MANAV RACHNA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

PROGRAM STRUCTURE

&

DETAILED SYLLABUS

B.Tech. Computer Science & Engineering

BATCH: 2019-2023

DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY

B.TECH-CSE (CSU01)

3 Weeks Induction
Programme
(Mandatory)

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
SEMESTER - 1											
PHH101B- T& P	QUANTAM MECHANICS FOR ENGINEERS	NIL	PH	HARD	CORE	3	1	2	0	6	5
MAH101B-T & P	CALCULUS & LINEAR ALGEBRA	NIL	MA	HARD	CORE	3	1	2	0	6	5
CSH101B-T&P	PROGRAMMING FOR PROBLEM SOLVING USING C	NIL	CS	HARD	CORE	3	1	2	0	6	5
HLS103B/HLS104B	PROFESSIONAL ENGLISH-ADVANCE/ PROFESSIONAL ENGLISH-BASIC	NIL	ED	SOFT	CORE	2	0	2	0	4	3
CSW102B	(HTML5,CSS,JAVASCRIPT,JQUERY)	NIL	CS	WORKSHOP	CORE	0	0	3	0	3	1.5
CHH137	ENVIRONMENTAL STUDIES	NIL	CH	AUDIT	CORE	2	0	0	2	2	0
SPECIALIZATION ELECTIVE BASKET											
CSH107B-T&P	OVERVIEW OF DATA SCIENCE & MACHINE LEARNING	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
CSH105B-T&P	THINKING	NIL	CS	Hard	ELECTIVE	3	1	2	0	6	5
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)						13	3	11	2	27	19.5

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
SEMESTER - 2											
CHH144-T&P	CHEMISTRY-I	NIL	CH	HARD	CORE	3	1	2	0	6	5
MAH104B-T & P	DISCRETE MATHS	NIL	MA	HARD	CORE	3	1	2	0	6	5
ECH103B-T/P	BASICS OF ELECTRONICS & ELECTRICAL ENGINEERING	NIL	EC	HARD	CORE	3	1	2	0	6	5
CSH103B-T&P	DATA STRUCTURES & ALGORITHMS	NIL	CS	HARD	CORE	3	1	2	0	6	5
MEW102B	ENGINEERING GRAPHICS & DRAWING	NIL	ME	WORKSHOP	CORE	0	0	3	0	3	1.5
LWS324	INDIAN CONSTITUTION	NIL	LW	AUDIT	CORE	1	0	0	0	1	0
SPECIALIZATION ELECTIVE BASKET											
CSH108B-T&P	PYTHON PROGRAMMING	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
CSH106B-T&P	AGILE SOFTWARE DEVELOPMENT	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)						12	4	11	0	28	21.5

CSO104B	Post 2nd Sem Summer Training (Mandatory) (Project Management)										2

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	OFFERING DEPARTMENT	COURSE NATURE (Hard/Soft/	(Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
SEMESTER - 3											
CSH201B-T&P	OOPS USING JAVA	PROGRAMMING FOR PROBLEM SOLVING USING C	CS	HARD	CORE	3	1	2	0	6	5
CSH202B-T&P	DATABASE MANAGEMENT SYSTEM	NIL	CS	HARD	CORE	3	1	2	0	6	5
CSH209B-T&P	COMPUTER ARCHITECTURE & ORGANISATION	NIL	CS	HARD	CORE	3	1	2	0	6	5
CSH204B-T&P	ANALYSIS & DESIGN OF ALGORITHMS	DATA STRUCTURES & ALGORITHMS-I	CS	HARD	CORE	3	1	2	0	6	5
CSW203B	(MONGODB,TYPESCRIPT,ANGULAR JS)	USER INTERFACE-I (HTML5,CSS,JAVASCRIPT,JQ	CS	WORKSHOP	CORE	0	0	3	0	3	1.5
FLS101/FLS102/FLS103	FOREIGN LANGUAGE (SPANISH-I/ GERMAN-I/ FRENCH-I)	NIL	FL	AUDIT	ELECTIVE	1	1	0	0	2	0
	NPTEL COURSES FROM MOOC										

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CDO201	ENHANCEMENT-I	NIL	CDC	OUTCOME BASED	CORE	0	0	1	0	1	0.5
RDO501	INTRODUCTION TO RESEARCH	NIL	RESEARCH	OUTCOME BASED	CORE	0	0	0	1	1	0.5
SPECIALIZATION ELECTIVE BASKET											
CSH212B-T&P	SUPERVISED LEARNING	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
CSH210B-T&P	SOFTWARE CRAFTMANSHIP	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)						13	5	12	1	31	22.5

SEMESTER - 4

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH202B-T & P	PROBABILITY & STATISTICS	NIL	MA	HARD	CORE	3	1	2	0	6	5
CSH205B-T&P	ARTIFICIAL INTELLIGENCE	NIL	CS	HARD	CORE	3	1	2	0	6	5
CSH206B-T&P	OPERATING SYSTEM	NIL	CS	HARD	CORE	3	1	2	0	6	5
CSH207B-T&P	SOFTWARE ENGINEERING.	NIL	CS	HARD	CORE	3	1	2	0	6	5
CSW208B	PROGRAMMING FOR PROBLEM SOLVING USING PYTHON	NIL	CS	WORKSHOP	CORE	0	0	3	0	3	1.5
FLS105/FLS106/FLS107	FOREIGN LANGUAGE	NIL	FL	AUDIT	ELECTIVE	1	1	0	0	2	0
CDO202	PROFESSIONAL COMPETANCY ENHANCEMENT-II	NIL	CDC	OUTCOME BASED	CORE	0	0	1	0	1	0.5
EDS240	KNOWLEDGE	NIL	ED	AUDIT	CORE	1	0	0	0	1	0
RDO502	RESEARCH & INNOVATION-1	NIL	RESEARCH	OUTCOME	CORE	0	0	0	1	1	0.5
SPECIALIZATION ELECTIVE BASKET											
CSH213B-T&P	NETWORK	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
CSH211B-T&P	MODERN WEB AND MOBILE FRAMEWORKS	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)						14	5	12	1	32	22.5
CSO213B	SUMMER TRAINING POST 4TH SEMESTER										2

SEMESTER - 5

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSH301B-T&P	COMPUTER NETWORKS	NIL	CS	HARD	CORE	3	0	2	0	5	4
ECH308B-T/P	DIGITAL ELECTRONICS & MICROCONTROLLER	NIL	EC	HARD	CORE	3	1	2	0	6	5
CSH303B-T&P	MOBILE COMPUTING WITH ANDROID	OOPS USING JAVA	CS	HARD	ELECTIVE	3	0	2	0	5	4
CSH304B-T&P	SYSTEMS	SYSTEM	CS								
CSH305B-T&P	NEURAL NETWORK & FUZZY LOGIC	NIL	CS								
CSH306B-T&P	SYSTEM NETWORK & ADMINISTRATION	NIL	CS								
CSH307B-T&P	SOFTWARE PROJECT MANAGEMENT	SOFTWARE ENGG.	CS								
MOOC	NPTEL COURSES FROM MOOC										
CHS234/ECS306B/CSS325B-T&P	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT/ GREEN COMPUTING/ E-WASTE MANAGEMENT	NIL	CH/CS/EC	SOFT	ELECTIVE	1	0	2	0	3	2
MOOC	NPTEL COURSES FROM MOOC										
CSW308B	ADVANCED JAVA	NIL	CS	WORKSHOP	CORE	0	0	3	0	3	1.5
LWS323/LWS325	CYBER LAW/ LAW RELATING TO INTELLECTUAL PROPERTY RIGHTS	NIL	LW	SOFT	ELECTIVE	2	0	0	0	2	2
MOOC	NPTEL COURSES FROM MOOC										

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	OFFERING DEPARTMENT	COURSE NATURE	COURSE TYPE	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CDO301	PROFESSIONAL COMPETANCY ENHANCEMENT-III	NIL	CDC	OUTCOME	CORE	0	0	1	0	1	0.5
RDO601	RESEARCH & INNOVATION-II	NIL	RESEARCH	OUTCOME	CORE	0	0	0	1	1	0.5
SPECIALIZATION ELECTIVE BASKET											
CSH323B-T&P	ADVANCED NEURAL NETWORK	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
CSH321B-T&P	DEVOPS AND TEST AUTOMATION	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)						12	1	12	0	26	19.5

SEMESTER - 6

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSH310B-T&P	COMUTER GRAPHICS & MULTIMEDIA	NIL	CS	HARD	CORE	3	1	2	0	6	5
CSH311B-T&P	THEORY OF AUTOMATA & COMPILER DESIGN	NIL	CS	HARD	CORE	3	1	2	0	6	5
CSH312B-T&P	ADVANCED ANDROID DEVELOPMENT	MOBILE COMPUTING WITH ANDROID	CS	HARD	ELECTIVE	3	0	2	0	5	4
CSH313B-T&P	DATA WAREHOUSE & DATA MINING	NIL	CS								
CSH314B-T&P	MACHINE LEARNING	NIL	CS								
CSH315-B-T&P	N/W SECURITY & CRYPTOGRAPHY	COMPUTER NETWORKS	CS								
CSH316B-T&P	OBJECT ORIENTED SOFTWARE ENGINEERING	SOFTWARE ENGG.	CS								
MOOC	NPTEL COURSES FROM MOOC										
CSH401B-T&P	PROGRESSIVE WEB APPLICATIONS	NIL	CS	HARD	ELECTIVE	3	0	2	0	5	4
CSH402B-T&P	BIG DATA	NIL	CS								
CSH403B-T&P	IMAGE PROCESSING	NIL	CS								
CSH404B-T&P	CLOUD COMPUTING	NIL	CS								
CSH405B-T&P	SOFTWARE TESTING	SOFTWARE ENGG.	CS								
CSH423B-T&P	INTRODUCTION TO BLOCKCHAIN TECHNOLOGY	NIL	CS								
MOOC	NPTEL COURSES FROM MOOC										
ECW312B/MEW315B/CSW317B	ELECTRONIC DESIGN WORKSHOP/ 3-D Software/ AGILE TECHNOLOGIES	NIL	ME/CS/EC	WORKSHOP	ELECTIVE	0	0	3	0	3	1.5
MOOC	NPTEL COURSES FROM MOOC										

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
ECW310B/MEW318B/CSW318B/CSW207B	SENSORS & IOT/ 3 D Printing/ R PROGRAMMING/ IMAGE EDITING & ANIMATION	NIL	EC/ME/CS	WORKSHOP	ELECTIVE	0	0	3	0	3	1.5
MOOC	NPTEL COURSES FROM MOOC										
EDH422	BIOLOGY	NIL	ED	HARD	CORE	2	0	0	0	2	2
CDO302	ENHANCEMENT-IV	NIL	CDC	OUTCOME	COE	0	0	1	0	1	0.5
SPECIALIZATION ELECTIVE BASKET											
CSH324B-T&P	NATURAL LANGUAGE PROCESSING	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
CSH322B-T&P	MODERN ARCHITECTURE PATTERNS	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)						75	17	69	3	31	23.5
CSO320B	SUMMER TRAINING POST 6TH SEMESTER										3

SEMESTER - 7

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSH408B-T&P	MOBILE APP. ANALYTICS	NIL	CS								
CSH409B-T&P	R	NIL	CS								
CSH410B-T&P	VISUAL RECOGINITION	NIL	CS	HARD	ELECTIVE	3	0	2	0	5	4
CSH411B-T&P	CLOUD SECURITY	CLOUD COMPUTING	CS								
CSH412B-T&P	SOFTWARE REQUIREMENT ENGINEERING	SOFTWARE ENGG.	CS								
MOOC	NPTEL COURSES FROM MOOC										
ECH403B-T&P/ MEH403B-T&P/ CSH414B-T&P	WIRELESS SENSOR NETWORK/ OPERATION RESEARCH BY OPTIMISING TECHNIQUE/ INFORMATION RETRIEVAL	NIL	ECE/ME/CSE	HARD	ELECTIVE	3	1	2	0	6	5
MOOC	NPTEL COURSES FROM MOOC										
MCS368B	ENTREPRENEURSHIP	NIL	MC	SOFT	ELECTIVE	2	0	0	0	2	2
MOOC	NPTEL COURSES FROM MOOC										
MCS232/MCS231/PSE301-P/MCH-370	INTRODUCTION TO FINANCE/ BASICS OF ECONOMICS/ESSENTIAL OF PEACE & SUSTAINBILITY/ DIGITAL MARKETING/E-COMMERCE/ENTREPRENEURIAL FINANCE FOR ENGINEERS	NIL	MC	SOFT	ELECTIVE	1	0	2	0	3	2
MOOC	NPTEL COURSES FROM MOOC										
CSW406B/CSW407B/CSW423B	.NET / USER EXPERIENCE/DATA VISUALIZATION WITH TABLEAU	NIL	CS	WORKSHOP	ELECTIVE	0	0	3	0	3	1.5
MOOC	NPTEL COURSES FROM MOOC										
EDS288/EDS289/EDS235	APP. PHILOSOPHY/APP. PSYCHOLOGY/ APP. SOCIOLOGY	NIL	ED	SOFT	ELECTIVE	1	0	2	0	3	2
MOOC	NPTEL COURSES FROM MOOC										
SPECIALIZATION ELECTIVE BASKET											

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSH416B-T&P	COMPUTER VISION & DATA VISUALIZATION	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
CSH422B-T&P	VIRTUALIZATION - CONTAINERS/CLOUD	CLOUD COMPUTING	CS	HARD	ELECTIVE	3	1	2	0	6	5
CSH415B-T&P	CONTINUOUS DELIVERY	NIL	CS	HARD	ELECTIVE	3	1	2	0	6	5
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					10	1	11	0	22	16.5

SEMESTER - 8

SUBJECT CODES	SUBJECT NAME	PRE-REQUISITE	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC/Audit/Outcome)	COURSE TYPE (Core/Elective)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSN413B	PROJECT	NIL	CS	NTCC	CORE	320 TO 360					8
	TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)									0	8

160.5

award of B.Tech CSE degree

*COURSE NATURE	
	Hard course (H): A course having L-T and P and/or O component ; L(Lecture), T(Tutorial), P(Practical) and O(Outcome)
	Soft Course (S): A course aimed at development of a person's emotional, social, ethical, professional and creative potentials. The course shall have L-P and/or O component
	Workshop course(W): A completely 'hands on' course conducted in laboratory, aimed at developing application/ implementation/ designing skills of a person. The course shall have P component
	Audit Course (A):Are University compulsory courses for which no credit is assigned but are mandatory to earn the degree
	Non Teaching Credit Course(N): The course involves no teaching and has P and O component. Shall include projects, seminars, dissertations etc.

**OFFERING DEPARTMENT NAMES		A course shall be assigned credits as under:
EC	DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING	One credit for each lecture hour; One credit for each tutorial hour ; One credit for each Outcome hour; Half credits for each hour of workshop/ laboratory/practical/project session of 3 hours; Half credit for each hour of laboratory or practical or project session of 2 hours **NOTE: FOR ENGG PROGRAMS AS PER AICTE REGULATIONS - For all workshop/lab courses one credit shall be assigned to a 2 hours engagement.**
PH	DEPARTMENT OF PHYSICS	
CS	DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY	
CH	DEPARTMENT OF CHEMISTRY	
MA	DEPARTMENT OF MATHEMATICS	
ME	DEPARTMENT OF MECHANICAL ENGINEERING	
MC	DEPARTMENT OF MANAGEMENT & COMMERCE	
ED	DEPARTMENT OF EDUCATION & HUMANITIES	
LW	DEPARTMENT OF LAW	
MRCFL	MANAV RACHNA CENTRE OF FOREIGN LANGUAGES	

*** Electives are subject to change according to expertise available/ required.

SEMESTER	NO. OF CREDITS
I	19.5
II	21.5
TRAINING	2
III	22.5
IV	22.5
SUMMER TRAINING	2
V	19.5
VI	23.5
SUMMER TRAINING	3
VII	16.5
VIII	8
TOTAL	160.5

PROGRAMME BOOKLET
B.Tech. CSE (CSU01)

(2019-2023)

(Syllabus: Scheme B)

Department of Computer Science and Technology

Manav Rachna University

MANAV RACHNA UNIVERSITY

Vision

To educate students in frontier areas of knowledge enabling them to take up challenges as ethical and responsible global citizens

Mission

- To impart outcome based holistic education
- To disseminate education in frontier areas
- To produce globally competitive, ethical and socially responsible human resources
- To produce human resources sensitive to issues of Environment and Sustainable Development
- To develop Environment and Sustainable development as a thrust area of research and development.

Quality Policy

To continuously learn from the best practices, study role models and develop transparent procedures for empowerment of stakeholders.

Strategic Objectives

- To facilitate, enhance & promote innovation in curriculum design and delivery and have Outcome-oriented Learning Culture.
- To promote Research Environment and Management Practices.
- To enhance the quality of the student learning experience.
- To provide Resources and Infrastructure for Academic Excellence.

DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY

Vision

To be quality conscious, research-centric, and change-oriented technological leader in the relevant areas.

Mission

- To develop and impart knowledge and skills in the field of Computer Science and Engineering.
- To encourage and support the generation and implementation of innovative ideas
- To focus on new techniques, tools, and technology, in an ethical and responsible manner.
- To carry out collaborative interdisciplinary Academic and Research activities with a focus on
- Sustainable Development.
- To create employment-ready human resources.

Program Educational Objectives

- Core Competency: To inculcate analytical, design and implementation skills required to provide software solutions in industry.
- Breadth: To groom graduates to innovate, design and develop products to provide sustainable solutions to contemporary societal and business problems.
- Professionalism: To instill the ability to work in teams, communicate effectively and lead as ethically and socially responsible professionals and entrepreneurs.
- Lifelong Learning: To foster the ability of lifelong learning to constantly adapt to emerging technologies, to pursue higher education and instill life skills for a successful career.

Program Outcomes (PO's)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

<u>Programme Specific Outcomes (PSO's)</u>

1. **PSO1:** Design and develop computer programs and possess acquaintance with emerging technologies and
   open-source platforms in the area of mobile app development, artificial intelligence, machine learning, web development, data analytics, cloud computing , networking , cyber security , gaming and animation to build effective computer-based systems.
2. **PSO2:** Acquire technical competency to deliver computer-based innovative and effective solutions to tackle
   business and societal challenges, for pursuing successful career, entrepreneurship, research and higher studies.

DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY

B.TECH. IN COMPUTER SCIENCE & ENGINEERING

B.TECH. (CSU01)

Semester-I							
Course Code	Course Name	Offering Department	Course Type	Structure			Credits
			(Core/Elective)	L	T	P	
PHH101B-T& P	QUANTAM MECHANICS FOR ENGINEERS	PH	CORE	3	1	2	5
MAH101B-T & P	CALCULUS & LINEAR ALGEBRA	MA	CORE	3	1	2	5
CSH101B-T&P	PROGRAMMING FOR PROBLEM SOLVING USING C	CS	CORE	3	1	2	5
HLS104B / HLS103B	PROFESSIONAL ENGLISH-BASIC/ PROFESSIONAL ENGLISH-ADVANCE	ED	CORE	2	0	2	3
CSW102B	USER INTERFACE-I (HTML5,CSS,JAVASCRIPT,JQUERY)	CS	CORE	0	0	3	1.5
CHH137	ENVIRONMENTAL SCIENCES	CH	CORE	2	0	0	0
TOTAL (L-T-P) /CREDITS)				13	3	11	19.5
SPECIALIZATION ELECTIVE BASKET							
CSH107B-T&P	OVERVIEW OF DATA SCIENCE & MACHINE LEARNING	CS	ELECTIVE	3	1	2	5
CSH105B-T&P	DIGITAL PRODUCT ENGINEERING AND DESIGN THINKING	CS	ELECTIVE	3	1	2	5
Semester-II							
Course Code	Course Name	Offering Department	Course Type	Structure			Credits
			(Core/ Elective)	L	T	P	

Course Code	Course Name	Offering Dept	Course Type	L	T	P	Credits
CHH144-T&P	CHEMISTRY-1	PH	CORE	3	1	2	5
MAH104B-T & P	DISCRETE MATHEMATICS	MA	CORE	3	1	2	5
ECH103B-T&P	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	EC	CORE	3	1	2	5
CSH103B-T&P	DATA STRUCTURES & ALGORITHMS	CS	CORE	3	1	2	5
MEW102B	ENGINEERING GRAPHICS & DRAWING	ME	CORE	0	0	3	1.5
TOTAL (L-T-P) /CREDITS)				12	4	11	21.5

SPECIALIZATION ELECTIVE BASKET							
CSH108B-T&P	PYTHON PROGRAMMING	CS	ELECTIVE	3	1	2	5
CSH106B-T&P	AGILE SOFTWARE DEVELOPMENT	CS	ELECTIVE	3	1	2	5
CSO104B	Post 2nd Sem Summer Training (Mandatory) (Project Management)						2

Semester-III

Course Code	Course Name	Offering Department	Course Type (Core/ Elective)	L	T	P	Credits
CSH201B-T&P	OOPS USING JAVA	CS	CORE	3	1	2	5
CSH202B-T&P	DATABASE MANAGEMENT SYSTEM	CS	CORE	3	1	2	5
CSH209B-T&P	COMPUTER ARCHITECTURE & ORGANISATION	CS	CORE	3	1	2	5
CSH204B-T&P	ANALYSIS & DESIGN OF ALGORITHMS	CS	CORE	3	1	2	5
CSW203B	USER INTERFACE-II (MONGODB,TYPESCRIPT,ANGULAR JS)	CS	CORE	0	0	3	1.5
FLS101/FLS102/FLS103	FOREIGN LANGUAGE (SPANISH/GERMAN/FRENCH)	FL	ELECTIVE	1	1	0	0
CDO201	PROFESSIONAL COMPETANCY ENHANCEMENT-I	CDC	CORE	0	0	1	0.5
RDO201	INTRODUCTION TO RESEARCH	RESEARCH	CORE	0	0	0	0.5

	TOTAL (L-T-P) /CREDITS)			13	5	12	22.5
SPECIALIZATION ELECTIVE BASKET							
CSH212B-T&P	SUPERVISED LEARNING	CS	ELECTIVE	3	1	2	5
CSH210B-T&P	SOFTWARE CRAFTMANSHIP	CS	ELECTIVE	3	1	2	5
Semester IV							
Course Code	**Course Name**	**Offering Department**	**Course Type**	**Structure**			**Credits**
			(Core/ Elective)	**L**	**T**	**P**	
MAH202B-T & P	PROBABILITY & STATISTICS	MA	CORE	3	1	2	5
CSH205B-T&P	ARTIFICIAL INTELLIGENCE	CS	CORE	3	1	2	5
CSH206B-T&P	OPERATING SYSTEM	CS	CORE	3	1	2	5
CSH207B-T&P	SOFTWARE ENGINEERING.	CS	CORE	3	1	2	5
CSW208B	PROGRAMMING FOR PROBLEM SOLVING USING PYTHON	CS	CORE	0	0	3	1.5
FLS105/FLS106/ FLS107	FOREIGN LANGUAGE(SPANIS-H-II/GERMAN-II/FRENCH-II)	FL	ELECTIVE	1	1	0	0
CDO202	PROFESSIONAL COMPETANCY ENHANCEMENT-II	CDC	CORE	0	0	1	0.5
EDS240	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	ED	CORE	1	0	0	0
RDO502	RESEARCH & INNOVATION-1	RESEARCH	CORE	0	0	0	0.5
	TOTAL (L-T-P) /CREDITS)			14	5	12	22.5
SPECIALIZATION ELECTIVE BASKET							
CSH213B-T&P	UnSUPERVISED LEARNING & NEURAL NETWORK	CS	ELECTIVE	3	1	2	5
CSH211B-T&P	MODERN WEB AND MOBILE FRAMEWORKS	CS	ELECTIVE	3	1	2	5
CSO219B	SUMMER TRAINING POST 4TH SEMESTER						2
Semester-V							

