	M		M	H		H	H	H	H
		CLO 5. Able to design Turing machines for given any computational problem.	H					H	H	M	H	
CA424	Data Communication & Computer Networks	CLO 1. Build an understanding of the fundamental concepts of data communication and computer networking required for employability.	H	M		H			M	H	H	

		CLO 2. Understand how errors detected and corrected that occur in transmission	H	H		H	H		H	M	H	
		CLO 3. How collisions to be handled when many stations share a single channel		H	H	H	M	H		H	M	
		CLO 4. Know about routing mechanisms and different routing protocols	H	M		M	H		H	H	H	H
		CLO 5. Understand transport layer functions	H					H	H	M	H	
		CLO 6. Know about different application layer protocols	H	M		H			M	H	H	

CA425	Operating System Principals	CLO 1. Gain extensive knowledge on principles, types and advance concepts of operating systems.	H	H		H	H	H		H	H	H
		CLO 2. Recognize key mechanisms in design of operating systems modules for employability.	H	H	H	H	M		H	H	H	H
		CLO 3. Compare performance of processor scheduling algorithms.	H	H	H	M		H	H	M	H	H

		CLO 4. Practice with operating system concepts such as process management, concurrent processes and threads, memory management, virtual memory concepts, deadlocks.	H	H	M		H	H	H	M	H	H
		CLO 5. To identify various system security and protection issues.	H	H		H	H		H	M	H	
		CLO 6. To learn the latest trends in building mobile OS.		H	H	H	M	H		H	M	
CA429AA	Full Stack web development	CLO 1. Use their learned skills, knowledge and abilities to develop web sites for the internet	H	M		M	H		H	H	H	H

		CLO 2. Apply basic design principles to present ideas, information, products, and services on websites	H	M		M	H		H	H	H	H
		CLO 3. Apply basic programming principles to the construction of websites	H					H	H	M	H	
		CLO 4. Effectively manage website projects using available resources	H	M		H			M	H	H	
		CLO 5. Demonstrate communication skills, service management skills, and presentation skills	H	H		H	H	H		H	H	H

		CLO 6. Complete job preparation tasks including writing resumes and cover letters, conducting job interviews and developing an ePortfolio	H	H	H	H	M		H	H	H	H
		CLO 7. Apply employability skills including fundamental skills, personal management skills, and teamwork skills	H	M		M	H		H	H	H	H
CA429BA	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	CLO 1. Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies for enterprenureship.	H					H	H	M	H	

		CLO 2. Hands-on familiarity with the leading tools and techniques used in the customer-facing aspects of Digital Marketing & Internet Technologies.	H	M		H			M	H	H	
		CLO 3. Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.	H	H	H	H	M		H	H	H	H
		CLO 4. E-business is booming and so are the opportunities for graduates with an E-Business	H	M		M	H		H	H	H	H

CA429BB	Search Engine Marketing (SEO & PPC), Web Analytics and Email Marketing & Management	CLO 1. Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.	H					H	H	M	H	
		CLO 2. Hands-on familiarity with the leading tools and techniques used in the customer-facing aspects of Digital Marketing & Internet Technologies.	H	H	H	M		H	H	M	H	H

		CLO 3. Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.	H	H	M		H	H	H	M	H	H
		CLO 4. Skills of E-business is booming and so are the opportunities for graduates	H	H		H	H		H	M	H	
CA429CA	Cloud Infrastructure & foundation	CLO 1. Understand the fundamental principles of distributed computing.		H	H	H	M	H		H	M	

		<p>CLO 2. Understand how the distributed computing environments known as Grids can be built from lower level services.</p>	H	M		M	H		H	H	H	H
		<p>CLO 3. Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.</p>	H					H	H	M	H	
		<p>CLO 4. Analyze the performance of Cloud Computing for employability.</p>	H	M		H			M	H	H	
		<p>CLO 5. Understand the concept of Cloud Security.</p>	H	H		H	H	H		H	H	H