Course Code	Course Name	Offering Department	Course Type (Core/ Elective)	Structure			Credits
				L	T	P	
CSH301B-T&P	COMPUTER NETWORKS	CS	CORE	3	0	2	4
ECH308B-T&P	DIGITAL ELECTRONICS & MICROCONTROLLER	EC	CORE	3	1	2	5
CSW308B	ADVANCED JAVA	CS	CORE	0	0	3	1.5
CSH303B-T&P/ CSH304B-T&P/ CSH305B-T&P/ CSH306B-T&P/ CSH307B-T&P/ MOOC	MOBILE COMPUTING WITH ANDROID/ ADVANCED DATABASE MANAGEMENT SYSTEMS/ NEURAL NETWORK & FUZZY LOGIC/ SYSTEM NETWORK & ADMINISTRATION/ SOFTWARE PROJECT MANAGEMENT/MOOC	CS	ELECTIVE	3	0	2	4
CHS234/ CSS325B/ ECS306B/ MOOC	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT/ GREEN COMPUTING/ E-WASTE MANAGEMENT/ MOOC	CH/CS/EC	ELECTIVE	1	0	2	2
LWS323/LWS325/ MOOC	CYBER LAW/ LAW RELATING TO INTELLECTUAL PROPERTY RIGHTS / MOOC	LW	ELECTIVE	2	0	0	2
CDO301	PROFESSIONAL COMPETANCY ENHANCEMENT-III	CDC	CORE	0	0	1	0.5
RDO601	RESEARCH & INNOVATION-II	RESEARCH	CORE	0	0	0	0.5

Course Code	Course Name	Offering Department	Course Type	L	T	P	Credits
	TOTAL (L-T-P) /CREDITS)			12	1	12	19.5
SPECIALIZATION ELECTIVE BASKET							
CSH323B-T&P	ADVANCED NEURAL NETWORK	CS	ELECTIVE	3	1	2	5
CSH321B-T&P	DEVOPS AND TEST AUTOMATION	CS	ELECTIVE	3	1	2	5

Semester-VI

Course Code	Course Name	Offering Department	Course Type (Core/ Elective)	Structure			Credits
				L	T	P	
CSH310B-T&P	COMPUTER GRAPHICS & MULTIMEDIA	CS	CORE	3	1	2	5
CSH311B-T&P	THEORY OF AUTOMATA & COMPILER DESIGN	CS	CORE	3	1	2	5
CSH312B-T&P/ CSH313B-T&P/ CSH314B-T&P/ CSH315-B-T&P/ CSH316B-T&P/ MOOC	ADVANCED ANDROID DEVELOPMENT/DATA WAREHOUSE & DATA MINING/MACHINE LEARNING/ NETWORK SECURITY & CRYPTOGRAPHY/ OBJECT ORIENTED SOFTWARE ENGINEERING/ MOOC	CS	ELECTIVE	3	0	2	4
CSH401B-T&P/ CSH402B-T&P/ CSH403B-T&P/ CSH404B-T&P/ CSH405B-T&P/ MOOC	PROGRESSIVE WEB APPLICATIONS/ BIG DATA/IMAGE PROCESSING/ CLOUD COMPUTING/ SOFTWARE TESTING/ MOOC	CS	ELECTIVE	3	0	2	4
ECW312B/ME W315B/CSW317B/ MOOC	ELECTRONIC DESIGN WORKSHOP/ 3-D SOFTWARE/ AGILE TECHNOLOGIES/ MOOC	ME/CS/EC	ELECTIVE	0	0	3	1.5
ECW310B/ME W318B/CSW318B/CSW207B/ MOOC	SENSORS & IOT/ 3 D PRINTING/ R PROGRAMMING / IMAGE EDITING & ANIMATION/ MOOC	EC/ME/CS	ELECTIVE	0	0	3	1.5
EDH422	BIOLOGY	ED	CORE	2	0	0	2
CDO302	PROFESSIONAL COMPETANCY ENHANCEMENT-IV	CDC	CORE	0	0	1	0.5

				11	2	13	23.5
TOTAL (L-T-P) /CREDITS)							
SPECIALIZATION ELECTIVE BASKET							
CSH324B-T&P	**NATURAL LANGUAGE PROCESSING**	**CS**	**ELECTIVE**	3	1	2	5
CSH322B-T&P	**MODERN ARCHITECTURE PATTERNS**	**CS**	**ELECTIVE**	3	1	2	5
CSO320B	**SUMMER TRAINING POST 6TH SEMESTER**						3
Semester-VII							

Course Code	Course Name	Offering Department	Course Type	Structure			Credits
			(Core/ Elective)	**L**	**T**	**P**	
EDS288/EDS289 / EDS290/MOOC	**APP. PHILOSOPHY/APP. PSYCHOLOGY/ APP. SOCIOLOGY/ MOOC**	**ED**	**ELECTIVE**	1	0	2	2
CSH408B-T&P/ CSH409B-T&P/ CSH410B-T&P/ CSH411B-T&P/ CSH412B-T&P/ MOOC	**MOBILE APP. ANALYTICS/ BUSINESS INTELLIGENCE & ANALYTICS WITH R/ CONVOLUTIONAL NEURAL NETWORK FOR VISUAL RECOGINITION / CLOUD SECURITY/ SOFTWARE REQUIREMENT ENGINEERING/MOOC**	**CS**	**ELECTIVE**	3	0	2	4
ECH403B-T&P/ MEH403B-T&P/ CSH414B-T&P/MOOC	**WIRELESS SENSOR NETWORK/ OPERATION RESEARCH BY OPTIMISING TECHNIQUE/ INFORMATION RETRIEVAL/MOOC**	**ECE/ME/CSE**	**ELECTIVE**	3	1	2	5
MCS368	**ENTREPRENEURSHIP**	**MC**	**ELECTIVE**	1	0	2	2
CSW406B/CSW407B/MOOC	**INTRODUCTION TO .NET / USER EXPERIENCE/MOOC**	**CS**	**ELECTIVE**	0	0	3	1.5

MCS232/MCS231/PSE301-/MOOC	INTRODUCTION TO FINANCE/ BASICS OF ECONOMICS/ ESSENTIAL OF PEACE & SUSTAINBILITY/MOOC	MC	ELECTIVE	1	0	2	2
LWS324	INDIAN CONSTITUTION	LW	CORE	1	0	0	0
TOTAL (L-T-P) /CREDITS)				8	1	11	16.5

SPECIALIZATION ELECTIVE BASKET							
CSH416B-T&P	COMPUTER VISION & DATA VISUALIZATION	CS	ELECTIVE	3	1	2	5
CSH422B-T&P	VIRTUALIZATION - CONTAINERS/CLOUD	CS	ELECTIVE	3	1	2	5
CSH415B-T&P	CONTINUOUS INTEGRATION AND CONTINUOUS DELIVERY	CS	ELECTIVE	3	1	2	5

Semester-VIII							
SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	COURSE TYPE (Core/Elective)	L	T	P	NO. OF CREDITS
CSN413B	PROJECT	CS	CORE	320 TO 360 HOURS			8
TOTAL (L-T-P) /CREDITS)				4			8

Total Credits Scheme

S. No.	Semester	Contact Hours	Credits
1	I	27	19.5
2	II	27	21.5
3	Summer Training (Post II Sem)		2
4	III	31	22.5
5	IV	32	22.5
6	Summer Training (Post IV Sem)		2
7	V	26	19.5
8	VI	26	23.5
9	Summer Training (Post 6th Sem)		3
10	VII	23	16.5
11	VIII	8	8
	Total		160.5

Semester-I

Course Code	Course Name	Offering Department	Course Type	Structure			Credits
			(Core/Elective)	L	T	P	
PHH101B-T& P	QUANTAM MECHANICS FOR ENGINEERS	PH	CORE	3	1	2	5
MAH101B-T & P	CALCULUS & LINEAR ALGEBRA	MA	CORE	3	1	2	5
CSH101B-T&P	PROGRAMMING FOR PROBLEM SOLVING USING C	CS	CORE	3	1	2	5
HLS104B / HLS103B	PROFESSIONAL ENGLISH-BASIC/ PROFESSIONAL ENGLISH-ADVANCE	ED	CORE	2	0	2	3
CSW102B	USER INTERFACE-I (HTML5,CSS,JAVASCRIPT,JQUERY)	CS	CORE	0	0	3	1.5
CHH137	ENVIRONMENTAL SCIENCES	CH	CORE	2	0	0	0
TOTAL (L-T-P) /CREDITS)				13	3	11	19.5
SPECIALIZATION ELECTIVE BASKET							
CSH107B-T&P	OVERVIEW OF DATA SCIENCE & MACHINE LEARNING	CS	ELECTIVE	3	1	2	5
CSH105B-T&P	DIGITAL PRODUCT ENGINEERING AND DESIGN THINKING	CS	ELECTIVE	3	1	2	5

DETAILED SYLLABUS

CSU01- Semester-I

Course Title/ Code	**Quantum mechanics for engineers** (**PHH101B-T**) & (**PHH101B-P**)
Course Type	Core (Allied)
Course Nature	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	1. To apply the concepts of quantum phenomena on physical systems. 2. To apply quantum mechanics on one- and three-dimensional physical problems. 3. To understand the basic concepts of quantum computing.

Course Outcome	**Mapping**
CO1: Discuss and Interpret experiments that reveal the wave properties and particle properties of matter so as to bring about the difference that motivates in developing the old classical mechanics with a wave/particle equation in Quantum Mechanics	Employability & Skill Development
CO2: Understand the central concepts and principles in quantum mechanics, such as the Schrodinger wave equation, the wave function and their statistical interpretation so as to compare the wave nature and particle nature of light using the uncertainty principle and applying this to the concept of wave packets	Employability & Skill Development
CO3: Apply the Schrodinger wave equation for explaining various physical phenomena and simultaneously determining the energy-eigen values for one to three dimensional systems so as to further solve problems related to analyzing the H-Atoms and its properties.	Employability & Skill Development
CO4: Compare and review of classical gates with those of quantum gates, describe the basic building blocks of quantum computing and develop the quantum gates based on the requirement of the circuit/projects	Employability & Skill Development
CO5: Demonstrate an ability to conduct investigations of practical/technical issues consistent with their level of knowledge and understanding while designing/performing/resolving the experiments to develop their individual capabilities and representing the collective team work so as to demonstrate an ability	Employability & Skill Development

to analyze data and reach a valid conclusion	

Section A

Introduction to Quantum mechanics: Qualitative description of black body radiation, Compton effect and photo-electric effect. Uncertainty principle. Wave nature of Particles, phase and group velocity, Time-dependent and time independent Schrodinger equation for wavefunction, Born interpretation, probability current, Expectation values. Mathematical Preliminaries and introduction to quantum mechanics: Wave nature of particles and the Schrodinger equation. Complex numbers, Linear vector spaces, inner product, operators, eigenvalue problems, Hermitian operators.

Section B

Applications of Schrodinger equation (one dimensional): Solution of stationary-state Schrodinger equation for one dimensional problem– particle in a box, particle in attractive delta-function potential, linear harmonic oscillator. Numerical solution of stationary-state Schrodinger equation for one dimensional problem for different potentials. Scattering from a potential barrier and tunneling; related examples like alpha-decay, field ionization and scanning tunneling microscope (qualitative description)

Section C

Applications of Schrodinger equation (Three dimensional): Three-dimensional problems: particle in three-dimensional box and related examples, Angular momentum operator, Rigid Rotor, Hydrogen atom ground-state and orbitals, interaction with magnetic field and spin, Numerical solution stationary-state radial Schrodinger equation for spherically symmetric potentials.

Section D

Introduction to Quantum Computing: Difference between conventional and quantum computing, Mathematical Preliminaries to Quantum Computing: notation, Matrix Product, Kronecker Product, Qubits and quantum state, Quantum Gates, Basis states and superposition, Product states and entanglement, Notation for quantum circuits.

List of Experiments

1. Photoelectric effect experiment
2. Frank-Hertz experiment
3. Hall effect
4. At least 4-5 experiments using computer, based on the syllabus.
5. Black body radiation.
6. Tunneling diode characteristic.
7. Ultra-Thin film characteristic.

Text Books

1. David Griffiths, Introduction to Electrodynamics
2. Quantum Physics by Ishwar singh Tyagi (Pearson Publication)

Reference Books

1. Halliday and Resnick, Physics
2. W. Saslow, Electricity, magnetism and light

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	3	3	3	3	-	-	-	-	-	-
CO2	3	3	-	-	3	3	-	3	3	2	-	2	-	-
CO3	3	3	3	3	2	-	-	3	3	2	-	2	-	2
CO4	3	3	3	2	3	-	2	3	3	3	3	-	-	3
CO5	3	3	3	3	3	-	3	3	-	-	-	3	-	-

Course Title	(Calculus and Linear Algebra) (MAH101B-T) & (MAH101B-P)
Course Type	Core (Allied)
Course Nature	Hard
L-T-P structure	(3-1-2)
Credits	5
Course Objective	The objective of this course is to familiarize the prospective engineers with techniques in basic calculus and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines

Course Outcome	Mapping
CO1: Apply the concept of differentiation, partial differentiation, curvature and solve the problems	Employability & Skill Development
CO2 Apply the concepts of integral and multiple integral and find the area and volume of the problems arising in different engineering problems	Employability & Skill Development
CO3: Describe the vector spaces and different types of vector spaces, geometrical representation and construction of new vector space.	Employability & Skill Development
CO4: Apply the concept of eigenvalues and eigenvectors, inner product and Gram Schmidt theorem in solving the real-world problem.	Employability & Skill Development
CO5: Solve mathematical problems using software (Octave/MATLAB).	Employability & Skill Development

Section – A

Calculus: Curvature (Cartesian, Parametric and Polar coordinates), Curvature at origin, Centre of curvature, Evolutes and involutes, Higher order partial order derivative, Homogeneous function and Euler's theorem, Differentiation of composite functions, Taylor's theorem for function of several variables.

Section – B

Applications of definite integrals to evaluate surface areas and volumes of revolutions, Double integration, properties of double integration, Evaluation of double integral (Cartesian and Polar coordinates), Change of variables, change of order, Area and volume.

Section – C

Vector spaces- 1: Inverse of a matrix (Gauss elimination and Gauss-Jordan elimination), rank of a matrix, Linear systems of equations, Cramer's Rule., Vector Space, linear dependence and independence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse

of a linear transformation, rank nullity theorem, composition of linear maps, Matrix associated with a linear map.

Section – D

Vector spaces-2: Eigenvalues, eigenvectors, symmetric, skew-symmetric and orthogonal Matrices, Eigen bases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

Lab Exercise (Software used Octave / scilab / MATLAB / Altair)
- Introduction to mathematical software and use of some simple commands.
- Introduction to some of the fundamentals of mathematical software's: Variables, operators, expressions and Arrays (including vectors and matrices)
- Introduction to graphics: Basic Two-Dimensional Graphs, Labels, Multiple plots on the same axes, Line styles, Markers and color, Axis limits and Subplots.
- Curvature of Cartesian, Parametric and Polar coordinates
- Higher order partial derivative
- Multiple Integration and applications of integrations
- Rank of a matrix, Inverse of a Square matrix and to reduce a matrix into Normal Form.
- Solution e the system of simultaneous linear equations. To find the Eigen values and Eigen vectors of a square matrix.
- Find Basis and Dimension
- Diagonalizations of Matrix

Suggested Text/Reference Books

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

3. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

7. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	2	2	-	2	-	-
CO2	3	3	3	3	2	-	-	-	3	2	-	3	3	-
CO3	3	3	2	3	3	-	-	-	3	3	-	3	3	-
CO4	3	3	3	2	2	-	-	-	2	3	-	2	-	-
CO5	3	3			2	-	-	-	3	2	-	2	2	-

Course Title/ Code	Programming for Problem Solving Using C (CSH101B-T & CSH101B-P)
Course Type	Core (Departmental)
Course Nature	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	Students are able to construct a program of moderate complexity from a specification

Course Outcome	Mapping
CO1: Analyze Test Driven Development approach to design programs.	Employability & Skill Development
CO2 Apply basic Structure of C-Programming, declaration and usage of variables, iteration, selection and use of functions on open-source platform	Employability & Skill Development
CO3: Analyze problems by breaking them down into component parts using the concept of arrays, structures, union and enumeration.	Employability & Skill Development
CO4: Implement Programs using pointers with structures, arrays and perform pointer arithmetic.	Employability & Skill Development

Section A

Programming and UNIX

Introduction to Programming, test driven development, Scratch: Introduction, statements, expressions, conditions, selection, iteration, variables, functions, arrays. UNIX: Basic commands- pwd, ls, cd, rm, cat, less, mkdir, rmdir; permissions, root. C language: statements, expressions, conditions, selection iteration, variables, functions, arrays.

Section B

Applying programming constructs
Students will learn how to write programs that satisfy unit tests. The instructor will build the unit tests, demonstrating how to break a problem down into smaller components. In the labs and homework, students will construct programs that satisfy the unit tests. Students become familiar with the constructs of the C programming language.
Moving to C: Data Types, constants, and variables, Statements, Expressions, Conditions, Selection, iteration, Functions and recursion
Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, structured Programming

Arrays; One dimensional array: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; Null terminated strings as array of characters, Standard library string functions

Introduction to Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type, Function call, Block structure, passing arguments to a Function: call by reference, call by value, Recursive Functions, arrays as function arguments.

Section C

Practical programming

During the third quarter of the class, students will begin building their own programs by decomposing problems into smaller tasks and writing unit tests that will check to see that the program accurately accomplishes the task using Test Driven Development. They will then write the program that satisfies their own unit tests. Students will learn to apply the constructs of the C programming language to create programs.

Students will learn to apply these programming techniques: Structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions, Break, Continue and Goto, Type Conversion; Enumerations; Macros. Students will be able to use these techniques to develop programs

Section D

Memory Management and Abstraction

During the final quarter, students will be introduced to dynamic memory allocation and dynamic data structures including: dynamic arrays. They will consolidate their ability to use the C programming techniques they have learned in the earlier sections.

Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation,

Software Configuration Management, Modules, CUnit, GIT, SCRUM, MAKE. Dynamic Memory Allocation.

LIST OF EXPERIMENTS:

1. Scratch: Covering Concepts of
     I.   Sequential Statements
     II. Variables
     III. Blocks
2. Unix Commands: pwd, mkdir, cd, ls, less, touch, cp,move, cat, rm, rmdir –r etc.
3. Moving to C Using nano and gcc.
4. Project on Calculator Using Agile Methodology, Nano, Cunit, Git, Scrum , Agile Methodology, Nano, Gcc, Make. Covering Conepts :
     I.   Statements
     II. Functions
     III. Arrays
     IV. Structures
     V.   Pointers
     VI. File Handling.

Books
   1. The C Programming Language, Brian Kernighan and Dennis Ritchie

2. The Unix Programming Environment
3. Pro Git

Help Pages
1. Eclipse C/C++ Development Guide

Wikipedia Pages
1. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
2. Unit testing, http://en.wikipedia.org/wiki/Unit_testing

Tool Web Sites
1. Eclipse, https://eclipse.org/users/
2. Git, http://git-scm.com/
3. GCC, https://gcc.gnu.org/onlinedocs/gcc-4.9.3/gcc/
4. Make
5. Unix

Web tutorials
1. Harvard's CS50, https://courses.edx.org/courses/HarvardX/CS50x3/2015/info

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		3		3		2	3			2	2
CO2	3	3	3		3			3	3	2	2	3	3	2
CO3	3	3	3		3	3	3	3	3	3	2	2	3	3
CO4	3	3	3		3	2		3	3	3	3	3	3	3

Course Title/ Code	Professional English-Advanced (HLS103B)
Course Type	Core (Allied)
Course Nature	Soft
L-T-P Structure	(2-0-2)
Credits	3
Objectives	The students (A) will be able to articulate (B) communication skills and develop talent (C) for increased understanding of corporate requirement (D).

Pre requisites: Knowledge of fundamental grammar along with **LSRW** (**L**istening, **S**peaking**, R**eading & **W**riting).

Learning Outcomes: Course Learning Outcomes: At the end of the semester the students will be able:

- To communicate articulately.

- To show the spirit of cohesiveness and art of collaborative approach through activities.

- To exhibit the substantive writing skills.

- To demonstrate the procedure of debating skills.

- To display the developed critical aptitude.

Course Outline:

Course Outcome	Mapping
CO1: To communicate articulately.	Employability & Skill Development
CO2 To reflect the spirit of cohesiveness and art of collaborative approach through activities.	Employability & Skill Development
CO3: To exhibit the substantive writing skills.	Employability & Skill Development
CO4: To demonstrate the procedure of debating skills.	Employability & Skill Development
CO5: To display the developed critical aptitude.	Employability & Skill Development

Section – A
Lexis & Semantics: Vocabulary Building: The Concept of Word Formation, Root Words from Foreign Languages and their use in English, and Standard abbreviations.
Sentence: Parts and Kinds, Simple, Compound & Complex Sentences, Sentence Structures, Use of Phrase & Clause in Sentences.
Section – B
Oral Communication: Importance of Speech Sounds, Organs of Speech, Vowel Sounds, Consonant Sounds, IPA Symbols, Phonetic Transcription, Intonation, Word Stress, Sentence Stress, Pronunciation,

Listening Comprehension, Speech Training through Everyday Situations, Conversations & Dialogues, Interviews.

Section – C

Presentation Skills: Communication, Process of Communication, Basic forms of Communication, Barriers & Filters of Communication, Body Language and Paralanguage, Gestures and Postures, Kinesics, Proxemics, Importance of Body Language in Presentation, Etiquette of the Telephone Handling and Business Meetings, Hearing and Listening, Essentials of Effective Listening, Importance of Effective Listening, Visual Presentation – How to prepare slide presentation, Formal Presentation.

 Section – D

Technical Writing: Nature & Style of Sensible Writing, Writing Introduction & Conclusion, Creating

Coherence, Organizing Principles of Paragraphs in Documents, Techniques of Writing Precisely, Writing Practices: Comprehension, Paraphrasing, Essay Writing & Importance of Proper Punctuation.

Suggested Text Book Reading:

CIEFL, Hyderabad. Exercises in Spoken English Parts I-III. Oxford University Press.
Koneru, Aruna. Professional Communication. Mcgraw Hills Education Pvt. Ltd.
Kumar, Sanjay and Pushpa Lata. Oxford University Press, 2011. Print.
Lyons, Liz Hamp and Ben Hearsly. Study Writing. Cambridge University Press. 2006. Print.
Swan, Michael. Practical English Usage. OUP, 2014. Print.
Wood, F T. Remedial English Grammar. Macmillan, 2007. Print.
Zinsser, William. On Writing Well. Harper Resource Book, 2006. Print.
Subhrmania, T. Bala. A Textbook of English Phonetics for Indian Students.: Macmillan.
R C Sharma & Krishna Mohan. Communication. McGraw Hill Education, Chennai, 2017.
Effective Technical Communication. M Ashraf Rizvi. McGraw Hill Education, Chennai, 2018.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	3	3	3	-	3	-	3
CO2	-	-	-	-	-		2	3	3	3	-	3	-	-
CO3	-	-	-	-	-	3	3	3	3	3	-	3	-	3
CO4	-	-	-	-	-	-	2	3	3	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	1	-	2

Course Title/ Code	Professional English-Basic (HLS104B)
Course Type	Core (Allied)
Course Nature	Soft
L-T-P Structure	(2-0-2)
Credits	3
Objectives	The students (A) will be able to imbibe (B) the basics of communication skills & English Language and literature (C) by understanding the need of industry (D).

Pre-requisite:

Knowledge of elementary grammar and basic nuances of oral and written English communication skills.

Course Learning Outcomes: At the end of the semester the students will be able:

- To demonstrate the basic skills of effective communication.

- To build an elementary understanding of form, meaning and use of words in varied discourses.

- To equip with fundamental writing skills.

- To show the essentials of debating skills.

- To exhibit creative thinking.

Course Outline

Course Outcome	Mapping
CO1: To demonstrate the basic Skill Developments of effective communication.	Employability/Skill Development
CO2 To develop an elementary understanding of form, meaning and use of words in varied discourses.	Employability/Skill Development
CO3: To exhibit the substantive writing Skill Developments. To demonstrate fundamental writing Skill Developments.	Employability/Skill Development
CO4 To showcase the essentials of debating Skill Developments.	Employability/Skill Development
CO5: To exhibit creative thinking.	Employability/Skill Development

Section – A

Communication: Communication: Introduction to Business Communication, Basic forms of communication – Verbal & Non-Verbal Communication, Process of Communication, Principles of Effective Communication, 7 Cs of Communication, Media of Communication, Types of Communication, Barriers of Communication, Formal and Informal Communication Network, Grapevine Communication, Miscommunication, Steps for improving communication, Impact of cross-cultural communication.

Section – B

Grammar: Parts of Speech, Subject-Verb Agreement, Tenses, Sentence: Kinds & Parts, Active & Passive Voices, Direct & Indirect Narration, Spotting the Errors.

Section – C

Lexis: Homonyms, Homophones, Homographs, Words often confused, One-word Substitutes, Synonyms and Antonyms, Foreign Words, Phrasal Verbs & Idioms and Phrases.

Section – D

Technical Writing: ABC of Writing, 7 Cs of Writing Skills, Notice Writing, Situation Writing, Précis Writing, Report Writing, Email Writing & Email Etiquettes, Paraphrasing, Comprehension, Essay Writing.

Suggested Text Book Reading:

Wren and Martin: High School English Grammar and Composition A Text Book for Indian Students. S.Chand and Co. ed. Paperback 2018.

A Practical Course for Developing Writing Skills in English. J K Gangal: PHI Learning Pvt.

McMillan English Check your Vocabulary. MaCarthy: Foundation Books, OUP, 2007.

English Grammar, Competition and Correspondence. M.A. Pink and A.C. Thomas: S. Chand and Co.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	3	-	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	2	-	2
CO3	-	-	-	-	-	-	-	-	3	3	-	3	3	3
CO4	-	-	-	-	-	-	-	-	2	3	-	2	2	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	3	-

Course Title/ Code	USER INTERFACE-I (HTML5, CSS, JAVASCRIPT, JQUERY) (CSW102B)
Course Type:	**Core** (Departmental)
Course Nature:	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5
Objectives	Students (A) would be able to understand and implement (B) components(C) constituting a computer (D).

Course Outcome	Mapping
CO1: Demonstrates the fundamentals of HTML,CSS and JavaScript to create web pages (Knowledge)	Employability & Skill Development
CO2: Design static web pages layouts with a good aesthetic sense of HTML and CSS structure and semantic components(Comprehension & Applications)	Employability & Skill Development
CO3: Develop interactive web pages using the JavaScript components (Application)	Employability & Skill Development
CO4: Apply the concepts to design websites/portfolios using HTML, CSS, and JavaScript for a real world problem majorly focused on SDGs (Application)	Employability & Skill Development

Section A

INTRODUCTORY CONCEPTS: What Is HTML5, Structure of a Web Page: HTML5 DOCTYPE, Page Encoding, HTML5 Markup, New and Updated Elements, Structural Elements (html, head, body, div, br, hr, p, text formatting, text styles, layouts, marquee, lists: ordered, unordered and definition lists,), New Attributes, Deprecated Elements and Attributes.

HTML 5.0 Form, Graphics & Media: HTML5 DOM, Form: new input types & attributes, form validation, HTML canvas and SVG: Drawing shapes, Text & images, working with pixels, embedding media**:** Audio and Video based On Plug-in, New Audio/Video Markup, Attributes and Methods, Audio/Video Events & Controls, Plug-ins in HTML inserting YouTube videos.

Section B

CSS & CSS3: Introduction to CSS, Syntax, Selectors, Pseudo classes, Applying CSS to backgrounds, Text, Fonts, Links, Lists, Tables, Box Model: Border, Margin, Padding, Dimension, Display, Positioning, Align, CSS to Images and image Opacity, CSS Media Types, CSS Attr Selectors.

Section C

CSS3: Introduction**,** Rounded Corners, Border Images, Backgrounds, Colors, Gradients, Shadows, Fonts and text effects, 2D transforms, 3D Transforms, Transitions & Animations.

JAVASCRIPT: Advantages of JavaScript; writing JavaScript into HTML; Attaching an External JavaScript File, Working with Data Types and Variables, operators and expressions; arrays.

JAVASCRIPT: Functions in JavaScript: Creating & Calling Functions, Sending Parameters to a Function; condition checking, loops, If Structure, If Else Structure, For Loop, While Loop, dialogue boxes, Event Handling.

List of labs:
1. HTML5.0 Basic Tags
2. HTML5.0: DOM & Forms
3. HTML5.0: Canvas &SVG
4. HTML5.0: Plugins
5. CSS
6. CSS
7. CSS
8. CSS
9. CSS
10. JavaScript
11. JavaScript
12. JavaScript
13. JavaScript
14. JavaScript
15. Minor Project

Text Books:

Pro HTML5 and CSS3 Design Patterns Paperback – 2012 by Dionysios Synodinos, Michael Bowers, Victor Sumner

2. "Programming JavaScript Applications: Robust Web Architecture with Node, HTML5, and Moderns JS Libraries"

3. Dive into HTML5 by Mark Pilgrim.

Reference Book:
1. "JavaScript for Kids: A Playful Introduction to Programming" by Nick Morgan,.

2. HTML5 Guidelines for Web Developers by Klaus Förster.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		1		3					3		3	3	
CO2	3		3	3			3			3		3	3	3
CO3	3		3		3		2	3		3		3		3
CO4	3	3	3	3	3	3		2	3	3		3	3	3

Course Title Code	Environmental Sciences (CHH137)
Course Type	Audit (Allied)
Course Nature	Soft
L-T-P Structure	(2-0-0)
Credit	0
Objectives	1. to make the student identify the areas of environmental degradation 2. to make the student identify the impact of environmental degradation on the surroundings 3. To apply the concepts such as sustainable development in real life. 4. To help the engineering student to correlate his field with various aspects of the environment. .

Course Outcome	Mapping
CO1: Explain the multidisciplinary dimension of environmental issues	Employability & Skill Development
CO2 Explain the environmental issues and demonstrate potential solutions	Employability & Skill Development
CO3: Present the various types of organisms and draw inferences about their interactions in different environmental settings	Employability & Skill Development
CO4: Explain the principles governing the interactions between social and environmental factors	Employability & Skill Development
CO5: Create an environmental awareness event/article/campaign/eco-friendly product	Employability & Skill Development

SECTION A
Unit 1: Multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness (OC)

Unit 2: Renewable and Non-Renewable Resources

Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources: Growing energy needs, renewable and non-renewable energy sources, **use of alternate energy sources. Case studies (OC).**

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. (OC)

Equitable use of resources for sustainable lifestyles

SECTION B

Unit 3: Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem.

- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the
- Following ecosystem: -
  - Forest ecosystem
  - Grassland ecosystem
  - Desert ecosystem
  - **Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (OC)**

Unit 4: Biodiversity and its conservation

• **Introduction** – Definition: genetic, species and ecosystem diversity.
• Biogeographical classification of India
  - **Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic And option values (OC)**
  - Biodiversity at global, National and local levels.
  - India as a mega-diversity nation
  - Hot-sports of biodiversity.
  - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
  - Endangered and endemic species of India
  - **Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity (OC).**

SECTION C

Unit 5: Environmental Pollution

Definition
• Cause, effects and control measures of: -
  - Air pollution
  - Water pollution
  - Soil pollution
  - Marine pollution
  - Noise pollution
  - Thermal pollution
  - Nuclear hazards
  - Solid waste Management: Causes, effects and control measures of urban and Industrial wastes. (OC)

- Role of an individual in prevention of pollution. (OC)
- Pollution case studies. (OC)
- Disaster management: floods, earthquake, cyclone and landslides.

Unit 6: Social Issues and the Environment

• From Unsustainable to Sustainable development
• Urban problems related to energy
• Water conservation, rain water harvesting, watershed management
• Resettlement and rehabilitation of people; its problems and concerns. Case Studies
• Environmental ethics: Issues and possible solutions.
• Climate change, global warming, acid rain, ozone layer depletion, nuclear Accidents and holocaust. Case Studies (OC).
• Wasteland reclamation.
• Consumerism and waste products.
• Environment Protection Act.
• Air (Prevention and Control of Pollution) Act (OC)
• Water (Prevention and control of Pollution) Act (OC)
• Wildlife Protection Act
• Forest Conservation Act
• Issues involved in enforcement of environmental legislation (OC).
• Public awareness (OC).

SECTION D

Unit 7: Human Population and the Environment

• Population growth, variation among nations.
• Population explosion – Family Welfare Programme

• Environment and human health.

• Human Rights (OC).
• Value Education (OC).
• HIV/AIDS (OC).
• Women and Child Welfare (OC).
• Role of Information Technology in Environment and human health.
• **Case Studies (OC).**

*OC = Outcome component

Field work
• Visit to a local area to document environmental assets river/ forest/grassland/hill/mountain
• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
• Study of common plants, insects, birds.
• Study of simple ecosystems-pond, river, hill slopes, etc.
● Any socially relevant problem identification and proposing its possible solution

NOTE: Manav Rachna has adopted five villages, where students would be visiting, will identify the socially relevant issues and work on to provide possible solution.

	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	3	2	1	2	-	2	-	-
CO2	3	-	-	-	-	2	3	2	2	2	-	2	-	2
CO3	3	2	2	-	2	2	2	2	2	3	-	2	-	-
CO4	3	-	-	-	-	2	3	2	2	2	-	2	-	-
CO5	3	-	-	-	-	2	3	3	3	3	-	3	-	2

Course Title/Code	Overview Of Data Science & Machine Learning (**CSH107B-T**) & (**CSH107B-P**)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	To provide the students with an introductory and broad treatment of the field of statistics and linear algebra.

Course Outcome	Mapping
CO1: Students would be able to understand the basic concepts of Data Science & Machine Learning Concepts and their application in modern context.	Employability
CO2: Students would be able to apply the basic statistical concepts for solving various problems	Skill development
CO3: Students would be able to distinguish between various probability distributions and apply the concepts for the solution of related problems	Employability
CO4: Students would be able to learn the essential tools of matrices and linear algebra including linear transformations, eigen values, diagonalization and orthogonalization	Skill development

Section A

Overview of DS & ML:

Foundations of DSML: Data Basics, Data omnipresent, Sources of data, Introduction Data Science, History of Data Science, Types of data, Data explosion, Increase in Storage Capacities, Data Processing Abilities, Emerging Data Formats, Data Availability, Data Classification, Organization of structured data, Structured data, Semi-structured data, Comparison Types, Data essentials, Know the history, How Big is Data, Sources of Big Data, Characteristics of Big Data

Basic Statistical Concepts: Introduction to Statistics, Classification of Statistical Methods, Descriptive Statistics, Inferential Statistics, Scale of Measurements (Nominal, Ordinal, Ratio and Interval), Nominal Scales, Nominal Scales, Ratio Scales, Mean, Median, Mode, Measures of Variability/Spread, range, Quartiles and Interquartile Range, Standard Deviation (SD), Measures of Shape, Skewness, Kurtosis.

Section B

Probability Theory: Definitions of probability theory, independent events, mutually exclusive events, conditional probability, Bayes' Theorem, Discrete probability distribution (Poisson Distribution, Bernoulli Distribution, and Binomial Distribution), Continuous probability distribution, normal distribution, Covariance and Correlation.

Section C

Matrices: Elementary transformations, Elementary matrices, inverse using elementary transformations, Rank of a matrix, Normal form of a matrix, Linear dependence and independence of vectors, Consistency of linear system of equations, Eigen Values and Eigen vectors, Properties of Eigen values (without proof), Cayley Hamilton theorem, Diagonalization of a matrix.

Section D

Linear Algebra: Introduction to linear algebra, vector space, basis, dimension, Linear Transformation, Orthogonal transformation, Orthogonal Matrix, Singularity of Matrix, Matrix factorization and types like LU, QR and SVD.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	2	-	3	-	-
CO2	3	3	3	3	2	-	-	-	-	3	-	2	3	3
CO3	3	3	3	2	3	-	-	-	-	3	-	2	-	3
CO4	3	3	3	3	2	-	-	-	-	2	-	3	3	3

Course Title/Code	Digital product Engineering & Design Thinking (CSH105B-T) & (CSH105B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	Student would be able to learn product engineering concepts and apply basics of these topics to study various business in the industry.

Digital Product Engineering & Design Thinking

Course Outcome	Mapping
CO1: Understand Digital transformation, innovation, and its need. Methodologies and lean startups.	Entrepreneurship
CO2: Study and compare Business Model Canvases, product development	Skill development
CO3: Analyze various product management roles & responsibilities.	Entrepreneurship
CO4: Design business model canvases and design think new business ideas.	Skill development
CO5: Review User Experience design, prototyping and digital marketing	Skill development

Section A
Digital Transformation Engineering

Definition of Digital Transformation (DT), Evolution of Digital transformation, The Digital Era, Why DT? The need for DT, Factors influencing Digital transformation, Principles of DT and advantages of DT, Business model definition, challenges of traditional business mode, Types of business model, Business model canvas and its components, Value proposition and its importance

Section B
Product Management & Service Mindset

Introduction to Product Management & Service Mindset, Product Manager, Building Products and services, Product lifecycle and phases, product development & Methodology; systems thinking, value chain, Introduction of Capability Optimization and Capability Maturity Model, Business Integration methods, Agile methodology, Product Marketing; User Experience Design

Section C

Digital Innovation & Lean Startup

History of Design Thinking, Design Thinking, Different Phases of Design Thinking, define a Problem Statement, Divergence, Emergence and Convergence of Design Thinking, Challenges of Design Thinking, Design Sprint and its Phases, Design Thinking Vs Design Spirit, Sprints, Lean Sprints, Lean, building your MVP and approaches to testing, The benefits of building an MVP, Continuous Deployment, Best practices, Benefits of continuous deployment. Split testing, the process and benefits, Actionable metrics: definition and methods, Pivot: definition and types, build measure learn: its phases.

Section D

Introduction to User Experience Design

Introduction to UI and UX, User Experience Design, creating a user centered design, Requirements Gathering, Functional requirements, Non-functional requirements, Capturing UX requirements, Designing Alternatives, Prototyping and its Types, Evaluation, Performance

Section E

Digital Marketing

Traditional marketing, Consumer buying patterns, Common digital channels, Digital marketing, framework and its take away, Paid Social and Advertising, why use paid social? Social media advertising tips, Content Marketing, Benefits and challenges, Customer Engagement and Retention, Strategies to improve customer strategy

Course Outcomes	Program Outcome												PSO 1	PSO 2
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2		
CO1	3	-	-	-	3	-	-	-	1	2	-	3	1	1
CO2	2	3	2	3	-	-	-	-	1	1	2	1	3	2
CO3.	-	-	-	-	2	-	2	-	2	2	3	2	2	2
CO4	3	2	2	-	-	2	3	2	3	3	3	3	2	3
CO5	2	3	3	3	3	3	3	3	3	3	3	3	3	2

SEMESTER-II

Course Code	Course Name	Offering Department	Course Type	Structure			Credits
			(Core/ Elective)	L	T	P	
CHH144-T&P	CHEMISTRY-1	PH	CORE	3	1	2	5
MAH104B-T & P	DISCRETE MATHEMATICS	MA	CORE	3	1	2	5
ECH103B-T&P	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	EC	CORE	3	1	2	5
CSH103B-T&P	DATA STRUCTURES & ALGORITHMS	CS	CORE	3	1	2	5
MEW102B	ENGINEERING GRAPHICS & DRAWING	ME	CORE	0	0	3	1.5
TOTAL (L-T-P) /CREDITS)				12	4	11	21.5
SPECIALIZATION ELECTIVE BASKET							
CSH108B-T&P	PYTHON PROGRAMMING	CS	ELECTIVE	3	1	2	5
CSH106B-T&P	AGILE SOFTWARE DEVELOPMENT	CS	ELECTIVE	3	1	2	5

DETAILED SYLLABUS
CSU01- Semester-II

Course Title/ Code	**Chemistry-I (CHH144-T) &(CHH144-P)**
Course Type	Core (Allied)
Course Nature	Soft
L-T-P Structure	(3-1-2)
Credits	5
Objectives	Student would be able to learn basic of atomic structure, intermolecular forces, and importance of pH, stereochemistry, learn basic of spectroscopic techniques and apply basic of these topics to industrial and domestic purpose.

Course Outcome	**Mapping**
CO1: Demonstrate basics of atomic structure, periodicity and van der Waal's forces.	Skill development
CO2: Describe the importance of thermodynamic properties of Gibbs free energy and entropy functions.	Skill development
CO3: Present on water chemistry, theories of corrosion and concepts of metallurgy through Ellingham diagram.	Skill development
CO4: Describe the basics of stereochemistry and the importance of green synthesis with emphasis on its twelve principles.	Skill development
CO5: Apply spectroscopic techniques in various fields to deduce structures.	Employability

SECTION A

(i) Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi2$. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.

(ii) Periodic properties

Electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital, energies of atoms in the periodic table, polarizability and Polarization, Fajan's Rule, oxidation states and their stabilities.

SECTION B

(iii)   Intermolecular forces and potential energy surfaces

Ionic, dipolar and van der waals interaction, equations of state of real and gases and critical phenomenon.

(iv)   Use of free energy in chemical equilibria

Thermodynamic functions: entropy and Gibbs free energy; estimations of entropy and free energies. Relationship between Free energy and emf Cell potentials. Nernst equation and application. Acid base, oxidation reduction and solubility equilibria, Water chemistry: Introduction - Use of water for Industrial and domestic purposes, sources of water supply, Hardness of water, degree of hardness and its estimation by EDTA methods). PH-value of water, disinfection of water Softening of hard water (Lime-Soda method, Calgon methods. Corrosion: introduction, cause and theories: Dry and wet theory and prevention methods, use of free energy consideration in metallurgy through Ellingham Diagram.

SECTION C

(v)   Stereochemistry

Representations of three-dimensional structures, introduction to the terms: achirality, chirality, enantiomers, diastereomers, optical activity, structural isomers and stereoisomers, relative and absolute configurations, conformational analysis of ethane and n-butane. Structural isomerism in transitional metal compounds.

(vi)   Organic reactions and synthesis using conventional and green approach

Introduction to Green Chemistry, its 12 principles, Synthesis of a commonly used molecules: Aspirin, Ibuprofen, bio-diesel and bio-ethanol.

SECTION D

(vii)   Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging.

Text Books
1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Laboratory
1. Determination of chloride content of water

2. Colligative properties using freezing point depression
3. Determination of the rate constant of a reaction
4. Synthesis of a polymer (UF, Resol, PMMA).
5. Determination of surface tension and viscosity.
6. Determination of cell constant and conductance of solutions.
7. Saponification/acid value of oil.
8. Adsorption of acetic acid by charcoal.
9. Determination of the partition coefficient of a substance between two immiscible liquids.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3	-	-	2	-	-	3	-	3	-	3
CO2	3	3	-	3	-	-	3	-	-	3	3	2	-	2
CO3	3	2	3		-	3	2	-	-	3	2	3	-	3
CO4	3	3	-	-	-	3	3	-	-	3	3	2	-	2
CO5	3	2	-	-	-	-	2	-	-	3	-	3	-	3

Course Title	**Discrete Mathematics** (MAH104B-T) & (MAH104B-P)
Course Type	Core (Allied)
Course Nature	Hard
L-T-P structure	3-1-2
Credits	5
Objective	. Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following: 1. Use mathematically correct terminology and notation. 2. Construct correct direct and indirect proofs. 3. Use division into cases in a proof. 4. Use counterexamples. 5. Apply logical reasoning to solve a variety of problems.

Course Outcome	Mapping
CO1: Describe the concept of basic mathematical objects such as sets, relations, POSETs and Lattices and will also be able to verify simple mathematical properties that these objects possess explain partial ordering and solve related problems.	Skill development
CO2: Apply basic counting techniques to solve combinatorial problems.	Employability
CO3: Demonstrate mathematical properties formally via the formal language of propositional logic and predicate logic explain Algebraic structures and solve related problems.	Employability
CO4: Simplify simple Boolean functions by using the basic Boolean algebraic properties and K-map.	Skill development
CO5: Analyze Graphs and trees and solve related problems.	Employability

SECTION – A

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation

POSET and Lattices; Partial orderings, POSETS, Totally Ordered Set, Dual Order, Hasse Diagram, Lexicographic Ordering, Well-Ordering Theorem, Lattices and their properties, Bounded Lattices, Sub Lattices, Direct Products.

SECTION – B

Counting Techniques: Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm,

The Fundamental Theorem of Arithmetic. Basic counting techniques-inclusion and exclusion, pigeon-hole principle.

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers.

SECTION – C

Boolean algebra: Introduction to Boolean algebra and Boolean functions, Different representations of Boolean functions, Application of Boolean functions to synthesis of circuits. Karnaugh maps.

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields (Definition and examples only

SECTION – D

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Coloring, Coloring maps and Planar Graphs, Coloring Vertices, Coloring Edges, List Coloring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

DISCRETE MATHEMATICS LAB (MAH104-P)

LAB EXERCISE:

1. Introduction to programming.

2. Programming with control flow, i.e., for-loop, if-else-end etc.

3. Creation of user defined functions.

4. To use the set operation, i.e., union, intersection, Cartesian product etc.

5. Use of Boolean logics

Mini Project

Objective: Mini Project encourage students to explore and strengthen the understanding of subject through practical application of theoretical concepts. It also helps students to boost their skills and widen their horizon of thinking.

Students are required to identify an application of the given topics in the real-life problems by using discrete mathematics concepts theory. Students can work individually or in a group of 2 & 3. Some suggested topic for mini project is

1. Application of Graph theory in Physics

2. Application of Graph theory in Chemistry

3. Application of Graph theory in Signal Processing

4. Application of Graphs in Networking

5. Applications of Boolean algebra in switching circuit

6. Application of Kruskal's and prim's algorithm in real life problems.

7. Application of Boolean algebra in computer science.

8. Routing problems (e.g., Hamiltonian paths, travelling salesman problem)

9. Graph colorings applications (Chromatic Number, chromatic polynomial)

10. Traffic management using graph algorithm

11. Job Assignment problem. … etc.

RECOMMENDED BOOKS:

Text books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill

2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.

3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics: A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.

4. M.K. Sen (Author), D.S. Malik (Author), Discrete Mathematics: Theory and Applications, Cengage.

Reference books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, Tata McGraw-Hill

2. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press. Schum's Outlines Series, Seymour Lipchitz, Marc Lipson,

3. Discrete Mathematics, Tata McGraw - Hill

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	3	-	-	-	3	3	-	-	-	-
CO2	3	3	3	-	3	-	-	-	3	3	-	-	2	-
CO3	3	3	3	-	3	-	-	-	3	3	-	-	3	3
CO4	3	3	3	-	3	-	-	-	3	3	-	-	3	3
CO5	3	2	3	-	3	-	-	-	3	3	-	-	2	3

Course Title/ Code	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING (ECH103B-T) & (ECH103B-P)
Course Type:	Core (Allied)
Course Nature:	Hard
Credits	5
L-T-P Structure	(3-1-2)
Objective	Understand the working principles of basic electrical circuits and electronic devices (diode, Transistors, OP-Amp etc.), analyze their behavior and implement the knowledge to design their various applications.

CO Statement	Mapping
CO1: Apply the fundamental concepts of Basic Electrical circuits.	Employment
CO2: Apply the concepts and working principles of Diodes for its various applications	Skill Development
CO3: Demonstrate familiarity with electronic devices viz., Transistors, Feedback Amplifiers and Oscillators and design implementation	Skill Development
CO4: Analyze and Design Operational Amplifiers and real-life applications using 555 Timer.	Skill Development

SECTION A

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition Theorem, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits. AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel) resonance.

SECTION B

Diodes and Applications covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications.

SECTION C

Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations. Transistor Amplifiers and Oscillators, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors. Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge Oscillators.

SECTION D

Operational Amplifiers and Applications covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground. IC 555 and its applications as A stable and mono-stable multi-vibrators.

List of Experiments:

1. Familiarization with the lab Equipment's.

2. To verify the Kirchhoff's Voltage Law and Kirchhoff's Current Law

3. To experimentally verify Thevenin Theorem

4. Introduction to CRO and measuring various parameters of Sine wave

5. Characteristics of PN junction diode in Forward and reverse bias configuration.

6. Truth table Verification of AND and OR gate using diode

7. Half wave and full wave rectifier circuit.

8. To plot the characteristics of Transistor in CE Configuration

9. RC Phase Shift Oscillator

10. Op Amp as Inverting and Non-Inverting Amplifier

11. Minor project on 555 Timer Application

Suggested Text / Reference Books

(i) D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.

(ii) D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

(iii)L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

(iv) David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India.

(v) SantiramKal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India 3. Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals by Pearson Education,

(vi) Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH 5

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	2	-	-	-	3	-	-	3	-	3
CO3	3	3	3	3	3	-	-	-	3	3	2	3	-	3
CO4	3	3	3	3	3	-	-	-	3	3	3	3	-	-

Course Title/ Code	**Data Structures & Algorithms (CSH103B-T) & (CSH103B-P)**
Course Type:	**Core (Departmental)**
Course Nature:	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	The course should assess how the choice of data structures and algorithm design methods impacts the performance of programs and choose the appropriate data structure and algorithm design method for a specified application.