		CLO 6. Learn the Concept of Cloud Infrastructure Model.	H					H	H	M	H	
CA429CB	IoT and Cloud Computing	CLO 1. Understand the various concept of the IoT and their technologies.	H	H	H	M		H	H	M	H	H
		CLO 2. Develop the IoT application using different hardware platforms	H	H	M		H	H	H	M	H	H
		CLO 3. Implement the various IoT Protocols for employability	H	H		H	H		H	M	H	
		CLO 4. Understand the basic principles of cloud computing.		H	H	H	M	H		H	M	
		CLO 5. Develop and deploy the IoT application into cloud environment	H	M		M	H		H	H	H	H
CA429DA	Design Thinking and Fundamentals	CLO 1.Examine Design Thinking concepts and principles	H					H	H	M	H	

		CLO 2. Practice the methods, processes, and tools of Design Thinking	H	M		H			M	H	H	
		CLO 3. Apply the Design Thinking approach and model to real world situations	H	H		H	H	H		H	H	H
		CLO 4. Analytical skills for role of primary and secondary research in the discovery stage of Design Thinking	H	H		H	H	H		H	H	H
CA429DB	UX Design & Digitalization	CLO 1. Understand the importance of the user experience	H	H	H	H	M		H	H	H	H
		CLO 2. Apply the user experience design process	H	M		M	H		H	H	H	H
		CLO 3. Develop empathy for users through user research methods	H					H	H	M	H	
		CLO 4. Discover and analyse user needs	H	M		H			M		H	

		CLO 5. Organize information and design the Information architecture	H	H	H	H	M		H	H	H	H
		CLO 6. Learn skills for design principles in interface, navigation, visual, and interaction design	H	M		M	H		H		H	H
		CLO 7. Ideate, create, and validate prototypes	H					H	H	M	H	
		CLO 8. Apply usability test techniques	H	M		H			M	H	H	
CA429EA	Object Oriented Database Design With UML	CLO 1. The importance of modeling in the software development life cycle	H	H		H	H		H	M	H	
		CLO 2. Skills for the UML notation and symbols		H	H	H	M	H		H	M	

		CLO 3. The object-oriented approach to analyzing and designing systems and software solutions	H	M		M	H		H	H	H	H
		CLO 4. How to Employ the UML notation to create effective and efficient system designs	H	H	M	H	H	H	M	H	H	H
CA429EB	Database Administration	CLO 1.Design, model and install any database management systems by using Oracle database as sample.	H	H	H	H	H	H	H	M	H	H

		CLO 2. Plan, design, construct, control and manage database instances, database network environment, storage structures, user security, database backup and recovery, database maintenance		H	M	H		H		M		
		CLO 3. Define and devise transaction management, concurrency control, crash recovery components	H	H	H	H	H	H	H	H	H	H
		CLO 4. Examine and perform data base administration roles and operations by using Oracle database system as a sample.	H	H	H	H	H	H	M	H	M	H

		CLO 5. Skills to Compare and contrast by examining the database systems and new trends in data storage, data retrieval and maintenance techniques.	H	H	M	H	H	M	H	H	H	H
CA429FA	Research Methodology	CLO 1.Students will be able to select appropriate quantitative methodologies for use in a study to be performed in the spring. These methodologies include, but are not limited to, experimental, survey and content analysis.	H	H	H	H	H	M	H	H	M	H

		CLO 2. Students will be able to learn basic skills and approaches to qualitative research. These methodologies include, but are not limited to, case studies, indepth interviews and focus groups.	H	H	H	M	H	H	H	M	H	H
		CLO 3. Students will be able to identify and critique articles based on different research methods	H	M		M	H		H	H	H	H
		CLO 4. Students will be able to construct a questionnaire relying on several types of questions	H					H	H	M	H	

CA429FB	Statistical Data Analysis using R	CLO 1. Understand the fundamental syntax of R through readings, practice exercises, demonstrations, and writing R code.	H	M		H			M	H	H	
		CLO 2. Apply critical programming language concepts such as data types, iteration, control structures, functions, and boolean operators by writing R programs and through examples	H	H	H	H	M		H	H	H	H
		CLO 3. Skills to import a variety of data formats into R using RStudio	H	M		M	H		H	H	H	H
		CLO 4. Prepare or tidy data for in preparation for analysis	H					H	H	M	H	