Course Outcomes (Cos)	Mapping
CO1: To demonstrate the understanding of Dynamic memory management, algorithms and their complexity; and abstract properties and operations of Linear data structures (using Static Memory Allocation): Array; To apply different Searching and Sorting algorithms.	**Employment**
CO2: Demonstrate the abstract properties and operations of Linear data structures (using Dynamic Memory Allocation): Link List and variations of Linked List.	**Skill Development**
CO3: Demonstrate the abstract properties and operations of Linear data structures (using Static & Dynamic Memory Allocation): Stacks, Queues	**Skill Development**
CO4: Demonstrate the abstract properties and operations of Non-Linear data structures (using Static & Dynamic Memory Allocation): Trees, Graphs	**Skill Development**

Section A

Data structures and Algorithms: Introduction to Data structure: Concept of data structure, choice of right data structures, types of data structures, Abstract Data types, Introduction to algorithms, how to design and develop an algorithm: stepwise refinement, algorithm analysis, complexity of algorithms

Arrays: Introduction, One Dimensional Arrays, two-dimensional array, Multidimensional arrays, address calculation of a location in arrays operations defined: traversal, selection, searching, insertion, deletion, and sorting.

Searching: linear search, binary search, Sorting: selection sort, bubble sort, insertion sort, merge sort, quick sort.

Section B

Pointers: Introduction to pointers, Pointer variables, Pointer and arrays, array of pointers, pointers and structures, Dynamic allocation. Linked Lists: Concept of a linked list, circular linked list, doubly linked list, operations on linked lists: traversal, selection, searching, insertion, deletion, and sorting, concepts of header linked lists. Applications of linked lists.

Section C

Stacks: Introduction to Stacks, array representation of stack, operations on stack: PUSH, POP, Evaluation of Expression: Concept of precedence and associatively in expressions, difficulties in dealing with infix expressions, resolving precedence of operators and association of operands, postfix & prefix expressions, conversion of expression from one form to other form using stack (with & without parenthesis), Evaluation of expression in infix, postfix & prefix forms using stack. Recursion, Linked list representation of stack, Applications of stacks.

Queues: Queues, Circular queues, array representation of Queues, priority queues, dequeue, circular queue, operations on queue: insertion and deletion, Applications of Queues.

Section D

Non-Linear Structures: Trees definition, characteristics concept of child, sibling, parent child relationship etc., binary tree: different types of binary trees based on distribution of nodes: complete binary tree, binary tree (threaded and unthreaded),operation on binary tree: insertion, deletion, searching and traversal of binary trees, traversing: Preorder, Postorder and Inorder, Introduction to binary search tree, operations and Time complexity on BST: insertion, deletion, searching, Introduction to AVL tree: Concept of balanced trees, balance factor in AVL trees, insertion into and deletion from AVL tree, balancing AVL tree after insertion and deletion, in B trees, Application of trees.

Graphs: Definition, Relation between tree & graph, directed and undirected graph, connected and disconnected graph, Representation of graphs using adjacency matrix and list, Depth first and breadth first traversal of graphs, Applications of Graph.

List of Experiments:

1. Programs on C language
2. Write a program on Linear search and Binary search Using C
3. Write a program to implement bubble sort, insertion sort, selection sort
4. Write a program to implement Merge sort, Quick sort
5. Programs on Link list
6. Programs on stack
7. Programs on queues
8. Programs on binary trees
• Traversal
• Insertion
• Deletion
9. Programs on binary search tree:
• Calculate the height of BST

• Calculate the number of leaf nodes

• Insertion

• Deletion

10. Case studies on Trees

11. Programs on Graphs

• BFS

• DFS

Graphs.

Text Books:

1. Data Structures with C by Seymour Lipschutz ,McGraw Hill Education(India) Private Limited.

2. Data Structures using C by A. K. Sharma, Pearson Publication.

3. Data Structures using C-Yashwant Kanetkar Publication.

Reference Books:

1. Data Structures using C by A. M. Tenenbaum, Langsam, Moshe J. Augentem, PHI Pub.

2. Data Structures and Algorithms by A.V. Aho, J.E. Hopcroft and T.D. Ullman Publisher.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	-	-	-	-	3	2	2	2	3
CO2	3	3	3	3	3	-	-	-	-	3	3	3	2	3
CO3	3	3	3	3	3	-	-	-	3	3	3	2	3	2
CO4	3	3	3	3	3	-	-	-	3	3	3	3	3	2

Course Title/Code	ENGINEERING GRAPHICS & DRAWING (MEW102B)
Course Type:	Core (Allied)
Course Nature:	WORKSHOP
L-T-P Structure	(0-0-3)
Credits	1.5
Objective	Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views (principal, auxiliary, sections).Dimension and annotate two-dimensional engineering drawings

Course Outcomes (Cos)	Mapping
CO1: Understand the concept of projection and acquire visualization skills.	Skill Development
CO2: Analyze technical drawings using both CAD and basic manual tools	Skill Development
CO3: Utilize CAD software to create Geometric Constructions	Employment
CO4: Convert Isometric views to orthographic views	Employment

Section A

Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments

Introduction to Computer Aided Drafting and Design, Instrument Drawing Techniques

Section B
Drawing Management/File Types, Design Processes and Methods, Sketching

Section C
Orthographic Projection/Multiview, Geometric Constructions, Dimensioning and Tolerancing

Section D

Three-dimensional Modeling, Section Views & Auxiliary Views

Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. Corresponding set of) CAD Software Theory and User Manuals.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	2	-	-	3	3	3	-	2	2	-
CO2	3	-	3	-	2	-	-	3	3	3	-	2	3	-
CO3	3	-	3	-	2	-	-	3	3	3	-	2	2	
CO4	3	-	3	-	2	-	-	3	3	3	-	2	2	-

Course Title/Code	Python Programming (CSH108B-T) & (CSH108B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	To develop and enhance programming skills and data handling capabilities.

CO statement	Mapping
CO1: Demonstrate the installation of Python, and describe its fundamentals.	Employability& Skill development
CO2: Apply control structures and functions, iterators and generators in Python for solving problems	Employability & Skill development
CO3: Implement data pre-processing using Python	Employability & Skill development
CO4: Analyze data using statistical modeling in Python	Employability & Skill development

Section- A

Setting up the Python Environment

Compiler vs. Interpreter, statically vs. Dynamically Typed Languages, Introduction to Python, Installing Python, Anaconda, Jupyter Notebook, Spyder, Components and Versions of Python, Difference between Python 2 and Python 3, Python Distributions

Section- B

Programming with Python

Python REPL,Variables, control structures, functions and objects, First-class functions, immutable data, strict and non-strict evaluation, Recursion instead of an explicit loop state, Functions, iterators, and generators, Writing pure functions, functions as first-class objects, Using strings, tuples and named tuples, Using lists, dicts, and sets, The iter tools module,. Best practices and clean coding, reading data files into Python, writing files, Introduction to Python libraries

Section C

Data Preprocessing

Introduction, Introduction to Pandas and Basic Concepts of Pandas, Data Cleaning and Preparation, Handling Missing Data, filtering out Missing Data, Filling in Missing Data, Data Transformation, Removing

Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Renaming Axis Indexes, Discretization and Binning, Detecting and Filtering Outliers, Permutation and Random Sampling, String Manipulation, Feature Engineering

Section D Statistical Modeling

Derived Variables, Basic Exploratory Data Analysis, Methods for EDA and Examples, Statistical Modeling, Curve Fitting: Linear Regression, Nonlinear Regression

Python Programming Lab

List of Programs

1. Setting up the Python Environment using Anaconda IDE: Know Jupyter & Spyder
2. Write a program to perform Functions in Python
3. Write a program in Python First Class Functions & Immutable Data
4. Write a program in Python exploring Iterators
5. Write a program in Python exploring Generators
6. Work in Python using Collections
7. Write a program in Python to perform Higher Order Function-I
8. Write a program in Python to perform Higher Order Functions-II
9. Write a program in Python to perform File Operation in Python
10. Write a program in Python to perform Data Preprocessing
11. Write a program in Python to perform Exploratory Data Analysis
12. Write a program in Python to actuate Curve Fitting.

Course Learning Outcomes (CLOs): -

On completion of this course, the students will be able to: -
1. Get hands-on programming experience.
2. Learn statistical implementations
3. Carry out exploratory data analysis

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	-	2	-	2	-	-	-	3	-	-	-	2	3
CO3	3	3	2	-	2	3	-	3	2	-	-	-	2	2
CO4	3	3	2	2	3	3	-	3	3	3	2	-	2	3

Course Title/Code	Agile Software Development (CSH106B-T) & (CSH106B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	To introduce students to Agile Software Development Methodology and implement in software development in a project

Course Outcomes (Cos)	Mapping
CO1: Students should be able to demonstrate understanding of Traditional Software Development Methodologies, its merits and shortcomings	**Skill Development**
CO2: Students should be able to demonstrate understanding of history of evolution, need and principles of the following methodologies: Agile and Lean	**Skill Development**
CO3: Students should be able to apply Agile Methodology with two frameworks: SCRUM and Extreme Programming (XP) in a software development project.	**Employment**
CO4: Students should be able to describe other Agile Models: Feature Driven Development (FDD), Dynamic System Development Method (DSDM), Adaptive System Development (ASD), Lean Software Development (LSD), Kanban and Crystal	**Employment**
CO5: Students should be able to apply Agile Estimation and Agile Project Planning techniques in Estimation and Planning of an Agile Software Development Project.	**Employment**

Section A

Traditional Software Development

Software, Types of Software, System Software, Application Software, Initial Days of Software, History of Software Development Methodologies, Waterfall Model, Gated Waterfall Model, Traditional IT Organizations, Developers vs IT Operations Conflict, Problems with the Traditional Development and the Operations

Section B

Agile Methodologies and Lean

A recap of software development models, What Triggered the Rise of Agile? The Agile Manifesto Values of Agile Manifesto, Principles, Introduction and history of Agile, Agile development Agile Methodologies, Introduction and history of Lean, Lean principles

Section C

Agile & Scrum Methodology:

Scrum, Scrum Theory, Scrum Values, Scrum Roles, Scrum Development Team, Scrum Master Scrum Sprints, Scrum Ceremonies or Events, Artifacts, Product Backlog, Sprint Backlog, Increment, Benefits of Scrum, Extreme Programming, Introduction, XP Values, XP Rules, XP Roles, XP Activities, Different Categories of XP Practices

Section D

Agile Implementation

Agile Estimation and Planning, Agile Planning and its Need, The Agile Planning Onion, Levels of Agile Planning, Conditions of Satisfaction, Estimating the Size in Story Points and Ideal Days, Agile Estimating Techniques, Implementing Agile on Industry Projects, Soft Skills in Agile

Section E

Kanban Principles:

Kanban Principle, Kanban Board, Kanban Core Practices, make work visible, Limit work in progress (WiP), Manage flow, make progress policies explicit, implement feedback mechanisms, improve collaboratively (using methods and models)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	3	3	-	3	2	2
CO2	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	3	3	-	-	-	3	3	-	3	3	3
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	3	3	-	-	-	3	3	3	3	3	3

Semester-III

Course Code	Course Name	Offering Department	Course Type (Core/ Elective)	Structure L	T	P	Credits
CSH201B-T&P	OOPS USING JAVA	CS	CORE	3	1	2	5
CSH202B-T&P	DATABASE MANAGEMENT SYSTEM	CS	CORE	3	1	2	5
CSH209B-T&P	COMPUTER ARCHITECTURE & ORGANISATION	CS	CORE	3	1	2	5
CSH204B-T&P	ANALYSIS & DESIGN OF ALGORITHMS	CS	CORE	3	1	2	5
CSW203B	USER INTERFACE-II (MONGODB,TYPESCRIPT,ANGULAR JS)	CS	CORE	0	0	3	1.5
FLS101/FLS102/FLS103	FOREIGN LANGUAGE (SPANISH/GERMAN/FRENCH)	FL	ELECTIVE	1	1	0	0
CDO201	PROFESSIONAL COMPETANCY ENHANCEMENT-I	CDC	CORE	0	0	1	0.5
RDO201	INTRODUCTION TO RESEARCH	RESEARCH	CORE	0	0	0	0.5
	TOTAL (L-T-P) /CREDITS)			13	5	12	22.5
SPECIALIZATION ELECTIVE BASKET							
CSH212B-T&P	SUPERVISED LEARNING	CS	ELECTIVE	3	1	2	5
CSH210B-T&P	SOFTWARE CRAFTMANSHIP	CS	ELECTIVE	3	1	2	5

Course Title/ Code	**Object Oriented Programming Using Java (CSH201B-T) & (CSH201B-P)**
Course Type	Core (Departmental)
Course Nature	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	Student will be able to apply the object-oriented programming principles and techniques for solving the real-life problems.

Course Outcome	**Mapping**
CO1: To describe basic programing concepts in Java language.	Employability& Skill development
CO2: To enable the student to demonstrate given program scenario and apply different programming constructs	Employability& Skill development
CO3: To analyze the semantics of the given problem statement and apply programming techniques to distinguish static and dynamic polymorphism, inheritance and file handling to solve real life programming problems.	Employability& Skill development
CO4: To integrate the learned and applied concepts into given java projects to produce real life solutions	Employability& Skill development

Section A

Introduction to OOPS: Paradigms of Programming Languages - Basic concepts of Object-Oriented Programming, Differences between Procedure Oriented Programming and Object-Oriented Programming, Objects and Classes, Data abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic binding, Message communication, Benefits of OOP, Application of OOPs.

Introduction to Java: History of Java, Java features, Java Environment: JDK API. Types of java program, Creating and Executing a Java program, Java Tokens: Keywords, Character set, Identifiers, Literals, Separator, Java Virtual Machine (JVM), Comments in Java program, Command line input and Arguments, Data Types, Variables, Operators, Control Statements, Arrays, String handling, Scanner Class.

Class and objects: Defining a class, Methods, creating objects, Accessing class members. Constructors, Method overloading, constructor overloading, this keyword.

Section B

Inheritance: Defining a subclass, deriving a subclass, Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, overriding methods, super keyword, Final variables and methods, Final classes, Final methods, Abstract methods and classes, Visibility Control, Public access, Private access, protected.
Interfaces: Defining interface, extending interface, Implementing Interface, Accessing interface variables, Static members, Nesting of Methods

Packages: Java API Packages: System Packages, Naming Conventions, Creating & Accessing a Package, Adding Class to a Package, Hiding Classes

Section C

Code Design: Basic concepts of design patterns and preliminaries of its categories. SOLID Design Principles.

Exception Handling: Exception Handling Mechanism, using try and catch blocks, nesting try Statements, Multiple catch Block, Throwing Exceptions, using finally clause, creating a Custom Exception.

Section D

Multithreading: Getting the main thread, naming a Thread, pausing a thread, creating a Thread with the Runnable Interface, creating a Thread with Thread Class, Creating Multiple Threads, waiting for (joining) Threads, checking whether thread is alive, Setting Thread Priority and Stopping Threads, Thread Synchronization, Suspending and Resuming Threads.

I/O Streams: I/O Basics Reading Console Input Writing Console Output, Using the File Class, InputStream, OutputStream, FileInputStream, FileOutputStream, Buffered Input Stream, Buffered Output Stream, Random Access File, File Reader, File Writer, Buffered Reader, Buffered Writer, Serialization.

List of Experiments
1. Basic programs in java, use of if else construct and switch construct.
2. Programs on Loops and Arrays.
3. Programs on Strings and classes creation in java.
4. Programs on constructors and use of keyword this keyword, static keyword, final keyword, finalize method.
5. Programs on single inheritance,
6. Programs on multilevel inheritance, Hierarchical inheritance.
7. Programs on method overriding, super keyword and final method.
8. Programs on interfaces
9. Programs on SOLID design principles.
10. Programs on Packages
11. Programs Exception Handling
12. Programs on threads
13. Programs on File Handling

14. Mini-Project

Text Books:
1. Programming with Java Primer   by E BalagurusamyTmh Publication
2. Java; the complete reference, 7th editon, Herbert schildt, TMH.
3. H. M. Deitel and P. J. Deitel, Java How to Program, Prentice Hall, 7th Edition, 2007
4. Head First Design Patterns: A Brain-Friendly Guide 1st Edition, by Eric Freeman, Bert Bates, Kathy Sierra, Elisabeth Robson

Reference Books:
1. Java2 Programming Black Book, Steven Holzner (no. of copies: 23)
2. C. S. Horstmann and G. Cornell, Core Java 2 (Volume I-Fundamentals), Prentice Hall, 7th Edition, 2004. (no. of copies: 10)
3. Head First Java By Kathy Sierra

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	2	-	-	-	2	-	3
CO2	3	2	2	2	3	-	-	2	2	-	-	2	2	2
CO3	3	2	3	2	3	2	-	3	2	2	2	2	2	3
CO4	3	3	3	3	3	3	-	2	3	3	3	3	3	3

Course Title/Code	Database Management System (CSH202B-T) & (CSH202B- P)
Course Type	Core (Departmental)
Course Nature	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	To do logical and physical design of databases and manipulate them.

Course Outcome	Mapping
CO1: Describe the knowledge about file systems, database concepts and structured query language.	Employability & Skill development
CO2: Design, create and manipulate database systems using SQL, Relational Algebra and Relational Calculus.	Employability & Skill development
CO3: Design ER Models and convert the same to relational model	Employability & Skill development
CO4: Design and Decompose the Database using Formal and Informal methods including FD, Normalization	Employability & Skill development
CO5: Describe the principles of Transaction Processing, Concurrency control methods and recovery techniques.	Employability & Skill development

Section A

File system & Introduction to DBMS: File, operations on files, file header, Different file organizations - serial, sequential, indexed sequential, direct/hash, Indexing – primary, secondary, single level, multi-level, clustered, Introduction to DBMS – comparison with conventional file processing, ANSI SPARC three level DBMS architecture, data independence, data abstraction, different users of DBMS, Applications of DBMS, SQL (Introduction, Data Types, Constraints, Creation of Tables)

Section B

Relational model and Algebra: Introduction to SQL (Insertion of Data, updating in the data, Alternation in the Schema, Data Fetching, Functions), Relational model – Mathematical formulation, Relation and its properties, domain compatibility, Relational algebra – set operations (union, intersect, difference, cross product), relational operations (select, project, division, joins-cross, inner/outer, theta, natural, equivalence), group operations Tuple calculus, Relational Calculus.

Section C

Relational Database design: SQL (Set Operations, group by, order by, Joins), Relational Database Design and ER Model (Entity, Relationship, Strong Entity, Weak Entity, Type of Attributes and their representation), EER (Generalized and Specialization), Functional dependency, Armstrong inference

axioms, Closure and its algorithm, Minimal set of Functional Dependencies and its algorithm, Keys – super key, minimal super key, candidate keys, primary key, foreign key, Algorithm to find primary key.

Good decomposition properties – dependency preservation and loss less join, Algorithm for checking loss less join decomposition, Synthesis Approach, Anomalies – insertion, deletion and updating, I NF, 2 NF, 3 NF, BCNF, Multi - valued dependency, 4 NF, Join dependency, 5 NF.

Section D
Transaction processing, Concurrency control & recovery: SQL(Sub queries, View, Sequence, DCL(Roll back, commit)), Introduction to transaction, properties of transaction and life cycle of transaction, Schedule – serial, non-serial, serializable (result, conflict and view), strict schedule, Concurrency and problems related, Concurrency control techniques – Locking, two phase locking, strict, rigorous 2PL, Deadlock – detection, prevention, breaking deadlock, Recovery System, Basic Concepts of Recovery, Database Update(update in place, Deferred Update), Undo-Redo Algorithm, No Undo-Redo Algorithm, Undo-No Redo Algorithm, Shadow Paging Technique.

List of Experiments

1. File Vs DBMS
2. DDL statement
3. DML Statement
4. DCL Statement
5. Project
6. Tool related to RDBMS

Text Books:

1. Fundamentals of Database Systems by R. Elmasri and S.B. Navathe,6th edition, 2013, Addision-Wesley, Low Priced Edition
2. Database system concepts, 6th edition, McGraw-Hill, AviSilberschatz, Henry F. Korth, S. Sudarshan

Reference Book:
1. An Introduction to database systems by Bipin C. Desai, Galgolia Publications.
2. Modern Database Management by Feffray A. lioffcr, Mary B. Prcscotl, Fred R Mefaddcn, 6th edition. Pearson Education

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	2	-	1	3	2	2
CO2	3	3	3	2	3	-	-	-	2	2	3	2	2	3
CO3	3	2	3	3	3	-	-	-	3	2	3	2	2	3
CO4	3	2	3	2	2	-	-	2	2	3	3	2	3	2
CO5	3	2	2	-	-	3	-	3	2	-	2	2	-	3

Course Title/Code	Computer Architecture & Organization (CSH209B-T) & (CSH209B-P)
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	Students will be able to understand the design and working of various components constituting a computer system.

Course Outcome	Mapping
CO1: Describe General System Architecture, Instruction Set Architecture, Memory Hierarchy, various I/O techniques and concepts of parallelism.	Employability & Skill development
CO2: Design an efficient CPU with hardwired controlled & micro-programmed controlled methodologies by using set of specific instructions.	Employability
CO3: Design a memory module or an I/O module and analyze it's working.	Employability & Skill development
CO4: Compare the performance of a CPU organization and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology.	Employability & Skill development
CO5: Apply concepts to develop an assembly level program for a given problem.	Employability

Section A

Basic Computer Organization: Von Neumann concept - Store program control concept - Flynn's classification of computers (SISD, MISD, MIMD, SIMD) - Multilevel viewpoint of a machine: digital logic, micro architecture, ISA. Decimal, Binary, Octal and Hexadecimal number system, Binary arithmetic's, signed binary numbers, 1's & 2's Complement representation, Fixed and floating-point numbers; Boolean algebra and Logic gates - Combinational logic blocks (Adders, Multiplexers, Encoders, de-coder) - Sequential logic blocks (Latches, Flip-Flops, Registers, Counters).

Section B

CPU and Instruction Set Architecture: Basics: Instruction Codes – Computer Registers – Computer Instructions – Timing and Control – Instruction Cycle - Types of Instructions - Instruction set formats (fixed, variable, hybrid). Processor Organization: General register organization – Stack organization –

Instruction formats – Addressing modes – Data transfer and Manipulation – Program control - Instruction set based classification of processors (RISC, CISC, and their comparison) - Design of accumulator logic.

Section C

Memory Hierarchy & I/O Organization: The need for a Memory Hierarchy - Locality of reference principle - Memory parameters: access/ cycle time, cost per bit - Main memory (Semiconductor RAM & ROM organization, memory expansion, Static & dynamic memory types) - Auxiliary Memory - Cache memory (Associative & direct mapped & Set-associative Cache Organizations, Cache Coherence, I/O interface - Modes of transfer - DMA - Types of Interrupts - Input-Output and Interrupt.

Section D

Micro programmed Control: Control Memory - Address sequencing - Micro program example – Design of control unit - Microinstruction sequencing - Implementation of control unit. Introduction to Parallelism: Goals of parallelism (Exploitation of concurrency, throughput enhancement) - Enhancing performance with pipelining - Amdahl's law - Instruction level parallelism (pipelining, super scaling –basic features) - Processor level parallelism (Multiprocessor systems overview).

List of Experiments:

1. To recognize various components of PC.

2. To understand the programing language MASM 8086.

3. To print a string with and without using macro.

4. To print the successor and predecessor of a character.

5. To print factorial of a no and Fibonacci series.

6. To print the reverse of a string and check whether it is palindrome or not by using macro.

7. To check whether a number is even, odd or prime using assembly code.

8. To find the largest and smallest number.

9. To print square and cube of first n natural numbers using assembly code.

10. To design a simple calculator.

Text Books:

1. Computer System Architecture by M. Mano, 2001, Prentice-Hall.

2. Computer Organization and Design, 2nd Ed., by David A. Patterson and John L. Hennessy, Morgan 1997, Kauffmann.

3. Computer Architecture and Organization, 3rd Edi, by John P. Hayes, 1998, TMH.

Reference Book:

1. Operating Systems Internals and Design Principles by William Stallings,4th edition, 2001, Prentice-Hall Upper Saddle River, New Jersey

2. Computer Organization, 5th Edi, by Carl Hamacher, Zvonko Vranesic,2002, SafwatZaky.

3. Structured Computer Organisation by A.S. Tanenbaum, 4th edition, Prentice-Hall of India, 1999, Eastern Economic Edition.

4. Computer Organisation & Architecture: Designing for performance by W. Stallings, 4th edition, 1996, Prentice-Hall International edition.

5. Computer Architecture- Nicholas Carter, 2002, T.M.H.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	2	-	-	-	-	-	-	2	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	2	3	2	-	-	2	2	-	-	-	2	3
CO4	3	-	2	-	2	3	-	2	-	-	-	-	2	3
CO5	3	3	3	-	3	3	-	3	3	-	-	-	3	1

Course Title/Code	Analysis and Design of Algorithms (CSH204B-T) & (CSH204B-P)
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	To learn the ability to distinguish between the tractability and intractability of a given computational problem. To be able to devise fast and practical algorithms for real-life problems using the algorithm design techniques and principles learned in this course.

Course Outcome	Mapping
CO1: Students will be able to understand time and space complexity of algorithms of different design strategies through examples	Employability & Skill development
CO2: Apply appropriate algorithmic design paradigm to solve real life problems	Employability & Skill development
CO3: Student should be able to analyze asymptotic performance of any algorithms	Employability & Skill development
CO4: Students will be able to gain understanding of solvable and unsolvable (concepts of P and NP class) problems and will have the ability to do the analysis to categorize the problem.	Employability & Skill development
CO5: Students will be able to gain understanding of solvable and unsolvable (concepts of P and NP class) problems and will have the ability to do the analysis to categorize the problem.	Employability & Skill development

Section   **A**

INTRODUCTORY CONCEPTS: Growth of Functions, Summations, Algorithm Design Paradigms, Characteristics of Algorithm, Comparing the performance of different algorithms for the same problem, asymptotic notation. Polynomial vs. Exponential running time. Disjoint Set operations, Linked List representation of disjoint sets, disjoint set forests.

Section B

Divide and Conquer method: Recurrence relations: Solving Recurrence by substitution method, recurrence tree, master method; Binary search algorithm and its analysis. Sorting algorithms such as Merge sort, Quick sort, Heap sort, Radix Sort, Counting Sort, Bucket Sort and Bubble sort with analysis of their running times. Strassen's matrix multiplication

Section C

Greedy Method: Activity Selection Problem, knapsack problem, job sequencing with deadlines, minimum spanning trees, single source shortest paths, all pairs shortest path. Dynamic Programming: General method, optimal binary search trees, O/I knapsack, the traveling salesperson problem, Matrix chain multiplication, longest common Subsequence and their analysis.

Section D

Backtracking and Branch & Bound: General method, 8 queen's problem, graph coloring, Hamiltonian cycles, Vertex Cover Problem, analysis of these problems. Branch and Bound: Method, O/I knapsack and traveling salesperson problem, efficiency considerations, NP hard and NP Complete: NP Hard graph Problems, Cooks theorem

LIST OF EXPERIMENTS:

1. Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random   number   generator.
2. Implement a Merge Sort algorithm to sort a given set of elements and determine the time required to sort the   elements.
3. a. Obtain the Topological ordering of vertices in a given digraph.

b. Compute the transitive closure of a given directed graph using Wars hall's algorithm.

4. Implement 0/1 Knapsack problem using Dynamic Programming.

5. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.

6. Find Minimum Cost Spanning Tree of a given undirected graph using Kristal's algorithm.

a. Print all the nodes reachable from a given starting node in a digraph using BFS method.

b. Check whether a given graph is connected or not using DFS method.

7. Find a subset of a given set S = {sl,s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d.

For example, ifS= {1, 2, 5, 6, 8} and d= 9 there are two solutions {1,2,6}and{1,8}.

A suitable message is to be displayed if the given problem instance doesn't have a solution.

8. Implement any scheme to find the optimal solution for the Traveling Salesperson problem.

9. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.

10. Implement All -Pairs Shortest Paths Problem using Floyd's algorithm.

11. Implement N Queen's problem using Back Tracking.

Text Books:

1. Fundamental of Computer algorithms, Ellis Horowitz and SartajSahni, 1978, Galgotia Publ.,
2. Introduction To Algorithms, Thomas H Cormen, Charles E Leiserson And Ronald L Rivest: 1990, TMH

Reference Books:

1. The Design and Analysis of Computer Algorithm, Aho A.V. Hopcroft J.E., 1974, Addison Wesley.
2. Algorithms-The Construction, Proof and Analysis of Programs, Berlion, P.Bizard, P., 1986. Johan Wiley & Sons,
 Writing Efficient Programs, Bentley, J.L., PHI

3. Introduction to Design and Analysis of Algorithm, Goodman, S.E. &Hedetnieni, 1997, MGH.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-	1	3	3
CO3	3	3	2	3	2	3	-	-	-	-	-	3	3	3
CO4	-	3	3	2	3	3	-	-	-	-	-	3	3	3
CO5	3	2	-	-	-	3	-	-	-	-	-	2	-	3

Course Title/Code	USER INTERFACE-II (MONGODB, TYPESCRIPT, ANGULAR JS) (CSW203B)
Course Type:	CORE
Course Nature:	Workshop
L-T-P Structure	(0-0-3)
Prerequisite	User Interface I
Credits	1.5
Objectives	Student will be able to develop a dynamic website.

Course Outcome	Mapping
CO1: Describe the basic building blocks of scalable web development	Employability & Skill development
CO2: Design dynamic web pages with good aesthetic sense of designing by applying Typescript, nodejs, AngularJs and MongoDB concepts.	Employability & Skill development
CO3: Implement Responsive Web Applications with AngularJS	Employability & Skill development
CO4: Build a HTTP server using the core modules in Node.js and create modules to organize the server	Employability & Skill development
CO5: Implement Database Connectivity to web applications and collect data through form.	Employability

Section A
TypeScript: Introduction, Data Types and Variables, Destructuring & Spread, Working with Classes, Function Types, Modules, Namespaces, Ambients, Working with Interfaces, Generics.

Section B
Angular JS4: Introduction, Directives and Templates, Data binding, Modules, Styles Binding in Components, Advanced Components Features, Template Driven Forms.

Section C

Angular JS4: Model Driven Forms, Working with Pipes, Custom Attribute and Validators, Dependency Injection, Services, Routing, Module, Crud Operations Using Http Service.

Section D

Node.js and MongoDB: Introduction, Filesystem, URL Module, Events, NPM, Upload files, Email, MongoDB Create Database, create collection, Insert, Find, Query, Sort, Delete, Drop Collection, Update, Limit, join.

List of Experiments:
1. Revision of JavaScript.
2. Typescript
3. Typescript
4. Angular JS
5. Angular JS
6. Angular JS
7. Node jS
8. Node jS
9. Mongodb
10. Mongodb
11. Projec**t**

Text / Reference Book:
1. Learning AngularJS – A guide to AngularJS Development, Ken Williamson, O'reilly
2. MongoDB: The Definitive Guide, Book by Kristina Chodorow and Michael Dirolf
3. Learning Angular: A Hands-On Guide to Angular 2 and Angular 4, Brad Dayley, Brendan Dayley, Caleb Dayley
4. MongoDB in Action, Book by Kyle Banker.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	1	1	-	-	-	-	1	1	1	2
CO2	2	2	1	3	2	1	-	-	-	-	-	1	1	2
CO3	2	2	3	1	2	-	-	-	-	1	-	3	3	2
CO4	3	1	3	1	3	-	-	-	-	-	-	-	2	2
CO5	2	3	3	3	1	-	3	3	2	2	3	3	3	3

Course Title/Code	**FRENCH-I(FLS103)**
Course Type:	**Allied Elective**
Course Nature:	Audit (University Compulsory)
L-T-P Structure	(1-1-0)
Credits	0
Objectives	At the end of the course, students will be able to 1. Exchange greetings and do introductions using formal and informal expressions 2. Understand and use interrogative and answer simple questions 3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary 4. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed 5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary 7. Provide basic information about familiar situations and topics of interest 8. Express or/and justify opinions using equivalents of different verbs Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture

Course Outcome	**Mapping**
CO1: Students will be able to exchange greetings and introduce themselves using formal and informal expressions. They will be able to ask and answer simple questions.	Employability & Skill development
CO2: Usage of basic vocabulary that can be used to discuss everyday life and using simple sentences and familiar vocabulary	Employability & Skill development
CO3: Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary	Employability & Skill development
CO4: Present basic information about familiar situations and topics of interests	Employability & Skill development
CO5: Justify opinions using equivalents of different verbs.	Employability & Skill development

CO6: Describe various places, location, themselves using simple sentences and vocabulary	Employability & Skill development

SECTION A

Unit - Saluer et épeler l'alphabet

1.1 Les Salutations & forms of politeness

1.2 Alphabets

Unit 2- Usage de Vous et de Tu

2.1 Taking leave expressions

2.2 Les pronoms sujets

2.3 Basic Questions

SECTION B

Unit 3- Présentez-vous

3.1 Les verbes ER

3.2 Self introduction

3.3 Décrivez votre ami(e)

SECTION C

Unit 4- Identifier un nombre, compter

4.1 Les noms

4.2 Verbes Avoir, Etre, Aller & Faire

4.3 Les nombres

Unit 5- Demander/ donner l'explications

5.1 Les articles define et indefini

5.2 Les mois de l'annee

5.3 Les jours de la semaine

SECTION D

Unit 6- Parler des saisons et demander l'heure

6.1 Time

6.2 Weather

6.3 Unseen Passage

Text Books/Reference Books/ Suggested Readings:

1. Alter Ego Level One Textbook, Annie Berthet, Catherine Hugot, Hachette Publications
2. Apprenons Le Francais II & III, Mahitha Ranjit, 2017, Saraswati Publications

Weblinks:

www.bonjourfrance.com

www.allabout.com

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	2	-	-	-	2
CO3	-	-	-	-	-	-	-	-	2	3	-	-	-	2
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO5									1	2				
CO6									2	3				

Course Title/Code	GERMAN-I(FLS102)
Course Type:	**Allied Elective**
Course Nature:	Audit (University Compulsory)
L-T-P Structure	(1-1-0)
Credits	0
Objectives	At the end of the course, students will be able to 1. Exchange greetings and do introductions using formal and informal expressions 2. Understand and use interrogative and answer simple questions 3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary 4. Express their likes and dislikes. Also, will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed 5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary 7. Provide basic information about familiar situations and topics of interest 8. Express or/and justify opinions using equivalents of different verbs 9. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture

Course Outcome	Mapping
CO1: Students will be able to exchange greetings and introduce themselves using formal or informal expressions.	Employability & Skill development
CO2: Students will be able to form simple sentences using new verbs and familiar vocabulary.	Employability & Skill development
CO3: Students will be able to identify key details in short, highly-contextualized audio text dealing with a familiar topic and relying on repetition and extra linguistic support when needed.	Employability & Skill development
CO4: Students will be able to discuss likes and dislikes, demonstrate simple conversations about familiar topics (e.g., greetings, weather, Family, Friends) with repetition when needed.	Employability & Skill development
CO5: Capable to differentiate certain patterns of behavior in the cultures of the German- speaking world and the student's native culture.	Employability & Skill development

CO6: Students will be able to describe various places, locations, themselves using simple sentences and vocabulary.	Employability & Skill development

SECTION A

Unit-1: Begrüßungen

1.1 Salutations/Greetings

1.2 Introduction

Unit-2: sich vorstellen und Zahlen
2.1 Introduction

2.2 Alphabets

2.3 Numbers 1-20

SECTION B

Unit-3: Berufe/ Pronomen

3.1 Personal pronouns

3.2 Hobbies and professions

SECTION C

Unit-4: Café
4.1 Café related vocabulary and dialogues

4.2 Revision personal pronouns

Unit-5: Café dialog

5.1 Café related vocabulary and dialogues

5.2 Common verbs and their conjugations

SECTION D

Unit-6: Zeit und Monate

6.1 Time

6.2 Days

6.3 Months

Text Books/Reference Books:

1. Studio D A1, Hermann Funk, 2011, Cornelson Publication
2. Tangaram Aktuell A1, Kursbuch & Arbeitsbuch, 2011, Hueber

3. Netzwerk, Stefanie Dengler, Paul Rusch et. Al, 2011, Klett

Weblinks:

http://www.nthuleen.com/

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	2	-	-	-	2
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	1	-	-	-	2
CO6	-	-	-	-	-	-	-	-	2	3	-	-	-	-

Course Title/Code	SPANISH-I(FLS101)
Course Type:	Allied Elective
Course Nature:	Audit (University Compulsory)
L-T-P Structure	(1-1-0)
Credits	0
Objectives	At the end of the course, students will be able to 1. Exchange greetings and do introductions using formal and informal expressions 2. Understand and use interrogative and answer simple questions 3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary 4. Express their likes and dislikes. Also, will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed 5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary 7. Provide basic information about familiar situations and topics of interest 8. Express or/and justify opinions using equivalents of different verbs 9. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture

Course Outcome	Mapping
CO1: Students will exchange greetings, introductions and frame simple questions-answers using formal and informal expressions.	Employability & Skill development
CO2: Students will make simple sentences using familiar vocabulary and verbs.	Employability & Skill development
CO3: Students will learn cardinal-ordinal numbers and use the same in daily conversation.	Employability & Skill development
CO4: Students will identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. Students will describe themselves, other people, places and objects in short discourse using simple sentences and basic vocabulary.	Employability & Skill development
CO5: Demonstrate the ability to read critically, interpret analytically, speak persuasively, and write coherently about both visual and verbal texts produced in the Spanish-speaking world.	Employability & Skill development

CO6: Students will be able to describe various places, location, themselves using simple sentences and vocabulary.	Employability & Skill development

SECTION A

Unit 1: Introduction to Spanish and SER

1.1 Presentation on Spanish language

1.2 Greetings and goodbyes

1.3 Spanish letters

1.4 Introduction of verbo SER

Unit 2: Verb Ser, Nationality, Profession and Counting

2.1 Uses of verbo SER

2.2 Adjectives related to verbo SER.

2.3 Introduction of Nationality

2.4 Professions and vocabulary related to professions.

2.5 Counting till number 20.

SECTION B

Unit 3: Articles, Interrogative and Estar

3.1 Introduction of Articles and Indefinite articles

3.2 Interrogatives

3.3 Introduction of Verbo Estar

SECTION C

Unit 4: Estar, Preposition, Tener and Self Introduction

4.1 Uses of Verbo ESTAR and adjectives related to it

4.2 Introducton of 'my house' vocabulary

4.3 Prepositions related to the positioning of an object

4.4 Self – introduction

SECTION D

Unit 5: Day, Month and Regular AR verb

5.1 Days

5.2 Months

5.3 Introduction to regular –AR verbs

Text Books/Reference Books:

1. ¡Ole!-Langers
2. ¡Uno, dos, tres…………

Weblinks:

http://studyspanish.com/

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	2
CO3	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	1	-	-	-	-
CO6	-	-	-	-	-	-	-	-	2	3	-	-	-	2

Course Title/Code	PROFESSIONAL COMPETANCY ENHANCEMENT-I(CDO201)
Course Type:	**Allied Core**
Course Nature:	Soft
L-T-P Structure	(0-0-1)
Credits	0.5
Objectives	Students will become better in analytics, problem solving and acquire enhanced aptitude and reasoning.

Course Outcomes:

Students will acquire basic knowledge about aptitude
Students will become better at analytics and problem solving
Students will be able to solve aptitude problems quickly utilizing the short cuts
Students will have enhanced level of reasoning, numerical skills and speed
Students will have the ability to 'quickly think on their feet'
Students will have enhanced concentration & thinking ability.

Course Outcome	Mapping
CO1: Students will describe basic knowledge about aptitude	Employability & Skill development
CO2: Students will be able to apply analytical reasoning to problem solving	Employability & Skill development
CO3: Students will demonstrate enhanced concentration & thinking ability and demonstrate a higher level of reasoning, numerical skills and speed	Employability & Skill development
CO4: Students will be able to solve aptitude problems quickly utilizing short cuts and will have the ability to quickly think on their feet.	Employability & Skill development

SECTION A

Reasoning Ability

Unit 1: Mental Ability

1.1 Mental Ability Test

1.2 Direction Sense Test

1.3 Blood Relations Test

1.4 Cubes

1.5 Cuboids

1.6 Dice

1.7 Word Problems

1.8 Puzzles

Unit 2: Verbal & Non-Verbal Reasoning

2.1 Letter Series

2.2 Set Theory

2.3 Venn Diagram

2.4 Syllogism

2.5 Missing Value in figure

2.6 Practice Test

SECTION B

Unit 3: Logical Reasoning & Word Puzzles

3.1 Logical Reasoning I

  3.1.1. Row Arrangement

  3.1.2. Circular Arrangement

3.2 Logical Reasoning II

  3.2.1. Arrangement

  3.2.2. Puzzles

3.3 Logical Reasoning III

3.4 Practice Test

Personality Development

Unit 4: Personality Development

4.1 Concept of personality

Concept of personality

Bringing out the best in one's personality

4.2 Self awareness

 Different learning styles

Areas of Self awareness

Developing self-awareness

4.3 Goal Setting

 Five principles of goal setting

Setting "SMART" goals

6P's of goal setting

 SWOT analysis

Short term& Long-term goals

SECTION C

Unit 5: Resume Writing

What, why and how of Resume

Building different sections of the Resume through projects and activities during the course

Unit 6: Presentation Skills

Designing the presentation

 Audience and content analysis

 Delivering the presentation- Preparation, Practice, Performance

SECTION D

Unit 7: Professional Communication

Email writing

Diction and Speech Clarity

 LSRW & Introduction to verbal ability as an assessment tool for employability

Unit 8: Professional Grooming and Etiquette

Professional grooming

Personal Grooming

Professional Etiquette

Courtesy and communication discipline

Text Books/Reference Books:

1.   A Modern Approach to Logical Reasoning: R S Aggarwal, S Chand & Company Pvt Ltd
2.   A Modern Approach to Non-Verbal Reasoning: R S Aggarwal, S Chand & Company Pvt Ltd

3.   Developing Management Skills by *David A Whetten, Kim S Cameron*

4.   Personality and Soft Skills Development by *Rajeev Kumar*

5.   English for business, 100 tips foe effective communication, By: Dignen, Bob; McMaster, Ian. Planegg: Spotlight Verlag GmbH. 2016. eBook.

6.   Presentation Skills for technical professionals: Achieving Excellence,By: Karten, Naomi; Gottesdiener, Ellen. Series: Soft Skills for IT Professionals. Ely, Cambridgeshire, United Kingdom :IT Governance Publishing. 2010. eBook., Database: eBook Collection (EBSCOhost)

Weblinks:

http://www.indiabix.com/aptitude/questions-and-answers/

http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	2	2	-	1	-	-
CO2	2	2	3	3	-	-	-	-	2	2	-	2	-	2
CO3	3	2	-	3	-	-	-	-	1	2	-	3	-	3
CO4	2	-	-	-	-	-	-	-	3	3	-	2	-	2

Course Title/Code	**INTRODUCTION TO RESEARCH(RDO201)**
Course Type:	**Allied Core**
Course Nature:	Research Type
L-T-P Structure	(0-0-1)
Credits	0.5
Objective	To apply the contextual knowledge of designing in research and to understand and adopt the ethical practice that are to be followed in the research activities. The student is able choose specific area of research.

Course Outcomes:

1. The student shall be able to describe research and its impact.

2. The student shall be able to identify broad area of research, analyze, the processes and procedures to

Carryout research.

3. The student shall be able to use different tools for literature survey

4. The student is able choose specific area of research and supervisor/mentor is finalized

5. To understand and adopt the ethical practice that are to be followed in the research activities

6. To work in groups with guidance

Course Outcome	**Mapping**
CO1: The student shall be able to describe research and its impact.	Employability & Skill development
CO2: The student shall be able to identify broad area of research, analyze, the processes and procedures to Carryout research.	Employability & Skill development
CO3: The student shall be able to use different tools for literature survey.	Employability & Skill development
CO4: The student is able to choose specific area of research and supervisor/mentor is finalized.	Employability & Skill development
CO5: To understand and adopt the ethical practice that are to be followed in the research activities.	Employability & Skill development
CO6: To work in groups with guidance.	Employability & Skill development

<p style="text-align: center;">**SECTION A**</p>

Unit 1: What is Research and its impact?

   1.1 Capturing the current research trends

   1.2 Insight about scientific research performed by renowned experts in the related field (case studies)

   1.3 Do's and Don'ts pertaining to research

<p style="text-align: center;">**SECTION B**</p>

Unit 2: Identification of Broad Area of research

   2.1 Identification of thrust area of research for deciding broad area

   2.2 Framing the research questions and hypothesis

   2.3 Identification of the research gap based on feasibility of problem

   2.4 Exploration of in-house and commercially available facilities related to broad area

<p style="text-align: center;">**SECTION C**</p>

Unit 3: Understanding the tools for Literature Survey

   3.1 Finding research papers related to a topic

   3.2 Understanding the different aspects of Literature search

   3.3 Usage of different sources like Google scholar, WoS, SCI/ SCIE, PubMed, Scopus, ABDC, EBSCO etc.

   3.4 Search for online journals relevant to research area

   3.5 Indexing of Journals

   3.5 Usage of scholarly networking sites like ResearchGate, Mendeley, and Academia.edu etc.

   3.6 Demo sessions on the usage of above-mentioned sources

<p style="text-align: center;">**SECTION D**</p>

Unit 4: Review of research papers pertaining to broad area and specific area of research

   4.1 Selection of relevant papers

   4.2 Finding specific research problem from broad area of research

   4.3 Literature survey and justification of specific research problem

   4.4 Experimentation and data cleaning and verification

   4.5 Understanding and selection of the research domain

4.6 Seeking information through published work w.r.t the problem

4.7 Reading & categorizing the downloaded/referred papers and structuring of the idea

4.8 Model design about framing the research questions

Unit 5: Report Writing and Presentation skill Development

5.1 Report making on the surveyed literature to cater the basic idea of the research papers

5.2 Compiling and analyzing the published results to justify and understand the proposed ideas

5.3 Usage of MS-PowerPoint and other technical resources for the presentation

5.4 Development of presentation skills and group addressing

5.5 Scientific/technical writing and ethical practice, project report

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	-	-	-	-	-	-	2	-	1	3	3
CO2	2	3	3	3	-	-	-	-	-	-	-	3	3	3
CO3	1	3	3	3	1	-	-	-	-	-	-	3	3	3
CO4	1	2	2	2	-	-	-	-	2	-	-	3	2	2
CO5	-	2	3	3	-	-	-	3	-	-	-	2	3	3
CO6	-	-	-	2	2	-	-	-	3	2	-	2	1	1

Course Title/Code	Supervised Learning (CSH212B-T) & (CSH212B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	• To introduce students to the basic concepts and techniques of supervised machine learning. • To develop skills of using supervised learning techniques for solving complex real world problems. • To impart experience of doing independent study and research.