		CLO 5. Query data using SQL and R	H	H		H	H	H		H	H	H
		CLO 6. Analyze a data set in R and present findings using the appropriate R packages	H	H	H	H	M		H			H
		CLO 7. Visualize data attributes using ggplot2 and other R packages.	H	H		M		H		M		H
CA429GA	Accounting and Financial Management	CLO 1. Know and apply accounting and finance theory	H	H	M		H	H			H	H
		CLO 2. Explain and apply skills for international accounting standards	H	H		H	H			M	H	
		CLO 3. Critically evaluate financial statement information		H	H	H	M	H		H	M	
		CLO 4. Evaluate and compare different investments	H	M		M	H		H	H	H	H
CA429GB	Managerial Economics	CLO 1. To introduce the economic concepts	H					H	H	M	H	

		CLO 2. To familiarize with the students the importance of economic approaches in managerial decision making	H	M		H			M	H	H	
		CLO 3. To understand the applications and skills of economic theories in business decisions	H	H		H	H	H		H	H	H
CA429HA	Cyber security & Cyber Forensics	CLO 1. Analyze and resolve security issues in networks and computer systems to secure an IT infrastructure.	H	H	H	H	M		H	H	H	H
		CLO 2. Design, develop, test and evaluate secure software .	H	H	H	M		H	H	M	H	H
		CLO 3. Develop policies and procedures to manage enterprise security risks.	H	H	M		H	H	H	M	H	H

		CLO 4. Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.	H	H		H	H		H	M	H	
		CLO 5. Learn Skills to interpret and forensically investigate security incidents.		H	H	H	M	H		H	M	
CA429HB	Digital Security and Advanced Cryptography	CLO 1.Students should be able to: understand basic principles and results of the theory of secure communication;	H	M		M	H		H	H	H	H

		CLO 2. Know principles and problems of basic cryptosystems for encryption (both secret and public key), digital signing and authentication	H	M		M	H		H	H	H	H
		CLO 3. Know methods to create core cryptographic protocols primitives;	H					H	H	M	H	
		CLO 4. Practicall y use simple cryptosystems skills	H	M		H			M	H	H	

		CLO 5. Know how the real protocols enabling secure communication over internet, various tools and techniques to protect as well as attack a computer network.	H	H		H	H	H		H	H	H
CA427A	Data Mining & Data Warehousing	CLO 1. Study data warehouse principles and its working skills	H	H	H	H	M		H	H	H	H
		CLO 2. Learn Data mining concepts and understand Association Rule Mining	H	M		M	H		H	H	H	H
		CLO 3. Study Classification Algorithms	H					H	H	M	H	
		CLO 4. Gain knowledge of how data is grouped using clustering techniques.	H	M		H			M	H	H	

CA427B	Parallel and Distributed Computing	CLO 1. Analyze and critically discuss research papers both in writing and in class	H	H	H	H	M		H	H	H	H
		CLO 2. Formulate and evaluate a hypothesis by proposing, implementing and testing a project	H	M		M	H		H	H	H	H
		CLO 3. Relate one's project to prior research via a review of related literature	H					H	H	M	H	
		CLO 4. Learn skills to write a coherent, complete paper describing and evaluating a project	H	M		H			M	H	H	
		CLO 5. Orally present a clear and accessible summary of a research work	H	H		H	H		H	M	H	

		CLO 6. Understand the fundamental questions in parallel and distributed computing and analyze different solutions to these questions		H	H	H	M	H		H	M	
		CLO 7. Understand different parallel and distributed programming paradigms and algorithms, and gain practice in implementing and testing solutions using these.	H	M		M	H		H	H	H	H

CA427C	Digital Image Processing	CLO 1. Students understand how images are digitally represented and learn how to perform image processing, e.g. logic and arithmetic operations, convolution, and filtering	H					H	H	M	H	
		CLO 2. Students are able to implement low-level edge and corner detection algorithms to discard redundant and preserve useful information	H	M		H			M	H	H	

		<p>CLO 3. Students are able to learn skills of a projective pinhole camera by applying techniques such as perspective projection, rigid body motion and homogeneous coordinates. Students are able to discover the intrinsic and extrinsic camera parameters using linear least squares on a set of</p>	H	H		H	H	H		H	H	H
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		CLO 4. Students are able to extract 3D information from images and recover world positions through triangulation. They understand fundamental concepts in multiple view geometry, such as the correspondence problem, the essential/fundamental matrix, and the epipolar geometry	H	H	H	H	M		H	H	H	H
CA427D	Software Project Management	CLO 1. Understand Project Management principles while developing software.	H	H	H	M		H	H	M	H	H

		CLO 2. Gain extensive knowledge about the basic project management concepts, framework and the process models	H	H	M		H	H	H	M	H	H
		CLO 3. Obtain adequate knowledge about software process models and software effort estimation techniques	H	H		H	H		H	M	H	
		CLO 4. Learn skills to estimate the risks involved in various project activities		H	H	H	M	H		H	M	

		CLO 5. Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles	H	M		M	H		H	H	H	H
		CLO 6. Learn staff selection process and the issues related to people management	H	M		M	H		H	H	H	H
CA427E	Organizational Behavior	CLO 1. Identify and define organizational behavior concepts and learn the skills	H					H	H	M	H	
		CLO 2. Apply those concepts to improve your understanding of your own work attitudes and behaviors	H	M		H			M	H	H	

		CLO 3. Apply those concepts to improve the functioning of an organizational unit	H	H		H	H	H		H	H	H
CA427F	Agile Methods for Software Development	CLO 1. Realize the importance of interacting with business stakeholders in determining the requirements for a software system	H	H	H	H	M		H	H	H	H
		CLO 2. Perform iterative software development processes: how to plan them, how to execute them	H	M		M	H		H	H	H	H
		CLO 3. Point out the impact of social aspects on software development success	H					H	H	M	H	

		CLO 4. Develop techniques and tools for improving team collaboration and software quality require for employability	H	M		H			M	H	H	
		CLO 5. Perform Software process improvement as an ongoing task for development teams	H	H	H	H	M		H	H	H	H
		CLO 6. Show how agile approaches can be scaled up to the enterprise level	H	M		M	H		H	H	H	H
CA427G	Web Services	CLO 1. Understand the principles of SOA required for employability	H					H	H	M	H	
		CLO 2. Efficiently use market leading environment tools to create and consume web services	H	H	H	M		H	H	M	H	H

		CLO 3. Identify and select the appropriate framework components in creation of webservice solution	H	H	M		H	H	H	M	H	H
		CLO 4. Apply OOP principles to creation of web service solutions	H	H		H	H		H	M	H	
CA427H	Cyber Law and IT Security	CLO 1. Make Learner Conversant With The Social And Intellectual Property Issues Emerging From 'Cyberspace		H	H	H	M	H		H	M	
		CLO 2. Explore The Legal And Policy Developments In Various Countries To Regulate Cyberspace	H	M		M	H		H	H	H	H

		CLO 3. Develop The Understanding Of Relationship Between Commerce And Cyberspace;	H					H	H	M	H	
		CLO 4. Give Learners In Depth Knowledge Of Information Technology Act And Legal Frame Work Of Right To Privacy, Data Security And Data Protection	H	M		H			M	H	H	
		CLO 5. Make Study On Various Case Studies On Real Time Crimes	H	H		H	H	H		H	H	H
CA431	Computer Graphics and Multimedia	CLO 1.Explain the applications, areas, and graphic pipeline, display and hardcopy technologies.	H					H	H	M	H	

		CLO 2. Apply and compare the algorithms for drawing 2D images also explain aliasing, anti aliasing and half toning techniques.	H	H	H	M		H	H	M	H	H
		CLO 3. Discuss OpenGL application programming Interface and apply it for 2D & 3D computer graphics.	H	H	M		H	H	H	M	H	H
		CLO 4. Analyze and apply skills of clipping algorithms and transformation on 2D images.	H	H		H	H		H	M	H	
		CLO 5. Solve the problems on viewing transformations and explain the projection and hidden surface removal algorithms.		H	H	H	M	H		H	M	