Course Outcome	Mapping
CO1: Know the fundamentals and characteristics of machine learning techniques required to solve real-world problems	Employability & Skill development
CO2: Demonstrate the understanding of supervised machine learning algorithms known to solve classification and regression problems	Employability & Skill development
CO3: Apply supervised machine learning algorithms to real-world datasets	Employability & Skill development
CO4: Analyze the performance of supervised learning algorithms and model selection	Employability & Skill development
CO5: Design solutions to a range of complex real-world problems using supervised learning techniques	Employability & Skill development

Section A
Difference Between Supervised and Unsupervised Learning

Machine learning, why we need machine learning, machine learning process State the different types of learning: Supervised, unsupervised and reinforcement learning, detailing out on labeled data and its types, classification and regression models, unlabeled data and its types, clustering model; Gradient Descent-

Overview, Gradient Descent, finding a Minimum Using Gradient Descent, Estimating the Gradient, Using the Gradient Descent, Example, Loss Function, Different Loss Functions,

Section B
Regression Techniques

Regression Technique, Origin of Regression, Regression in Real World, regression concepts, Regression Types, Linear Regression Types, Linear Regression Variance, Co-Variance, Linear Regression Correlation Coefficient, OLS, R Squared, Goodness of fit, Linear Regression Using Gradient Descent, Gradient Descent Explained with an Example, Stochastic Gradient Descent, Cost Function –Partial Derivative, Testing Model Using Cross Validation, Cross Validation Types, regularized regression, Ridge Regression, lasso regression, L1 vs L2 Norm – Regression, Generalized Linear Regression, RANDOM COMPONENT OF A GLM

Section C
Classification Techniques- Decision Tress

Classification Technique, Decision Tree, Decision Tree Illustration using Sample Dataset, concept of homogeneity., entropy, Entropy Explained with Rainfall Example, plot of entropy versus the proportions, Information Gain, Algorithms to Create a Decision Tree, Gini Index, Truncation and Pruning, Decision Tree Working Methodology, Decision Tree Tuning Parameters

Section D
Classification Techniques- Naïve Bayes

Naïve Bayes, bayes theorem., Example, Naïve Bayes Algorithm for Categorical Data, Popular Naive Bayes Classifiers, Types of Naive Bayes Classifier, Naïve Bayes for Text Classification, popular naive bayes classifiers, Naïve Bayes Algorithm, K Nearest Neighbour classification, Curse of Dimensionality, K-Factor, Implementation of KNN using Python

Section E
Ensemble Methods

Ensemble Methods, Why Ensemble? Example, Methods for Constructing Ensemble, advantages and disadvantages of assembling. Random Forest, Random Forest Example, Random Forest Use Case, Random Forest Algorithm, comparing other Models Accuracy, Bootstrapping and Bagging, Out of Bag Error, OOB Score Before Tuning, OOB and Hyper Parameter Tuning, Ensemble Model Using Majority Voting, Gradient Boosting, Weak Learner, Gradient Boosting Example, Moving towards XGBoost, Parameters of XGBoost

Supervised Learning Lab

List of Programs
1. Understanding the Learning Implementation on Jupyter Notebook
2. Using NumPy functions in Jupyter
3. Using Pandas in Jupyter
4. Using SciPy in Jupyter
5. Using Simple Linear Regression, calculate Gradient and Cost minimum, along with line of best fit.
6. Understand Linear Regression and other regression techniques using house prices prediction dataset.
7. Understanding Decision tree with sample dataset.
8. KNN algorithm explained with Cancer Data. (Using Python)
9. Identifying optimal K value in K-means Clustering algorithm. (Using Python)
10. Random Forest algorithm explained with classification and Regression (Using Python)

11. Implement Gradient Boosting Machine using Python.

12. Understand Logistic Regression model using Iris dataset (using Python)

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	-	-	-	-	-	-	-	-	2	2
CO2	3	2	3	2	3	-	-	-	-	-	-	-	3	3
CO3	3	1	3	3	3	-	-	-	-	-	-	-	3	2
CO4	2	2	1	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	3	2	3	2	3	3	3

Course Title/Code	Software Craftsmanship - TDD/SOLID (CSH210B-T) & (CSH210B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	Students (A) would be able to understand and apply (B) concepts of Software Craftsmanship (C) for effective and efficient coding following clean coding and SOLID design principles (D).

Course Outcome	Mapping
CO1: Describe software craftsmanship and infer mastery of the paradigm.	Skill development
CO2: Demonstrating the fundamental characteristics of good design and apply SOLID design principles.	Employability
CO3: Apply Test Driven Development (TDD) to select and build software without code smells choosing common frameworks, code architectures and apt program strategy.	Employability
CO4: Utilize the learnt principles and techniques of software craftsmanship to evolve further.	Skill development

Section A

Introduction to Software Craftsmanship

Definition, History of the emergence of software craftsmanship, Software craftsmanship, Process versus paradigm, Software development processes, Software development models, Software design paradigms, Software development paradigms, Major programming paradigms Procedural programming paradigm, Object-oriented programming paradigm, Functional programming paradigm, Dimensions of craftsmanship, Craftsmanship - Mastery of the paradigm Describing and defining well-crafted code, Becoming a craftsman,The programming process

Section B

Code Design

Clean code and its fundamental concepts, Code Design, Software design considerations, Kent Beck's principle of simple design, Fundamental characteristics of good design, Design Patterns: Reusing best practices, SOLID design principles, Programming Principles

Section C

Code Structure

Classes, packages and methods: building blocks of code, organizing code: the size of methods and classes, what makes methods and classes "good", Software metaphors, Objects and data structures, data transfer objects, Using libraries, Overview of the best practices in structure: Law of demeter and open close principle,

Section D

Code Formatting & Documentation

Introduction, Variants, Vertical Openness, Vertical Density, Distance and Ordering, Naming Best Practices, Intention-Revealing Names, Avoid Mental Mappings, Naming Classes, Methods and Functions, Comments, Writing Code Documentation

Section E

Testing Debugging & Refactoring

Testing and Debugging, Basic Test-driven Development (TDD), Categories of TDD and Unit tests, Unit Testing Techniques, Automating Testing Using Junit, Refactoring: Improving Structure, Refactoring: Changing Code Structure without Changing Functionality, the need for Refactoring, The Refactoring Process and the Different Levels of Refactoring, Refactoring Strategies, Code Smells: Symptoms of Poorly Designed Code, Categories of Code Smells, Code Base, Using Frameworks & Tools

Software Craftsmanship Lab

1. Java1.8/Eclipse/Maven Setup and Configuration
2. Abstraction, Encapsulation, Inheritance and Polymorphism
3. Calculate Code Coverage for Java Code using Eclipse Plugins
4. Creating a Test Plan, Estimates, Define Exit/Entry Criteria for Test Cases for Features
5. SonarQube Setup and Analysis
6. Creating a Sample Junit Test Case
7. Mockito Framework and Test Cases
8. Agile Planning Case Study (General Dynamics UK)
9. Selenium Framework and Examples
10. Code Smells
11. Code Refactoring
12. Converting Junit to Testing Test Case

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	
CO2	3	3	3	-	2	-	-	3	-	-	-	-	3	3
CO3	3	3	3	-	3	-	-	3	-	-	-	-	-	-
CO4	3	3	3	-	3	-	-	3	3	3	3	3	3	3

SEMESTER-IV

Course Code	Course Name	Offering Department	Course Type (Core/Elective)	Structure			Credits
				L	T	P	
MAH202B-T & P	PROBABILITY & STATISTICS	MA	CORE	3	1	2	5
CSH205B-T&P	ARTIFICIAL INTELLIGENCE	CS	CORE	3	1	2	5
CSH206B-T&P	OPERATING SYSTEM	CS	CORE	3	1	2	5
CSH207B-T&P	SOFTWARE ENGINEERING.	CS	CORE	3	1	2	5
CSW208B	PROGRAMMING FOR PROBLEM SOLVING USING PYTHON	CS	CORE	0	0	3	1.5
FLS105/FLS106/ FLS107	FOREIGN LANGUAGE(SPANISH-II,GERMAN-II,FRENCH-II)	FL	ELECTIVE	1	1	0	0
CDO202	PROFESSIONAL COMPETANCY ENHANCEMENT-II	CDC	CORE	0	0	1	0.5
EDS240	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	ED	CORE	1	0	0	0
RDO502	RESEARCH & INNOVATION-1	RESEARCH	CORE	0	0	0	0.5
	TOTAL (L-T-P) /CREDITS)			14	5	12	22.5
SPECIALIZATION ELECTIVE BASKET							
CSH213B-T&P	UnSUPERVISED LEARNING & NEURAL NETWORK	CS	ELECTIVE	3	1	2	5
CSH211B-T&P	MODERN WEB AND MOBILE FRAMEWORKS	CS	ELECTIVE	3	1	2	5

DETAILED SYLLABUS
CSU01- Semester-IV

Course Title	Probability & Statistics (MAH202B-T) & MAH202B-P)
Course Type	Core (Allied)
Course Nature	Hard
L-T-P structure	(3-1-2)
Credits	5
Objectives	To solve & analyze problems related to distributions using probability and statistics

Course Outcome	Mapping
CO1: Apply the concept of probability theory and probability distributions to solve related problems.	Employability
CO2: Apply the concepts of some special discrete and continuous distributions to solve related problems.	Employability
CO3: Apply the concept of Joint probability theory and Joint probability distributions to solve related problems.	Employability
CO4: Solve and analyses problems related to curve fitting and applied statistics.	Employability/Skill development
CO5: Apply the knowledge of sampling theory to analyses and interpret given data.	Employability/Skill development

Section A

Module 1: Basic Probability: (12 hours) Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Section B

Module 2: Continuous Probability Distributions: (4 hours) Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Module 3: Bivariate Distributions: (4 hours) Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Section C

Module 4: Basic Statistics: (8 hours) Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Module 5: Applied Statistics: (8 hours) Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Module 6: Small samples: (4 hours) Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. 2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
2. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
3. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
6. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	3	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	3	-	-	-	3	3
CO3	3	3	-	2	3	-	-	-	3	-	-	-	3	2
CO4	3	3	3	3	3	-	-	-	3	-	-	2	3	3
CO5	3	3	3	3	3	-	-	-	3	-	-	2	3	3

Course Title/Code	Artificial Intelligence (CSH205B-T) & (CSH205B-P)
Course Type:	Core (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	The student will be able to solve computationally complex problems using artificial intelligence techniques.

Course Outcome	Mapping
CO1: Acquire and remember knowledge of basic Prolog Concepts.	Employability
CO2: Understand AI techniques and apply solutions to AI problems.	Employability
CO3: Learn and apply searching algorithms.	Employability
CO4: Learn and apply techniques of representing knowledge.	Employability & Skill development
CO5: Understand techniques of reasoning, planning and learning.	Employability
CO6: Analyze the role of AI techniques in applications and current trends of AI.	Employability & Skill development

Section A

Intelligent agents and AI Problems: Introduction to AI, Foundation and History of AI, Turing Test, Intelligent Agents: Architectures, Types: reactive, deliberative, goal-driven, utility-driven, and learning agents, Applications and Current Trends of AI.

Problem Representation in AI, State Space Representation and Problem Reduction, Production Systems: Inference Engine, Working Memory, Knowledgebase and Control Strategy using Water Jug Problem and n-Queens Problem.

Section B

Search Strategies and Knowledge Representation: Search Strategies: Uninformed Search Strategies, Informed Search strategies (Heuristic Search): Generate and Test, Hill Climbing, Best First Search, A*algorithm, AO*Algorithm, Constraint Satisfaction, Means End Analysis.

Game Playing: Minmax Strategy, Alpha-beta Pruning.

Introduction to Knowledge, Types of Knowledge, Issues in Knowledge Representation, Approaches to Knowledge Representation: Logic, Semantic Nets, Partitioned Semantic Nets, Frames and its types, Conceptual Dependency.

Section C

Knowledge Representation Techniques: Logical agents: Propositional logic, Inferences, First-order Predicate Logic, Inferences in First-order Predicate Logic, Forward Chaining, Backward chaining, Unification, Resolution.

Reasoning, Planning and Learning: Reasoning under Uncertainty: Monotonic and Non-Monotonic Reasoning, Statistical Reasoning: Review of probability: Axioms of probability, Probabilistic inference, Probabilistic Reasoning (Bayes Theorem), Bayesian Networks, Inferences in Bayesian networks, Temporal and Spatial Reasoning, Dempster-Shafer Theory, Fuzzy Reasoning, Hidden Markov models. Planning with state-space search, partial-order planning, planning graphs.

Learning from observation, Inductive learning, Deductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Machine Learning and its types: Supervised, Unsupervised and Reinforcement Learning, Natural Language Understanding, Overview of Natural Language Understanding and Deep Learning.

Section D

Advanced Topics and Applications of AI: Expert Systems: Architecture, Characteristics, Types, Advantages and Drawbacks, Knowledge Acquisition Principles, Study of MYCIN and DENDRAL, Overview of Knowledge Discovery from Databases, Web Intelligence, Robotics.

Semantic Webs, Natural Language Processing, Neural Networks, Genetic Algorithms, Big Data, Speech Processing.

Text Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar B. Nair, Third Edition, TMH.
2. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education.

Reference Books:

1. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Pearson Education.

2. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers, 1998

3. Simon Haykin, "Neural Networks", Pearson Education, Second Edition.

4. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Eastern Economy Edition, PHI

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	2	2	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	2	-	-	-	-	-	-	3	-	-
CO3	3	-	3	-	-	-	-	-	-	3	-	2	2	2
CO4	2	-	2	-	-	-	-	-	-	2	-	-	-	3
CO5	3	2	-	-	-	-	-	-	-	3	-	-	-	3
CO6	2	-	-	-	-	3	2	3	3	-	3	2	2	-

Course Title/ Code	Operating Systems (CSH206B-T) & (CSH206B-P)
Course Type:	Core
Course Nature:	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	Students shall be able to learn the conceptual design, functional architecture and services of an operating system to use the computer resources efficiently.

Course Outcome	Mapping
CO1: To interpret the basics of the Operating System (OS).	Employability
CO2: To apply the learned algorithms in relation to real problem scenario.	Employability
CO3: To analyze several concepts, techniques, algorithms and Operating Systems (OS).	Employability
CO4: Application, analysis and exploration of the learned aspects, concepts and prospects	Employability & Skill development

Section A

Introduction: Operating system and functions, Classification of Operating systems- Batch, Interactive, Time-sharing, Real-Time System, Multiprocessor Systems, Multiuser Systems, Multithreaded Systems, Operating System Structure- Layered structure, System Components, Operating System services, Reentrant Kernels, Monolithic and Microkernel Systems.

Processes and Threads: Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Interposes Communication, Communication in Client-Server Systems. CPU Scheduling: Scheduling criteria, scheduling algorithms (First Come First Serve (FCFS), Shortest-Job-First (SJF).

Section B

CPU Scheduling: Priority Scheduling, Round Robin (RR), multi-processor scheduling, Real-time scheduling. Multithreading Models, Threading Issues, Pthreads Basic Concepts.

Process Synchronization: Co-operating Process, Inter-Process Communication, Critical region, Semaphores. Classical Problems of Synchronization, Deadlocks: Overview, Methods of Handling Deadlocks, Deadlock Prevention, Avoidance, Detection and Recovery.

Section C

Memory Management: Logical & Physical Address Space, swapping, contiguous and non-contiguous memory allocation, paging and segmentation techniques, segmentation with paging; virtual memory management - Demand Paging & Page- Replacement Algorithms; Demand Segmentation. File System: Types of files and access methods, directory structures, various allocation methods, disk scheduling and management and its associated algorithms, Introduction to distributed file system.

Section D

Protection :Goals of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Revocation of Access Rights, Language-Based Protection, Capability-Based Systems, The Security Problem , User Authentication , Program Threats, System Threats, Securing Systems and Facilities.:: I/O Systems: Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O to Hardware Operations, STREAMS, Performance, Disk Structure, Disk Scheduling, Swap-Space Management.

List of Experiments:

1. Write programs using the following system calls of UNIX operating system fork, exec, getpid, exit, wait
2. Write programs using the following system calls of UNIX operating system: close, stat, opendir, readdir
3. Write programs using the I/O System calls of UNIX operating system (open, read, write, etc.).
4. Write C programs to simulate UNIX commands like ls, grep.
5. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for FCFS and SJF. For each of the Scheduling policies compute and print the average waiting time and average turnaround time.
6. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for SJF. For each of the Scheduling policies compute and print the average waiting time and average turnaround time.
7. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for Priority CPU scheduling. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
8. Given the list of processes, their CPU burst times and arrival times. Display/print the Gantt chart for round robin CPU scheduling. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
9. Implement some Memory management schemes FIRST FIT
10. Implement some Memory management schemes BEST FIT.
11. Implement some Memory management schemes WORST FIT.
12. Implement any file allocation techniques Contiguous.
13. Implement any file allocation techniques Linked.
14. Implement any file allocation techniques Indexed.

Text Books:
1. Silberschatz, Galvin, and Gagne, "Operating System Concepts with Java," 7th Edition. *John Wiley & Sons*, Inc. 2007. ISBN: 0-471-76907-X
2. Harvey M Dietel ,"An Introduction to Operating System", Pearson Education

Reference Book:

1. William Stallings, "Operating Systems: Internal and Design Principles," 5th Edition. *Prentice-Hall*, Inc. 2005. ISBN: 9780131479548.
2. Andrew S. Tanenbaum and Albert S Woodhull, "Operating Systems Design and Implementation," 3rd Edition .*Prentice Hall*, 2006. ISBN: 9780131429383.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO4	3	2	3	2	-	-	-	2	2	3	-	3	2	3

Course Title/Code	Software Engineering (CSH207B-T) & (CSH207B-P)
Course Type:	Core (Department)
Course Nature:	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objective	To study software development principles and to focus on the fundamentals of modeling aspects of software project using the Unified Modeling Language.

CO STATEMENT	Mapping
CO1: Students will be able to decompose the given project in various phases of a lifecycle.	Employability & Skill development
CO2: Apply software engineering principles and techniques to develop software systems	Employability & Skill development
CO3: Apply various project planning models and testing principles on software projects	Employability & Skill development
CO4: Design SRS and various diagrams using StarUML.	Employability & Skill development
CO5: Analyze risks and maintain software projects to ensure quality.	Employability & Skill development

Section A

Introduction: Evolving role of software, Software Characteristics, Software crisis, Silver bullet, Software myths, Software process, Personal Software Process (PSP), Team Software Process (TSP), emergence of software engineering, project and product

Software Development Life-cycle: Software life cycle models: Build and fix, Waterfall, incremental and evolutionary process, model, spiral model, agile methodology, and selection of a life cycle model.

Section B

Software Requirement Analysis and Specifications: Problem Analysis, Requirements engineering: Requirement elicitation, Requirement Analysis, Requirement documentation, Requirement Review, Types of requirements, Behavioral and non-behavioral requirement, feasibility study, Requirement elicitation: Interviews, Brainstorming, FAST, QFD, Use case Approach; Requirement analysis: DFDs, E-R diagram; Requirement documentation: Software Requirement Specification.

Software Project Planning: Project management concepts, planning the software project, Size Estimation—LOC based, FP based, COCOMO- A Heuristic estimation techniques, staffing level estimation, Putnam Resource Allocation model, risk analysis and management

Section C

Software Design: Design concepts and principles: the design process, Modularity: Cohesion, Coupling, Strategies of design: bottom up, top down, hybrid design, User interface design, Object Oriented design: Class Diagrams, Interaction Diagrams-State chart Diagrams-Activity Diagrams

Software Metrics: Token Count, Data Structure Metrics, Information Flow Metrics.

Software Quality Models and Standards: Quality concepts, Software quality Assurance, SQA activities, CMM, The ISO 9000 Quality standards: The ISO approach to quality assurance systems, The ISO 9001 standard, software reliability

Section D

Software Testing: Software process, Functional testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing: Path testing, Data flow and mutation testing, unit testing, integration and system testing, Debugging, Testing Tools & Standards.

Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Reverse Engineering, Software Re-engineering, Configuration Management, Documentation

LIST OF EXPERIMENTS: Tool Used: - Rational Rose Software

1. To identify the requirements of the project from the Problem statement and conduct Requirement elicitation techniques like Interviews, Brainstorming, FAST, QFD.
2. To perform E-R Modeling (E-R diagram, DFD) for the Problem Statement.
3. To Model UML Use Case Diagrams and capture Use Case Scenarios.
4. To design Software Requirement Specification document.
5. To estimate Size Metrics by calculating the number of Unadjusted Function points of the project using programming
6. To estimate Size Metrics by calculating the number of total Function point of the project using programming.
7. To draw Class Diagram and Interaction Diagrams.
8. To draw State Chart and Activity Diagrams.
9. To design test cases for the project using Black box testing.
10. To design test cases for the project using White box testing.

Text Books:

1. R. S. Pressman, "Software Engineering – A practitioner's approach", 3rd ed., McGraw Hill Int. Ed., 1992.
2. K.K. Aggarwal&Yogesh Singh, "Software Engineering", New Age International, 2001

Reference Books:

1. R. Fairley, "Software Engineering Concepts", Tata McGraw Hill, 1997.
2. P. Jalote, "An Integrated approach to Software Engineering", Narosa, 1991.
3. James Peter, W Pedrycz, "Software Engineering", John Wiley & Sons
4. Sommerville, "Software Engineering", Addison Wesley, 1999.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	1	2	-	2
CO2	3	3	3	-	2	-	-	-	-	3	2	3	-	2
CO3	3	3	3	-	3	-	-	-	-	3	-	3	2	3
CO4	3	3	3	-	2	-	-	-	-	-	-	3	2	2
CO5	-	-	-	-	2	-	-	-	-	-	-	3	-	3

Course Title/Code	Programming for Problem Solving using Python (CSW208B)
Course Type:	Domain Core (Department)
Course Nature:	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5
Objective	The course is designed to provide Basic knowledge of **Python**. **Python** programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the **Python** programming language.

Course Outcome	Mapping
CO1: To describe basic programing concepts in Python programming language	Employability & Skill development
CO2: To enable the student to demonstrate given program scenario and apply different programming constructs	Employability & Skill development
CO3: To analyze the semantics of the given problem statement and illustrate the programming techniques to solve them.	Employability & Skill development
CO4: To integrate the learned and applied concepts into given python projects to produce real life solutions	Employability & Skill development

Section A

Introduction: Introducing the Python language, Understanding the Python shell, writing a simple program, Development environment setup, Concept of module and packages,

Basic Operators – Arithmetic, Relational, Assignment, Logical, Membership and Identity operators, Variables and Data Types, Understanding Mutable and Immutable types, Working with various type – None, Boolean(True/False), Numeric(int, float, long), Sequence(String, List & Tuple), Mapping(Dictionary) Understanding the concept of header & suites in the language construct, Conditionals and inline syntax, Multiple assignments in variables, Working with data type conversion, Working with Loops – While & For Effects of break, continue, pass & else statement in various construct.

Section B

Implementing custom functions, Variable scope – Global vs. Local, Dealing with various function arguments – default, named and variable length arguments, Understanding the concept of pass by value and pass by reference, Returning multiple values from a function, Anonymous & Recursive function,

Understanding Strings in Python & different type of its delimiter, working with special string operators & formatted strings, exploring some useful built in string methods, Working with Date & Time,

Section C

Understanding File Operations, working with the File Object for reading & writing, Object oriented programming in Python, Understanding Classes & Objects, and Exploring different components of a Class**, Class** inheritance & Method overriding, working with multiple Inheritance, Understanding the Abstraction mechanism in Python, Built-in Class attributes, Exception handling,

Section D

Python DB Interaction. Python Demonstration: Reading and Writing CSV files, The Series Data Structure, querying a Series, The Data Frame Data Structure, Data Frame Indexing and Loading, querying a Data Frame, Indexing Data frames, Missing Values.

LIST OF EXPERIMENTS: Tool Used: - Eclipse Java Oxygen

1. Using IDE to create and execute Python Program.
2. Programming Constructs in Python – Hands- on - Practice
3. Control Structure - Hands- on - Practice
4. String & List: Hands- on - Practice
5. Operation on Tuples: Hands- on - Practice
6. Mapping (Dictionary): Hands- on - Practice
7. Function – Pass by reference: Hands- on - Practice
8. Working with the File Object for reading & writing
9. UML, Object Oriented Programming
10. Class inheritance & Method overriding: Hands- on – Practice
11. Exception handling: Hands- on - Practice
12. Python DB Integration

Text Books:
1. Dave Kuhlman, "A Python Book: Beginning Python, Advanced Python, and Python Exercises", December 2013.
2. Mark Lutz's, "Learning Python", O'Reilly, 2001

Reference Books:
1. Sahana Kumaraswamy, Roy Antony Arnoid G, "Assignment for Object Oriented Programming using Python", Infosys, Dec 2015.
2. Lutz, Mark, and Mark Lutz. Programming python. Vol. 8. O'Reilly, 1996.
3. Sommerville, "Software Engineering", Addison Wesley, 1999.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	2	2	2	2	2	-	-
CO2	3	3	3	3	-	-	-	-	2	2	2	2	-	2
CO3	3	2	2	-	-	2	2	2	2	2	3	2	2	-
CO4	3	3	2	2	3	-	3	3	-	2	2	2	2	-

Course Title/Code	FRENCH-II (FLS107)
Course Type:	Allied Elective
Course Nature:	Audit (University Compulsory)
L-T-P Structure	(1-1-0)
Credits	0
Objectives	At the end of the course, students will be able to 1. Recognize numbers and tell their age using numbers. 2. Tell and ask time in 12 hour and 24-hour format 3. Learn Basic vocabulary that can be used to discuss the weather and seasons 4. Identify colors, professions and adjectives in French and describing different people and objects using these three. 5. Describe orally and in writing themselves, their family and their friends. 6. Use reflexive verbs to describe daily routine. 7. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 8. Provide basic information about familiar situations and topics of interest 9. Express or/and justify opinions using equivalents of different verbs 10. Differentiate certain patterns of behavior in the cultures of the French-speaking world and the student's native culture

Course Outcome	Mapping
CO1: Use listening and speaking skills in a variety of small and large group activities	Skill Development
CO2: Write basic descriptive paragraphs with clear topic sentences and supporting detail	Skill Development
CO3: Analyze reading segments on a diverse number of cultural topics	Skill Development
CO4: Use reflexive verbs to describe daily routine.	Skill Development
CO5: Learn the usage of appropriate grammatical structures which include beginning-level vocabulary, and verb conjugations	Skill Development
CO6: Learn Basic vocabulary that can be used to discuss the weather and seasons	Skill Development

SECTION A

Unit 1- Se présenter (1)

1.1 Les pluriels

1.2 Adjectives to describe a person

Unit 2- Se présenter (2)

2.1 Professions

2.2 Short essay on family & friend

2.3 Comprehension

SECTION B

Unit 3- Parler de ses habitudes quotidiennes

3.1 Les verbes pronominaux

3.2 Décrivez votre journée

SECTION C

Unit 4- Nommez et localiser des lieux dans la ville

4.1 Prepositions

4.2 Asking & telling the way

Unit 5- Informations simples sur le climat, la météo

5.1 Les saisons

5.2 Les expressions de la saison

5.3 Comprehension

SECTION D

Unit 6- Demander/ indiquer les horaires et les couleurs

6.1 Timings

6.2 Colours

Text Books/Reference Books/ Suggested Readings:

1. Alter Ego Level One Textbook, Annie Berthet, Catherine Hugot, Veronique M Kizirian,Hachette Publications
2. Apprenons Le Francais II & III, Mahitha Ranjit, 2017, Saraswati Publications

Weblinks:

www.bonjourfrance.com

www.allabout.com

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	3	-	-	-	2

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CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	2
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO4	-	-	-	-	-	-	-	-	1	2	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	2		-	-	-
CO6	-	-	-	-	-	-	-	-	1	3	-	-	-	-

Course Title/ Code	GERMAN-II (FLS106)
Course Type:	Allied Elective
Course Nature:	Audit (University Compulsory)
L-T-P Structure	(1-1-0)
Credits	0
Objectives	At the end of the course, students will be able to 1. Exchange greetings and do introductions using formal and informal expressions 2. Understand and use interrogative and answer simple questions 3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary 4. Express their likes and dislikes. Also will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed 5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 6. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary 7. Provide basic information about familiar situations and topics of interest 8. Express or/and justify opinions using equivalents of different verbs 9. Differentiate certain patterns of behavior in the cultures of the German-speaking world and the student's native culture.