CA433	Compiler Design	CLO 1. Specify and analyze the lexical, syntactic and semantic structures of advanced language features	H	M		M	H		H	H	H	H
		CLO 2. Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation	H					H	H	M	H	
		CLO 3. Apply skill to write a scanner, parser, and semantic analyser without the aid of automatic generators	H	M		H			M	H	H	
		CLO 4. Turn fully processed source code for a novel language into machine code for a novel computer	H	H		H	H	H		H	H	H

		CLO 5. Describe techniques for intermediate code and machine code optimisation	H	H		H	H	H		H	H	H
		CLO 6. Design the structures and support required for compiling advanced language features.	H	H	H	H	M		H	H	H	H
CA434	Software Engineering Design Testing and Quality Assurance	CLO 1. Infer various software models concepts for making the software.	H	M		M	H		H	H	H	H
		CLO 2. Analyze requirements for software development and to determine the entities involved in the system and their relationship to one another.	H					H	H	M	H	

		CLO 3. To make sure that the result meets the business and user requirements Software testing plays an instrumental role	H	M		H			M	H	H	
		CLO 4. To satisfy the BRS that is Business Requirement Specification and SRS that is System Requirement Specifications and finally gain the confidence of the customers by providing them a quality product.	H	H	H	H	M		H	H	H	H
		CLO 5. To create test cases and learn the skills for employability.	H	M		M	H		H	H	H	H

CA437	Intellectual Property Rights	CLO 1.To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.	H					H	H	M	H	
		CLO 2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects	H	M		H			M	H	H	
		CLO 3. To disseminate knowledge on copyrights and its related rights and registration aspects	H	H		H	H		H	M	H	

		CLO 4. To disseminate knowledge on trademarks and registration aspects for employability		H	H	H	M	H		H	M	
		CLO 5. To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects	H	M		M	H		H	H	H	
		CLO 6. To aware about current trends in IPR and Govt. steps in fostering IPR	H	H	M	H	H	H	M	H	H	H
CA439AA	Advanced Web Technologies: I(MongoDB, Express, Angular, React, Node)	CLO 1. Define the fundamental ideas and standards underlying Web Service Technology.	H	H	H	H	H	H	H	M	H	H

		CLO 2. Define the fundamental principles for cloud applications.	H	H	M	H	H	H	H	M	H	H
		CLO 3. Discuss concepts at the frontier of industrial practice and emerging standards.	H		H	H			H	H	H	
		CLO 4. Differentiate the major frameworks allowing to develop web services and cloud applications and assess their suitability for specific usage scenarios.	H	H	H	H	H	H	M	H	M	H
		CLO 5. Explain the link between the concepts of services and business processes and discuss and critique related standards.	H	H	M	H	H	M	H	H	H	H

		CLO 6. Develop skills of business processes using the Workflow foundation .	H	H	H	H	H	M	H	H	M	H
		CLO 7. Develop and deploy web services and cloud applications using appropriate Microsoft technologies.	H	H	H	M	H	H	H	M	H	H
CA439BA	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead	CLO 1. Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.	H	M		M	H		H	H	H	H

	Generation	CLO 2. Hands-on familiarity with the leading tools and techniques used in the customer-facing aspects of Digital Marketing & Internet Technologies for enterprenuership.	H					H	H	M	H	
		CLO 3. Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.	H	M		H			M	H	H	

CA439BB	Affiliate Marketing and Online Reputation Management (ORM)	CLO 1. Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.	H	H	H	H	M		H	H	H	H
		CLO 2. Hands-on familiarity with the leading tools and techniques used in the customer-facing aspects of Digital Marketing & Internet Technologies for employability.	H	H		H	H	H		H	H	H

		CLO 3. Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.	H	H	H	H	M		H			H
CA439CA	Cloud Computing with AWS	CLO 1. Understand the concepts, characteristics, delivery models and benefits of cloud computing	H	H		M		H		M		H
		CLO 2. Understand the key security and compliance challenges of cloud computing	H	H	M		H	H			H	H
		CLO 3. Understand the key technical and organisational challenges for entrepreneurship	H	H		H	H			M	H	

		CLO 4. Understand the different characteristics of public, private and hybrid cloud deployment models.		H	H	H	M	H		H	M	
CA439CB	Distributed System and Cloud Architecture	CLO 1.A thorough understanding of the fundamentals of cloud computing for employability	H	M		M	H		H	H	H	H
		CLO 2. Gain proficiency in programming paradigms and run time systems developed for the cloud.	H					H	H	M	H	
		CLO 3. Acquire the ability to analyze, design, and develop algorithms for solving several distributed systems problems.	H	M		H			M	H	H	

		CLO 4. Explore a wide range of system design alternatives for various aspects of cloud-native application development and understand their tradeoffs.	H	H		H	H	H		H	H	H
CA439DA	Empathy & Its Tools	CLO 1. Describe the intellectual, scientific, and historical origins of the concept of empathy.	H	H	H	H	M		H	H	H	H
		CLO 2. Use knowledge derived from reading and on-the-ground experience to identify and solve problems in the community.	H	H	H	M		H	H	M	H	H

		CLO 3. Identify and discuss one's own experiences of empathy (or lack of empathy) in a variety of settings and among people with different backgrounds.	H	H	M		H	H	H	M	H	H
		CLO 4. Articulate multiple perspectives on a variety of global issues for entrepreneurship .	H	H		H	H		H	M	H	
		CLO 5. Collaborate effectively and respectfully with peers and community members.		H	H	H	M	H		H	M	
		CLO 6. Heighten concern for individuals from different backgrounds .	H	M		M	H		H	H	H	H

CA439DB	User Interface Design	CLO 1. Analyze application structures to organize content clearly.	H	M		M	H		H		H	H
		CLO 2. Construct Navigation that enables users to easily accomplish tasks for employability	H					H	H	M	H	
		CLO 3. Design page layouts that support findability of hierarchical content and task completion	H	M		H			M	H	H	
		CLO 4. Determine how to display data to meet user needs	H	H		H	H	H		H	H	H
		CLO 5. Support contextually obvious user actions.	H	H	H	H	M		H	H	H	H

		CLO 6. Structure UI designs with feedback and help patterns.	H	M		M	H		H	H	H	H
CA439EA	Database Technologies & Essentials	CLO 1. Use the basic concepts of Database Systems in Database design	H					H	H		H	
		CLO 2. Apply SQL queries to interact with Database	H	M		H			M	H	H	
		CLO 3. . Design a Database using ER Modelling for employability	H	H	H	H	M		H	H	H	H
		CLO 4. Apply normalization on database design to eliminate anomalies	H	M		M	H		H		H	H
		CLO 5. Analyze database transactions and can control them by applying ACID properties.	H					H	H	M	H	

CA439EB	Database Administration-II	CLO 1.Design, model and install any database management systems by using Oracle database as sample.	H	M		H			M		H	
		CLO 2. Plan, design, construct, control and manage database instances, database network environment, storage structures, user security, database backup and recovery, database maintenance.	H	H		H	H		H	M	H	
		CLO 3. Define and devise transaction management, concurrency control, crash recovery components for employability		H	H	H	M	H		H	M	

		CLO 4. Examine and perform data base administration roles and operations by using Oracle database system as a sample	H	M		M	H		H	H	H	H
CA439FB	Advanced Research Methodology	CLO 1. Demonstrate articulation of research as both a systematic methodology and a systemic thinking process.	H					H	H	M	H	
		CLO 2. Demonstrate and understand the skills of inference and the use of research terms in describing educational practice on a spectrum from action research through experimental design	H	M		H			M	H	H	

CA439GA	E-Commerce and E-Governance, ERP	CLO 1. Define E-Marketplaces and list their components	H	H		H	H	H		H	H	H
		CLO 2. List the Major types of Electronic Markets and describe their features	H	H	H	H	M		H	H	H	H
		CLO 3. Describe the types of Intermediaries in EC and their roles in enterprenuership	H	H	H	M		H	H	M	H	H
		CLO 4. Describe electronic Catalogs, Shopping carts, and search Engines	H	H	M		H	H	H	M	H	H
		CLO 5. . Describe the various types of Auctions and list their characteristics	H	H		H	H		H	M	H	