Course Outcome	Mapping
CO1: Students will be able to discuss about various directions, countries and languages they speak.	Skill Development
CO2: Students will be able to write short essays on family and friends. They will have knowledge of tenses.	Skill Development
CO3: Students will be able to identify classroom vocabulary in the German language.	Skill Development
CO4: Students will be able to speak ordinal and cardinal numbers and they will also learn months, days in German.	Skill Development
CO5: They will be able to express or/and justify opinions using equivalents of different verbs.	Skill Development
CO6: They will be able to describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.	Skill Development

SECTION A

Unit 1

1.1 Ordinal & Cardinal numbers

1.2 Months, days, Feiertage and dates

SECTION B

Unit 2

2.1 Verbs: to be and to have

2.2 helping verbs practice worksheets

2.3 Vocabulary (Family) short essay on family, friends etc.

SECTION C

Unit 3

3.1 Vocabulary (classroom)

3.2 Definite and indefinite articles

SECTION D

Unit 4

4.1 Countries, languages, directions

4.2 Past of the verb 'to be'

Text Books/Reference Books:

1. Rita Maria Niemann, Cornelsen, 2005, Studio d A1: Deutsch als Fremdsprache, Volume 6
2. Dallapiazza, Rosa-Ma
3. ria and Jan, Eduard von. Tangram aktuell 1. Deutsch als Fremdsprache Tangram aktuell 1 - Lektion 1-4: Deutsch als. (Hueber Verlag, 2005).
4. Dallapiazza, Rosa-Maria and Jan, Eduard von. Tangram aktuell 1. Deutsch als Fremdsprache Tangram aktuell 1 - Lektion 5-8: Deutsch als. (Hueber Verlag, 2005)
5. Paul Rusch, 2015: Langenscheidt and Klett

Weblinks:

http://www.nthuleen.com/

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	3	2	-	-	-	2
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-

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CO5	-	-	-	-	-	-	-	-	3	1	-	-	-	2
CO6	-	-	-	-	-	-	-	-	2	3	-	-	-	2

Course Title/Code	SPANISH-II (FLS105)
Course Type:	**Allied Elective**
Course Nature:	Audit (University Compulsory)
L-T-P Structure	(1-1-0)
Credits	0
Objectives	At the end of the course, students will be able to 1. Exchange greetings and do introductions using formal and informal expressions 2. Understand and use interrogative and answer simple questions 3. Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary 4. Express their likes and dislikes. Also, will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed 5. Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. 6. Describe colors, clothing, profession, family and marital status in short discourse using simple sentences and basic vocabulary 7. Provide basic information about familiar situations and topics of interest 8. Express or/and justify opinions using equivalents of different verbs 9. Differentiate certain patterns of behavior in the cultures of the Spanish-speaking world and the student's native culture

Course Outcome	**Mapping**
CO1: Exchange greetings and do introductions using formal and informal expressions. Understand and use interrogative and answer simple questions.	Skill Development
CO2: Learn Basic vocabulary that can be used to discuss everyday life and daily routines, using simple sentences and familiar vocabulary. Express their likes and dislikes. Also, will have understanding of simple conversations about familiar topics (e.g., greetings, weather and daily activities,) with repetition when needed.	Skill Development
CO3: Identify key details in a short, highly-contextualized audio text dealing with a familiar topic, relying on repetition and extra linguistic support when needed. Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary.	Skill Development
CO4: Describe themselves, other people, familiar places and objects in short discourse using simple sentences and basic vocabulary. Provide basic information about familiar situations and topics of interest.	Skill Development
CO5: Express or/and justify opinions using equivalents of different verbs. Differentiate certain patterns of behavior in the cultures of the Spanish-speaking world and the student€™s native culture.	Skill Development

CO6: Describe various places, location, themselves using simple sentences and vocabulary.	Skill Development

SECTION A

Unit 1- Mi famila

1.1 Describe your family

1.2 Adjectives to describe a person

1.3 Short essay on family & friend

Unit 2- Gustar

2.1 Likes and dislikes

2.2 Conjugation

2.3 Comprehension

SECTION B

Unit 3- Verbos Irregulares y reflexivos

3.1 Conjugation

3.2 Routina diaria

3.3 Sentence formation

SECTION C

Unit 4- El horario

4.1 Timings

4.2 Colours

Unit 5- Estar+gerundio

5.1 Conjugation

5.2 Prepositions

5.3 Picture description

SECTION D

Unit 6- Ser y estar

6.1 Direction

6.2 Comprehension

Text Books/Reference Books:

1. ¡Ole!-Langers
2. ¡Uno, dos, tres…………

Weblinks:

http://studyspanish.com/

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	2
CO3	-	-	-	-	-	-	-	-	3	2	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	2
CO5	-	-	-	-	-	-	-	-	3	1	-	-	-	2
CO6	-	-	-	-	-	-	-	-	2	3	-	-	-	-

Course Title/Code	PROFESSIONAL COMPETANCY ENHANCEMENT-II (CDO202)
Course Type:	**Allied Core**
Course Nature:	Soft
L-T-P Structure	(3-0-0)
Credits	0.5
Objectives	1. to improve students' basic knowledge about Arithmetic Aptitude 2. to make students solve aptitude problems quickly utilizing the short cuts 3. to make students have the ability to 'quickly think on their feet' 4. to strengthen students' communication skills

Course Outcome	Mapping
CO1: Students will be able to solve problems based on arithmetic & number system	Employability & Skill development
CO2: Students will be able to solve problems based on verbal reasoning & simplification	Employability & Skill development
CO3: Students will be able to calculate the correct answers to the problems within given time	Employability & Skill development
CO4: Students will be able to plan their career meticulously by setting their time-oriented goals	Employability & Skill development
CO5: Students will be able to demonstrate a good personality & communication skill	Employability & Skill development

Section A

Quantitative Aptitude

Unit 1: Arithmetic I

.1 Simplification

1.1.1 Use of BODMAS rule and Formulas for solving equations.

1.1.2 Simple Fractions and Decimal Fractions.

1.1.3 Surds and Indices.

1.2 Ratio and Proportion

1.2.1 Changes in Ratios, Combined Ratio and Continued Proportion.

1.2.2 Application in different questions.

1.2.3 Variations and Partnership.

1.3 Percentage

1.3.1 Basic Conversion, Consumption & Expenditure, Successive changes and Errors.

1.3.2 Application in Areas and Volumes.

1.4 Profit and Loss

1.4.1 Sales and Purchase Transactions.

1.4.2 MRP and Discount, Equivalent discounts.

1.4.3 Errors in weight (Dishonest Dealer).

1.5 Average

1.5.1 Combined and Mistaken Averages.

1.5.2 Changes in Average.

1.5.3 Application in Cricket and others.

1.5.4 Practice Exercise.

1.6 Interest

1.6.1 Simple and Compound Interest Formulae.

1.6.2 Relations and their Applications.

1.6.3 Practice Exercise.

Unit 2: Arithmetic II

2.1 Time and work

2.1.1 Combined work, Work & Wages, Work & Efficiency.

2.1.2 Working Alternatively, Work and Equations.

2.1.3 Pipes and Cisterns, Inlet and Outlet pipes, Capacity of Tank and Leakage.

2.2 Allegations & Mixtures

2.2.1 Formula Based

2.2.2 Successive Displacement

2.2.3 Mixtures

2.2.4 Error in Measurement

2.2.5 Profit on False Weight

2.3 Revision & Practice

2.3.1 Problems on Ages & Numbers

2.3.2 Calendar

2.3.3 Coding & Decoding

2.3.4 Data Sufficiency

<div align="center">**Section B**</div>

Verbal Ability Test

Unit 3. Communication Skills in English

1.1 Relevance of Verbal Ability AND PREPARATORY GUIDELINES

1.2 Functional Grammar – Subject Verb Agreement

1.3 Tenses – Perfect, Simple, Continuous

1.4 Common Errors and rectification

Unit 4: Word Power Building Skills

2.1 Words: Antonyms, Synonyms, Analogies,

2.2 Compound words: Homophones, Homonyms, Word Families

2.3 Root Word Technique for Prefixes & Suffixes

2.4: Word Power: 7 Tips for Learning New Words

2.5 Practice Vocabulary Exercises

Section C

Unit 5: Writing Skills

3.1 Writing: Introduction of Writing Skills, Objectives of enhancing Writing Skills & Types of Writing

3.2 Sentences, Phrases, Types of Sentences, Parts of Sentences

3.3 Paragraph Writing: Construction, Linkage & Cohesion

3.4 Practice Exercises: Writing Skills

Section D

Unit 6: Reading Skills

4.1 Objectives of Reading, Definition & Types of Reading & Importance of Reading

4.2 Reading Techniques: SW3R, Active Reading, Detailed, Speed

4.2 Practice Exercises: Short & Medium Passages

Text Books/Reference Books:

1.   Quantitative Aptitude: R S Aggarwal, S Chand & Company Pvt Ltd

2.   Quantitative Aptitude for CAT: Arun Sharma

3.   Verbal Ability and Reading Comprehension: MVN Enterprises

Web links:

http://www.indiabix.com/aptitude/questions-and-answers/

http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	-	-	2	-	2
CO2	2	2	2	-	-	-	-	-	2	-	-	2	-	3
CO3	-	-	-	-	-	-	-	-	2	-	-	2	-	2
CO4	-	1	-	-	-	-	-	2	2	2	-	2	-	3

		2	2	-	-	-	-	-	2	1	2	-	2	-	2
CO5															

Course Title/ Code	**RESEARCH & INNOVATION-I (RDO502)**
Course Type:	**Research Type**
Course Nature:	Hard
L-T-P Structure	(0-0-1)
Credits	0.5
Objective:	Students will be able to evaluate and understand research methodologies/approaches and techniques

Course Outcomes:

1. The students will be able to critically evaluate the work done by various researchers relevant to

The research topic

2. To integrate the relevant theory and practices followed in a logical way and draw appropriate conclusions

3. To understand the research methodologies/approaches/techniques used in the literature

4. To structure and organize the collected information or findings through an appropriate abstract, headings, reference citations and smooth transitions between sections

Course Outcome	**Mapping**
CO1: Describe the work done by various researchers relevant to the research topic	Skill Development
CO2: Compare the relevant theory and practices followed in a logical way and draw appropriate conclusions	Skill Development
CO3: Describe the research methodologies/approaches/techniques used in the literature	Skill Development
CO4: Create a research article based on collected information or findings through an appropriate abstract, headings, reference citations and smooth transitions between sections	Skill Development

Section A
Unit-1 Literature Survey (LS)/Design of Experiment

1.1 Collection of research papers related to previously identified gap/problem (15 papers or more)

1.2 Comprehend and arrange the literature based on the idea framed

1.3 Presenting the collected data and inferring it with the further scope of expansion and designing the experiment wherever applicable.

<div align="center">

Section B

</div>

Unit-2 Structuring of Review Paper and setting up of experimental facility

2.1 Analysis of different approach/methodology adopted by various researchers

2.2 Listing out the components of the paper/ setting up experimental facility w.r.t the problem

2.3 Identification of suitable Journal or Conference

2.4 Formatting/Styling the paper according to the respective template

<div align="center">

Section C

</div>

Unit-3 Departmental Presentation in the Mid Term Exam

3.1 Structuring and preparation of PPT

3.2 Mock presentation

3.3 Review on presentation skills and content delivered both

3.4 Incorporating the review comments in the slides

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-						2	3	3
CO2	3	2	2	1	2	2						3	3	3
CO3	3	2	2	1	2	2						3	3	3
CO4	3		2	1	1		2			3		2	3	3

Course Title/Code	Essence of Indian Traditional Knowledge (EDS240)
Course Type	Core
Course Nature	Audit
L-T-P Structure	(1-0-0)
Credits	0
Objectives	The course aims at · Imparting basics of Indian Traditional Knowledge from modern perspective. · Developing deeper understanding of various Indian Schools of Philosophy. · Appreciating the contribution of prominent Indian thinkers in shaping Indian Culture · Realizing the importance of Indian Traditional Knowledge in bringing a holistic and meaningful worldview

Course Outcome	Mapping
CO1: Describe basics of Indian Traditional Knowledge from modern perspective.	Skill Development
CO2: Developing deeper understanding of various Indian Schools of Philosophy.	Skill Development
CO3: Recognize the contribution of prominent Indian thinkers in shaping Indian Culture.	Skill Development
CO4: Reflect on the importance of Indian Traditional Knowledge in bringing a holistic and meaningful worldview.	Skill Development

Section A

Epistemology as branch of Philosophy and Conceptualization of Knowledge in Indian Tradition

Section B

Different Philosophical Schools: Idealism, Realism, Naturalism, Existentialism and Pragmatism

<div align="center">**Section C**</div>

Contribution of Indian Philosophers:Kautilya, Vivekananda, Gandhi, Tagore and Aurobindo

<div align="center">**Section D**</div>

Relevance of Indian Traditional Knowledge in modern context with special reference to Yoga and Spirituality

REFERENCE BOOKS

Agarwal, D.P. 2000. Ancient Metal Technology and Archaeology of South Asia. New Delhi: Aryan Books International.

Biswas, Arun Kumar. 1994. Minerals and Metals in Ancient India. Vol. 1 Archaeological Evidence. New Delhi: D. K. Printworld (P) Ltd.

Dilip K. Chakrabarti. The Early use of Iron in India. 1992. New Delhi: The Oxford University Press.

Chakrabarti D.K. (1996a). Copper and its Alloys in Ancient India. Delhi: MunshiramManoharlal Publishers Private Limited

Mukherjee, M. 1978 Metal craftsmen of India, Calcutta

Rakesh Tewari, 2003, The origins of iron-working in India: new evidence from the Central Ganga Plain and the Eastern Vindhyas

Srinivasan, Sharda and SrinivasaRangnathan. 2004. India's Legendary Wootz Steel. Bangalore: Tata Steel.

Tripathi, Vibha (Ed.). 1998. Archaeometallurgy in India. Delhi: Sharada Publishing House.

Tripathi, Vibha. 2001. The Age of Iron in India. New Delhi: Aryan Books International.

Chatterjee, Satischandra. 2007. An introduction to Indian philosophy.

Michaels, Axel (2004). Hinduism: Past and Present. New York: Princeton University Press.

Radhakrishnan, S (1929). Indian Philosophy, Volume 1. Muirhead library of philosophy (2nd ed.). London: George Allen and Unwin Ltd.

Radhakrishnan, S.; Moore, CA (1967). A Sourcebook in Indian Philosophy.Princeton.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	2	3	-	-	2	-	-
CO2	-	-	-	-	-	3	3	2	3	-	-	2	-	-
CO3	-	-	-	-	3	2	2	3	-	-	-	2	-	1
CO4	-	-	-	-	-	3	3	2	3	-	-	2	-	2

Course Title/Code	Unsupervised Learning (CSH213B-T) & (CSH213B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	By the completion of the course, the student will be able to understand and apply the knowledge of unsupervised algorithm of Machine Learning.

Course Outcome	Mapping
CO1: Demonstrate the understanding of dimensionality reduction techniques and unsupervised learning algorithms	Skill development
CO2: Demonstrate the understanding of neural networks and preliminary deep learning approaches	Skill development
CO3: Apply dimensionality reduction and learning algorithms to real world datasets	Employability
CO4: Evaluate the performance of learning algorithms	Employability
CO5: Design solutions to a range of real-world problems using learning techniques	Employability

Section A
Dimensionality Reduction
Introduction, Singular Value Decomposition, SVD code: Principal Component Analysis (PCA), Isometric Maps (Isomaps), Multidimensional Scaling (MDS), ISOMAPS with MDS, ISOMAPS (Code), Visualizing the ISOMAPS Data, Applying PCA on the Same Data, Visualization of PCA, Feature Selection Techniques, Wrapper Method

Section- B
Clustering
What is Clustering and Why is it Important? Techniques in Clustering, K-Means Clustering, Steps for K-Means Algorithms, Density Based Spatial Clustering (DBSCAN), Types of Points in DBSCAN, DBSCAN

Example, DBSCAN: Advantages, DBSCAN: Disadvantages, Hierarchical Clustering, Dendrograms, Hierarchical Clustering Code, DBSCAN Dendrogram Visualization

Section C
Neural Networks

Introduction to Neural Networks, Types of Neural Networks, Perceptron, Limitations of Perceptron, Activation Functions, Types of Activation Functions, Linear Activation Function, Non- Linear Data, Non-Linear Activation Function (Sigmoid), Non- Linear Activation Function (TanH), Non-Linear Activation Function (ReLu), Non-Linear Activation Function (Leaky ReLu), Derivative of Activation Functions Neural Networks, Feed Forward Network, ANN Forward Propagation, Flow of Data in ANN, Backpropagation, Cost Function in Backpropagation, ANN Evaluation, Complete Flow of Data in Neural Network, ANN Training ANN Design, Dropout in Neural Networks

Section D
Understanding Images:

Understanding Images, Need of Convolution Neural Network Convolution, Neural Network Working, Working of CNN with Kernel, Understanding Convolution Mathematically, An Example of CNN, Convolution of Images, Convolution Neurons Visualization, Parameters for Feature Maps, Activation Function in Convolution Neural Network, Pooling Step, Advantages of Pooling, Batch Normalization, Typical Convolution Neural Network, Training CNN using Backpropagation, Steps for CNN Backpropagation, Example of Convolution Neural Network Architecture, Visualization of Convolutional Neural Networks,

Section E
RNN Overview

Using MLP instead of RNN, Recurrent Neural Network (RNN), Steps in Recurrent Neuron, RNN Mathematically, Example of Forward Propagation for RNN, Back Propagation in Recurrent Neural Network, Steps for Back Propagation, Applications of RNN, Limitations of RNN, LSTM Conveyor Belt Analogy, Architecture of LSTM, Gates in LSTM, Forget Gate, Input Gate, Output Gate

Unsupervised Learning & Neural Networks Lab

List of Programs
1. Write a program for using PCA on MNIST Dataset.
2. Write a program for using PCA on Cat and Dog Dataset.
3. Write a program for using LDA on Cat and Dog Dataset.
4. Write a program for using DBSCAN on IRIS Dataset.
5. Write a program for using SVD on MNIST Digits Dataset.
6. Write a program for Feature Selection Techniques (Forward/ Backward).
7. Write a program for K-Means Clustering on IRIS Dataset.
8. Write a program for Hierarchical Clustering on Customers Dataset.
9. Write a program for Neural Networks on Mobile Price Classification.
10. Write a program for Convolution Neural Network on MNIST Dataset.
11. Write a program for Convolution Neural Network on Malaria Dataset.
12. Write a program for Convolution Neural Network on Aerial Cactus Dataset.

Course Learning Outcomes (CLOs)

On completion of this course, the students will be able to: -
1. Understand Unsupervised Techniques

2. Understand Neural Network basics with hands-on.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3	-	-	-	-	-	-	-	2	2
CO2	3	2	3	3	3	-	-	3	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	3	-	-	-	-	3	2
CO4	-	3	3	3	-	-	-	3	-	-	-	-	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Title/Code	Modern Web and Mobile frameworks (CSH211B-T) & (CSH211B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	Students would be able To develop cross platform applications.

Course Outcome	Mapping
CO1: Apply various application development standards studied in Software Engineering and basic of HTML, CSS studied earlier to observe new industry-standard application architecture that can be applied to application development.	Employability
CO2: Demonstrate the setup, designing and styling of a responsive web page using front end tools (HTML, CSS and JavaScript)	Employability
CO3: Construct web application to handle client and server-side scripting Node.js to run JavaScript code that can handle client requests.	Employability & Skill development
CO4: Develop a web and mobile application by using reusable components and JSX using React.js and Vue.js.	Employability & Skill development
CO5: Describe the functionality of various component used in the development of web and cross-domain application.	Employability & Skill development
CO6: Evaluate the performance of the application.	Employability

Section A

Web Designing

Introduction to HTML, Introduction, HTML Page Structure, Create HTML document, Understand the various elements available in HTML, HTML Use, Attributes in HTML, Need of Attributes, Common Attributes, HTML forms, Apply validations to the form elements, What is CSS, how to insert CSS in HTML, How CSS adds value to HTML, Difference between Semantic and HTML mark-up, CSS 3, CSS Selectors, Buttons, CSS float and clear, CSS align - horizontal and center, CSS Padding, CSS Links, CSS Lists, CSS Tables,

JavaScript:

What is JavaScript, Importance of JavaScript, what can JavaScript Do? JavaScript with HTML Attributes, JavaScript with CSS, Operators, JavaScript Syntax, JavaScript Data Types, JavaScript Functions, Setting up Environment, Variables, Control flow, if. Else, switch, loops, JavaScript HTML DOM Elements, JavaScript Syntax, Operators, Data Types, JavaScript String Methods, JavaScript Functions, Arrays, Sorting, Joins, Reduce map

Section C

Frontend Architecture

Introduction to Frontend Development, History, MVC, MVP, MVVM& Web Apps, Development of AJAX, Introduction to DOM, Basic DOM Manipulation, Reactive Programming, Introduction, ECMA Script, ES6 let and const, the arrow functions, New Literal Syntax, Classes, Inheritance using extends, Default Parameter Values, Spread Operator (...), Iterators and Generators, Features of React, Practical Application, why need React, How React Works, Leveraging Virtual DOM, setting up React

Section D

'REST API, GraphQL, & HTTP/2' REST API

Intro to API, History of API Development, Development of AJAX, CRUD; GraphQL; HTTP, HTTP 1.1, HTTP/2, Stream prioritization. Introduction to React Native, setting up React Native, The Expo Client, Working up on the First Project, Style, Fexbox Layout

Section

ENode.js

Introduction to Node.js, History, Why Node.js, Node.js Architecture, Features, Working of Node.js, Installation & Setting Up Node, setting up React, REPL Environment, REPL Commands, Variable, Components of Node.js, Local Modules, Module Exports: Export Object, Export Class, Loading Module from Separate Folder, Operating System, File Systems

Modern Web & Mobile Frameworks Lab Creating HTML Webpages using HTML Attributes

1. Create HTML Webpage using Links and Lists
2. Create HTML webpage using CSS Template
3. Create HTML Web page using CSS Opacity
4. Create HTML Web page using CSS Units
5. Create a Web page using CSS selectors
6. Exporting an object from a module using exports Object
7. Exporting nested objects and function from Module using exports Object
8. Writing to the server using request-response statements as a callback in create Server () function
9. Reading into a file asynchronously and writing code for handling error if file not found to read
10. Reading a text file on the server using http and fs module
11. Firing two events simultaneously simulating connection and receiving information from any database or server.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	3	3
CO2	3	3	-	2	3	-	-	3	-	-	-	2	3	3
CO3	3	3	-	3	-	3	-	-	3	-	3	3	3	3
CO4	-	-	-	-	-	-	-	-	3	-	3	3	3	3
CO5	3	3	-	3	-	3	-	3	3	-	3	-	3	3
CO6	3	-	-	2	2	-	-	-	-	-	-	2	3	3

Semester-V

Course Code	Course Name	Offering Department	Course Type (Core/ Elective)	Structure			Credits
				L	T	P	
CSH301B-T&P	COMPUTER NETWORKS	CS	CORE	3	0	2	4
ECH308B-T/P	DIGITAL ELECTRONICS & MICROCONTROLLER	EC	CORE	3	1	2	5
CSW308B	ADVANCED JAVA	CS	CORE	0	0	3	1.5
CSH303B-T&P/ CSH304B-T&P/ CSH305B-T&P/ CSH306B-T&P/ CSH307B-T&P/ MOOC	MOBILE COMPUTING WITH ANDROID/ ADVANCED DATABASE MANAGEMENT SYSTEMS/ NEURAL NETWORK & FUZZY LOGIC/ SYSTEM NETWORK & ADMINISTRATION/ SOFTWARE PROJECT MANAGEMENT/MOOC	CS	ELECTIVE	3	0	2	4
CHS234/ ECS306B/ CSS325B- T&P/ MOOC	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT/ GREEN COMPUTING/ E-WASTE MANAGEMENT/ MOOC	CH/CS/EC	ELECTIVE	1	0	2	2
LWS323/LWS325/ MOOC	CYBER LAW/ LAW RELATING TO INTELLECTUAL PROPERTY RIGHTS / MOOC	LW	ELECTIVE	2	0	0	2

CDO301	PROFESSIONAL COMPETANCY ENHANCEMENT-III	CDC	CORE	0	0	1	0.5
RDO601	RESEARCH & INNOVATION-II	RESEARCH	CORE	0	0	0	0.5
	TOTAL (L-T-P) /CREDITS)			12	1	12	19.5
SPECIALIZATION ELECTIVE BASKET							
CSH323B-T&P	ADVANCED NEURAL NETWORK	CS	ELECTIVE	3	1	2	5
CSH321B-T&P	DEVOPS AND TEST AUTOMATION	CS	ELECTIVE	3	1	2	5

DETAILED SYLLABUS
CSU01- Semester-V

Course Title/Code	Computer Networks (CSH301B-T) & (CSH301B-P)
Course Type	Core
Course Nature	Hard
L-T-P Structure	(3-1-2)
Credits	4
Objectives	● To familiarize the students with different protocols, network components, functioning of different layers and IEEE standards employed in computer networking.