CA439GB	Management Information Systems	CLO 1.Relate the basic concepts and technologies used in the field of management information systems		H	H	H	M	H		H	M	
		CLO 2. Learn skills to compare the processes of developing and implementing information systems	H	M		M	H		H	H	H	H
		CLO 3. Outline the role of the ethical, social, and security issues of information systems.	H	M		M	H		H	H	H	H

		CLO 4. Translate the role of information systems in organizations, the strategic management processes, with the implications for the management.	H					H	H	M	H	
		CLO 5. Apply the understanding of how various information systems like DBMS work together to accomplish the information objectives of an organization	H	M		H			M	H	H	
CA439HA	Secure Software Development	CLO 1.Explain the role of security throughout the Software Development Life Cycle process	H	H		H	H	H		H	H	H

		CLO 2. Determine software application security vulnerabilities and analyze attack consequences	H	H	H	H	M		H	H	H	H
		CLO 3. Apply secure design principles for developing attack resistant software for employability	H	M		M	H		H	H	H	H
		CLO 4. Analyze insecure software, utilizing automated code review tools with static analysis and symbolic execution	H					H	H	M	H	
		CLO 5. Compare tools and techniques for testing software resilience.	H	M		H			M	H	H	

CA439HB	Malware Analysis and Reverse Engineering	CLO 6. Be able to understand the cyber security challenges raised from malicious software attacks	H	H	H	H	M		H	H	H	H
		CLO 1. Learn skills to analyze the security risks, threats and potential vulnerabilities on enterprise networks environment	H	M		M	H		H	H	H	H
		CLO 2. Be able to carry out independent analysis of modern malware samples using behavioral, code analysis and memory forensic techniques	H					H	H	M	H	

		CLO 3. Be able to apply the learned techniques to protect, reduce the security risks and avoid malicious software attacks on computer systems or networks	H	H	H	M		H	H	M	H	H
		CLO 4. Be able to research independently and use learned skills and tools to investigate malicious software attacks and implement or update a cyber protection plan	H	H	M		H	H	H	M	H	H
CA436A	Artificial Intelligence and Neural Networks	CLO 1. Know the main provisions neuromathematics skills	H	H		H	H		H	M	H	

		CLO 2. Know the main types of neural networks;		H	H	H	M	H		H	M	
		CLO 3. Know and apply the methods of training neural networks;	H	M		M	H		H	H	H	H
		CLO 4. Know the application of artificial neural networks;	H					H	H	M	H	
		CLO 5. To be able to formalize the problem, to solve it by using a neural network.	H	M		H			M	H	H	
CA436B	Human Resource Management	CLO 1. Describe and explain the development of human resources management.	H	H		H	H	H		H	H	H

		CLO 2. Evaluate current methods of job analysis, recruitment, selection, training/development, performance appraisal, promotion, and separation.	H					H	H	M	H	
		CLO 3. Discuss management's ethical, socially responsible, and legally required actions.	H	H	H	M		H	H	M	H	H
		CLO 4. Assess methods of compensation and benefits planning for employability.	H	H	M		H	H	H	M	H	H
		CLO 5. Examine the role of strategic human resource planning in support of organizational mission and objectives.	H	H		H	H		H	M	H	

CA436C	Block Chain Technologies	CLO 1.Explain design principles of Bitcoin and Ethereum.		H	H	H	M	H			M	
		CLO 2. Learn and Explain skills of Nakamoto consensus.	H	M		M	H		H	H	H	H
		CLO 3. Explain the Simplified Payment Verification protocol.	H					H	H	M	H	
		CLO 4. List and describe differences between proof-of-work and proof-of-stake consensus.	H	M		H			M	H	H	
		CLO 5. Interact with a blockchain system by sending and reading transactions.	H	H		H	H	H		H	H	H
		CLO 6. Design, build, and deploy a distributed application.	H	H		H	H	H		H	H	H