Course Outcome	Mapping
CO1: Define knowledge of various transmission media, their components, and devices	Employability
C02: Describe the various networks and access techniques at data link layer level	Employability
CO3: Describe the IP addressing and various networks at the network layer level	Employability
CO4: Analyze the various protocols and congestion control at the transport layer level	Employability
CO5: Demonstrate the various network models at the application layer level	Employability

Section A

DATA COMMUNICATION: Components –Transmission Modes, Synchronous and Asynchronous transmission – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – TCP/IP Model
PHYSICAL LAYER: Transmission Media -- Line Configuration -- Line Coding -- Modem -- Interconnection devices: Hub, Repeater, Switch, Bridges, Router, and Gateway

Section B

DATA LINK LAYER& LOCAL AREA NETWORK: Framing -- Error – detection and correction, Window based – Flow Control and Error control - stop and wait –sliding window- go back-N ARQ –

selective repeat ARQ. –Access Techniques: STDM, FDMA, TDMA, Spread Spectrum techniques, and CDMA, DSSS, FHSSS – Media Access Control: Aloha. Pure Aloha, Slotted Aloha, Polling, CSMA, CSMA/CD -- IEEE 802 Standards -LAN - Ethernet IEEE 802.3 - IEEE 802.5 – IEEE 802.6 -- IEEE 802.11 – FDDI--X.25 – HDLC -- Frame Relay – ATM -- SONET/SDH

Section C

NETWORK LAYER*:* Internetworks Switching: Circuit Switching, Packet Switching, Virtual Circuit and PVC, Message Switching, Cell Switching – IP addressing – Subnetting–classful and classless– Routing Algorithms – Distance Vector Routing – Link State Routing, Path Vector Routing -- Error control and congestion control—ARP, RARP, ICMP, DHCP --IPV4 and IPV6 – NAT -- Mobile IP

Section D

TRANSPORT LAYER: Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS).

APPLICATION LAYER: Client Server model -- Network File System -- Remote Login- TELNET, FTP -- EMAIL SYSTEM: SMTP, POP3, IMAP4 -- DNS, DNS Server – HTTP – SNMP, Network Security. Firewalls -- Proxy Servers – VLAN-- VPN -- NETWORK Simulator case Study—Cisco Packet Tracer.

LIST OF EXPERIMENTS:

1. Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.
2. Working of Network Devices in Detail.
3. Sharing of Drive or folder over the Network
4. Sharing of printer over the network.
5. Study of basic network command and Network configuration commands i.e. attributes like ipconfig, ping, Tracert, Pathping, Netstat, Arp, Netstate
6. Find the IPAddress using getHostAddress,getByName.
7. Configure a Network topology using packet tracer software.
8. Track the network using a network management and monitoring tool
9. Connect the computers in Local Area Network using hub.
10. Find the MAC address using packet tracer software.
11. LAN-to-LAN Connections.
12. Advanced LAN Switching Configuration - VLANs
13. Building Inter-VLAN Network with a Router and Layer-3 Switch
14. Basic Router Configuration
15. RIP Version 2 and Debugging
16. Configure a Network using Distance Vector Routing protocol.
17. Configure Network using Link State Vector Routing protocol.

Text Books:

1. Data Communications and Networking by ForouzanBehrouz A., TMH Publications
2. Computer Networks (3rd edition), Tanenbaum Andrew S., International edition, 1996

Reference Books:

1. Data Communications, Computer Networks and Open Systems (4th edition), Halsall Fred, 2000, Addison Wesley, Low Price Edition. -
2. Computer Networks – A System Approach, Larry L. Peterson & Bruce S. Davie, 2nd Edition Computer Networking – ED Tittel , 2002, T.M.H.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	3	2	2	2	2	2	2

Course Title/Code	DIGITAL ELECTRONICS & MICROCONTROLLERS (ECH308B-T) & (ECH308B-P)
Course Type:	Core (Allied)
Course Nature:	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objective	This course presents the basic tools for the design of digital circuits and provides the fundamental concepts used in the design of digital systems

Course Outcome	Mapping
CO1: Apply the fundamental concepts and techniques used in digital electronics.	Employability
CO2: Describe the structure of various number systems and its application in digital design	Employability
CO3: Analyze and design various combinational and sequential circuits.	Employability
CO4: Identify basic requirements for a design application and propose a cost-effective solution	Employability
CO5: Find and prevent various hazards and timing problems in a digital design & also develop skill to troubleshoot the digital circuit.	Employability

Section A

Number Systems and Boolean algebra: Decimal, Binary, Octal and Hexadecimal number system, inter conversion of Decimal, Binary and Hexadecimal numbers. BCD numbers, BCD addition and subtraction.

De Morgan's theorem, standard POS and SOP forms, min-term and max-term representation of Boolean functions, simplification of Boolean functions using K-maps.

Section B

Combinational Circuits and Flip Flop: Half and Full adders, Half and Full Subtractor, Multiplexer, Demultiplexer, Encoder, Decoder, Priority encoder, Magnitude comparator, Code converter, Binary Multiplier, Latches, R-S, J-K and Master-Slave, T and D flip flops, Conversion of flip flops.

Section C

Sequential Circuits and Finite state machines: Shift registers, Ring counter, Ripple and Synchronous counter, Modulo-N counter, Decade counters, digital to analog converter (binary weighted register and

ladder types) and analog to digital converter (using D/A converter and comparator), Design of synchronous FSM, Algorithmic State Machines charts.

Section D

8051 Architecture and Programing: Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, addressing mode, 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction, Assembly language programs.

Text/Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.

2. Morris Manno, "Digital Circuits and Logic Design", Prentice Hall of India Pvt. Ltd., New Delhi.

3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.

4. Herbert Taub and Donald Schilling, "Digital Integrated Electronics", McGraw Hill Book Co

5. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989

6. M. A.Mazidi, J. G. Mazidi and R. D. McKinley, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.

7. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.

Course Outcomes	Program Outcomes													Program Specific Outcomes
	PO1	PO	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	2	-	-	-	2	2	1
CO2	3	3	2	-	-	-	-	2	-	-	-	2	2	2
CO3	3	3	3	-	2	-	-	-	2	-	2	-	3	2
CO4	3	2	3	2	-	2	2	2	-	-	-	-	3	2
CO5	3	3	2	-	-	-	-	1	-	-	-	-	2	2

Course Title/ Code	**Mobile Computing with Android (CSH303B-T) & (CSH303B-P)**
Course Type:	**Elective**
Course Nature:	Hard Course
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Students would be able to develop Android applications

Course Outcome	Mapping
CO1: Describe general programming knowledge to develop mobile applications and recall their skills of using Android software development tools.	Employability & Skill development
CO2: Demonstrate the understanding of the specific requirements, possibilities and challenges when developing for a mobile context and describe their ability to generalize software with reasonable complexity on mobile platform.	Employability & Skill development
CO3: Demonstrate the interaction between user interface and underlying application components and infrastructure	Employability & Skill development
CO4: Develop a prototype that can be evaluated with a specified user group and illustrate the deployment of app on various mobile API level.	Employability & Skill development
CO5: debug program/application running on mobile devices	Employability & Skill development
CO6: Demonstrate the ability to reflect over possibilities and demands in collaborative Android mobile application development	Employability & Skill development

Section A
Get started with Kotlin: Kotlin basics, installing IntelliJ IDEA, understanding project structure in Kotlin, Kotlin functions, classes and inheritance, interface, lambdas, higher order functions, and extension functions. Android Introduction: Android ecosystem, building blocks, framework architecture, installing Android Studio and AVD, understanding project structure, android resources, building your first app.

Section –B
Android application UI and Architecture: Creating activities and fragments and their lifecycle, understanding Implicit and Explicit**,** Manifest File use. User interfaces and layouts (Linear, Relative, and Constraint), layout properties, data binding, creating navigation graphs, and navigating between screens in an Android app. Architecture: UI layers, persistence.

Section C
Android Menu, Background operation and Testing: Component Event Handle, Component Focus, Threads, Menu: Appbar with Option menu, Contextual menu, Pop Menu, Sub menu, and menu via XML

and Code, Dialog, Navigation: Back & Hierarchy, Array & Base Adapters. Custom List View, Grid View using adapters & Recycler View, Styles and Themes, Adaptive Layout and Resource. Testing using Testcase Class / Espresso. **Background Operation:** AsyncTask and AsyncTaskLoader, Broadcast Receivers, Service, Notification.

Section D

DATABASES AND ANIMATIONS: Storing Options: Shared Preference, Internal & External Storage, SQLite, SQLite Operation, and Sharing Data between Applications with Content Providers and Content Resolver. Working with Cursors: Inserts, Update and delete. Reading and Updating Contacts, Reading Bookmarks. Graphics and Animation: Custom views, Canvas, animation APIs, Multimedia: Audio, Video. Permission, performance and Security. Firebase feature and App publish.

LIST OF EXPERIMENTS:

1. Installation and setup of java development kit (JDK), setup android Skeleton eclipse IDE, setup android development tools (ADT) plugins, create android virtual device.
2. Creating basic kotlin programs.
3. Create "Hello World" application. That will display "Hello World" in the middle of the screen using TextView Widget in the red color.
4. Create application for demonstration of android activity life cycle and Scroll View in Android.
5. Create an application for demonstration of Relative and Table Layout in android.
6. Create Registration page to demonstration of Basic widgets available in android.
7. Create sample application with login module. (Check username and password). On successful login, ChangeTextView "Login Successful". And on failing login, alert user using Toast "Login fail.
8. Create login application where you will have to validate username and passwords till the username and password is not validated, login button should remain disabled.
9. Create an application to run Explicit Activity using Intent.
10. Create an application that will get the Text entered in Edit Text and display that text using Toast.
11. Create an application that will pass two numbers using TextView to the next screen, and on the next screen display the sum of that number.
12. Create an application to Demonstrate Dialog Box Control in Android.
13. Create an UI such that one screen has list of all the types of cars. On selecting any car name, next screen should show Car details like: name, launched date, company name using database connectivity.
14. Run audio file in the background of previous application.
15. Animate an image view when it is clicked.

Text Books:
1. Dawn Griffiths, David Griffiths, "Head First Kotlin", O'Reilly Media, Inc., ISBN: 9781491996690
2. John Horton, "Android Programming with Kotlin for Beginners", Packt Publishing, ISBN:9781789800883, 1789800889

Reference Book:

1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd (2011).
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd(2009)
3. https://google-developer-training.github.io/android-developer-fundamentals-course-concepts-v2/index.html
4. https://developer.android.com/courses/kotlin-android-fundamentals/toc

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	3	-	-	3	-	-	-	-	3	3
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	-	-	-	-	3	-	-	-	-	3	3
CO4	3	3	3	-	-	-	-	3	3	-	-	3	3	3
	3	3	3	-	-	3	-	-	-	-	-	3	3	3
	3	3	-	3	3	-	-	-	-	-	-		3	3

Course Title/ Code	Advanced Database Management System (CSH304B-T) & (CSH304B-P)
Course Type	Elective (Department)
Course Nature	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	To the design and implement Distributed Databases. To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports.

Course Outcome	Mapping
CO1: Analyze different Data Model techniques e.g., RDBMS, OODBMS, ORDBMS, ERD by giving some examples	Employability & Skill development
CO2: Apply basic and Advanced SQL query and other emerging DBMS techniques	Employability & Skill development
CO3: Demonstrate the understanding of Database Transactions and Recovery Procedures	Employability
CO4: Analyze different advanced /emerging database management System	Employability & Skill development
CO5: Apply acquired knowledge for design holistic solution based on database system /database techniques	Employability

Section A

Overview of basic concepts of DBMS:
Formal review of ERD, relational database and FDs Implication, Closure, its correctness. Data Models: EER model and relationship to the OO model, Object Oriented Databases, Overview of concepts: object identity, object structure, type constructors, encapsulation of operations, methods and persistence, type hierarchies and inheritance, complex objects, overview of Object model of ODMG, object Relational databases, Databases design for an ORDBMS, Nested relational Model, storage and access method. Query Optimization, Cost Estimation in Query Execution, Semantic Query Optimization.

Section B

Database Transactions and Recovery Procedures:
Transaction Processing Concepts, Transaction and System Concepts, Desirable Properties of a Transaction, Schedules and Recoverability, Serializability of Schedules, Transaction Support in SQL, Recovery Techniques, Database Backup, Concurrency control, locking techniques for Concurrency Control, Concurrency Control Techniques, Granularity of Data Items. Client Server Computing: Client Server Concepts, 2-Tier and 3-Tier Client Server Systems, Client/Server Architecture and the Internet, Client

/Database Server Models, Technology Components of Client Server Systems, Application Development in Client Server Systems.

Section C
Distributed and Parallel Databases:

Reliability and Commit protocols, Fragmentation and Distribution, View Integration, Distributed database design, Distributed algorithms for data management, Heterogeneous and Federated Database Systems. Parallel database Architectures and their merits and demerits. Deductive and Web Databases: Recursive Queries, Prolog/Datalog Notation, Basic inference Mechanism for Logic Programs, Deductive Database Systems, Deductive Object-Oriented Database Systems; Web or Internet Databases: Introduction, uses, Building blocks of Web, tools, advantages and disadvantages.

Section D

Emerging Databases: Multimedia database: Definition, need of Multimedia databases, MDBMS, Multimedia database components and structure, Multimedia database queries and applications; Mobile database: definition, their need, Characteristics, architecture, uses and limitations of mobile databases; Digital libraries: Introduction, Objectives, types, components, myths, services, advantages, limitations, and comparison with traditional libraries; Spatial databases: Basic concepts, need, types and relationships, architecture, queries, indexing techniques, advantages and disadvantages of spatial databases; Temporal database: basic concepts, characteristics, components, merits and demerits.

LIST OF EXPERIMENTS:

1. To develop and write SQL queries for a distributed database of Bookstore at four sites S1, S2, S3 and S4. The bookstores are divided into four sites by their ZIP codes.

2. To implement Deadlock Detection Algorithm for Distributed Database using Wait-for Graph to check for Deadlock.

3. To design an Enhanced Entity Relationship model for university database and to write Object Query Language (OQL) to manage the database.

4. To implement University Counselling for Engineering Colleges using Parallel Database.

5. To implement parallel join and parallel sort algorithms to get marks from different colleges and publish 10 ranks for each discipline.

6. To create Triggers and Assertions for Bank Database handling deposits and loan and for Admission Database handling seat allocation and vacancy position.

7. To implement Query Optimizer with Relational Algebraic expression construction and execution plan generation for choosing an efficient execution strategy for processing the given query.

8. To design an XML Schema and to implement the queries using XQuery and XPath.

Project 1: A Case Study of the Faculty of Open Education.

Project 2: Case studies on the implementation and use of database management systems.

Text Book:

1. Fundamentals of Database Systems (3 edition), Elmasri R. and Navathe S.B., 2000, Addison Wesley, Low Priced Edition.

Reference Book:

2. Database System Concepts by A. Silbershatz, H.F. Korth and S. Sudarshan, 3rd edition, 1997, McGraw-Hill, International Edition.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	-	2	3
CO2	3	2	3	2	3	-	-	-	-	-	-	-	3	3
CO3	3	2	3	2	2	-	-	-	-	-	-	-	2	2
CO4	3	3	2	3	2	-	-	-	-	-	-	-	3	3
CO5	3	3	3	2	3	-	-	3	3	3	2	3	3	3

Course Title/Code	Neural Networks & Fuzzy Logic (CSH305B-T) & (CSH305B-P)
Course Type	Elective (Department)
Course Nature	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	The student will learn and apply the basic concepts of neural networks and fuzzy logic.

Course Outcome	Mapping
CO1: Demonstrate the knowledge of basic concepts of neural networks and fuzzy theory.	Employability & Skill development
CO2: Demonstrate the understanding of the application areas of neural networks and fuzzy theory.	Employability & Skill development
CO3: Apply models of neural networks on computational problems.	Employability & Skill development
CO4: Apply mathematical elements of fuzzy theory on computational problems.	Employability & Skill development

Section A

Biological Neurons: Introduction, working of the neurons relevant to ANN.

Artificial Neural Networks: Model of an Artificial Neuron, Basic Terminology related to ANNs, Models of ANNs: Feedforward& Feedback networks; Types of Learning: Supervised, Unsupervised and Recurrent; Neural Network learning rules: Hebbian learning rule, Perceptron learning rule, Delta learning rule, Widrow-Hoff learning rule, Correlation learning rule, Winner-take-all learning rule, Outstar learning rule.

Section B

Perceptron Networks: Single Layer Perceptron Networks: Classification model, Features & Decision regions; training & classification using discrete perceptron, algorithm, single layer continuous perceptron networks for linearly separable classifications.

Multilayer Perceptron Networks: linearly non-separable pattern classification, Delta learning rule for multi-perceptron layer, Generalized delta learning rule, Error back-propagation training, learning factors, Examples.

Section C

Self-Organizing Networks: Basic concepts, unsupervised learning of clusters.

Single layer feedback Networks: Basic Concepts, Hopfield networks, Training & Examples.

Associative memories: Linear Association, Recurrent Autoassociative memory: retrieval algorithm, storage algorithm; Bidirectional associative memory: Architecture, Association encoding & decoding, Stability.

Section D

Basics of Fuzzy Logic Theory: Crisp and Fuzzy Sets, Basic Set Operations, Fuzzy Relations, properties of membership functions, types of membership functions: triangular, trapezoidal, Gaussian, Composition of Fuzzy Relations, Mathematical Similarities between Neural Networks and Fuzzy Logic Models. Extension Principle, Linguistic Values, Linguistic variables, Fuzzy Rules, Membership Function Formulation and Parameterization, Fuzzy Reasoning.

List of Experiments

1. Simple MATLAB programs to implement Neural Networks and generating activation functions used in neural networks.
2. MATLAB programs to implement
   b. Single Layer Perceptrons for linearly separable classifications
   c. Mutilayer Perceptrons for linearly non-separable pattern classification
   d. Problems based on Self Organizing Networks
   e. Problems based on Back Propagation networks.
   f. Problems based on Associative Memory.
   g. Problems based on Hopfield Networks.
3. Given 3 fuzzy sets, A, B and C, write programs in MATLab to implement the following:
   a. $\underline{A}$
   b. $\underline{B}$
   c. $\underline{C}$
   d. A ∩ B
   e. A ∩ C
   f. B ∩ C
   g. A ∪ B
   h. B ∪ C
   i. A ∪ C
   j. A ∪ B ∩ C
   k. A ∩ B ∩ C

4. Write MATLAB programs to verify the following for the union operation, where P, Q and R are three given fuzzy sets:
5. Commutative Law for the sets P and Q
6. Associative Law for the sets P, Q and R
7. Distributive Law for the sets P, Q and R

Text Books:
1. Jacek M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House (15 copies available).
2. "Fuzzy Sets and Fuzzy Logic: Theory and Applications", by George J. Klir and Bo Yuan, 1995, Prentice Hall (24 copies available).

Reference Books:

1. Simon Haykin, "Neural Networks…. A comprehensive foundation", Prentice Hall International, 2nd Edition 1999, ISBN 0-13-273350-1 (11 copies available).

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	3	2	3	-	3	-	-	-	-	-	2	-	3	3
CO3	3	2	3	-	2	-	-	-	3	2	3	-	-	2
CO4	3	2	3	-	2	-	-	-	3	2	3	-	-	2

Course Title/Code	System and Network Administration (CSH306B-T) & (CSH306B-P)
Course Type:	Hard (Department)
Course Nature:	Elective
L-T-P Structure	(3-0-2)
Credits	4
Objectives	To understand roles and responsibilities of System and Network Administrator and to become skilled at related technologies.

Course Outcome	Mapping
CO1: demonstrate how to manage the tasks and responsibilities of the system and network administrator.	Employability & Skill development
CO2: demonstrate the understanding of how the system for a user/group can be established.	Employability
CO3: demonstrate the understanding of how the network can be established.	Employability & Skill development
CO4: apply the understanding of network security issues and plan for security.	Employability & Skill development
CO5: design/configure system and network in such a way that users can use the services without any interruption in spite of their activities.	Employability

Section –A

INTRODUCTION TO SYSTEMS AND NETWORK ADMINISTRATION: The Scope of Systems and Network Administration, Goals of Systems and Network Administration, System Components and their Management. Windows and Unix/Linux Variants: History, File Systems and Standards (UFS, NFS, NTFS), Processes and Job Control, Privileged, User and Group Accounts, Logs and Audits, Systems Performance Tuning.

Section B

HOST MANAGEMENT: Installing the Operating System, Basic DOS/Windows/Unix commands and tools, Command Line vs. GUI, Start up (booting) and Shutdown, Task Manager, System Processes: Scheduling jobs (Scheduler/Cron), job monitoring, (Event viewer/Ps), start and stop jobs, (Command vs. Scheduled Tasks GUI tool), Disk administration: Formatting, partitioning, Disk De-Fragmentation, RAID, Swap space, Basic client/server file sharing: Files, Directories and Memory Management, Permissions, Access Control List.

Section C

NETWORK ADMINISTRATION: TCP/IP, Connecting Devices, Addressing and Subnetting, DNS, DHCP, VLAN Principles and Configuration, Routing Concepts, Static and Dynamic Routing, Proxy Server, Network Address Translation (NAT), VPN, Firewalls: Filtering Rules.

Section D

ADVANCED TOPICS: Automating System Administration Tasks, Scripts, Registry edit (Shell/Python), Performance Monitoring and Optimization, Other Control Panel and Administration tools items, Computer Management GUI tool. Windows update, Security and backups, Patches, Passwords, Kerberos, Enigma, TCP Wrappers, Backup methods.

LIST OF EXPERIMENTS:

1. Installation of Operating System.
2. Management of User and Group account.
3. Setting up of a LAN environment.
4. Introduction and Installation of Window Server
5. Configuring the Windows Server