		CLO 7. Evaluate security, privacy, and efficiency of a given blockchain system.	H	H	H	H	M		H	H	H	H
CA436D	Open Source Technologies	CLO 1. Understand the difference between open source software and commercial software.	H	M		M	H		H	H	H	H
		CLO 2. Identify, install and run Linux operating system.	H					H	H	M	H	
		CLO 3. Install and manage applications for employability.	H	M		H			M		H	
		CLO 4. Identify, install open source web technologies Apache, MySql, PHP.	H	H	H	H	M		H	H	H	H
		CLO 5. Develop web applications using LAMP.	H	M		M	H		H	H	H	H

		CLO 6. Write session control PHP code for a website.	H					H	H		H	
CA436E	Cryptography and Network Security	CLO 1. Understand the most common type of information and network threat sources.	H	M		H			M		H	
		CLO 2. Understand the Public-Key Infrastructure for employability.	H	H		H	H		H	M	H	
		CLO 3. Understand security protocols for protecting data on networks.		H	H	H	M	H		H	M	
		CLO 4. Understand the information and network security issues and apply the related concepts for protection and communication privacy.	H	M		M	H		H	H	H	H

		CLO 5. Understand application security using smart- cards.	H	H	M			H	M	H		H
		CLO 6. Understand the operation of e-payments, micro-payments and related security issues protocols.		H			H		H	M	H	
CA436F	Deep Learning	CLO 1. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.	H	H	M	H	H	H	H	M	H	H
		CLO 2. Implement deep learning algorithms and skills to solve real-world problems.	H		H	H	H	H	H	H		H
CA436G	Data Science	CLO 1. Describe the various areas where data science is applied	H	H	H	H	H	H	M	H	M	H

		CLO 2. Identify the data types, relation between data and visualization technique for data	H	H	M	H	H	M	H	H	H	H
		CLO 3. Explain probability, distribution, sampling, Estimation	H	H		H	H		H	H	M	H
		CLO 4. Learn skills to solve regression and classification problem .	H	H	H	M	H	H	H	M	H	H
CA436H	Big Data Analytics	CLO 1. Identify Big Data and its Business Implications	H	M		M	H		H	H	H	H
		CLO 2. List the components of Hadoop and Hadoop Eco-System	H					H	H		H	
		CLO 3. Access and Process Data on Distributed File System		M		H			M	H	H	

		CLO 4. Manage Job Execution in Hadoop Environment	H	H	H	H	M		H		H	H
		CLO 5. Develop Big Data Solutions using Hadoop Eco System				M	H		H		H	H
		CLO 6. Analyze Infosphere Big Data Recommendations	H					H	H	M	H	
		CLO 7. Apply Machine Learning Techniques using R for employability	H	M		H			M		H	
CA436I	Natural Language Processing & Fuzzy Logics	CLO 1. Apply the principles and Process of Human Languages such as English and other Indian Languages using computers	H	H	H	M	H	H	H	H	M	H
		CLO 2. Realize semantics and pragmatics of English language for text processing	H		M	H	H	H	H	M	H	H

		CLO 3. Create CORPUS linguistics based on digestive approach (Text Corpus method)		H	H	H	H	H	H	H	M	H
		CLO 4. Check a current methods for statistical approaches to machine translation for research skills	H	H	H		H	H	M	M	H	H
		CLO 5. Perform POS tagging for a given natural language and Select a suitable language modelling technique based on the structure of the language		H	M		H	M	H	H	H	H

		CLO 6. Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology	H	H	M	H	H	H	H	H	H	H
		CLO 7. Develop a Statistical Methods for Real World Applications and explore deep learning based NLP	H	H	H	M	H	H	M	H	H	H
CA436J	Machine Learning Using Python	CLO 1. Recognize the characteristics of machine learning strategies	H	H	H	M		H	M	H	H	H
		CLO 2. Apply various supervised learning methods to appropriate problems	H	H	M	H	H	H	H	M	H	H

		CLO 3. Identify and integrate more than one technique to enhance the performance of learning skills		H	H	H	H		H		M	H
		CLO 4. Create probabilistic and unsupervised learning models for handling unknown pattern	H	H		H		H	H		H	H
		CLO 5. Analyze the co-occurrence of data to find interesting frequent patterns	H		H	H			H	H	M	
		CLO 6. Preprocess the data before applying to any real-world problem and can evaluate its performance	H	H	M	H		H	M		H	H

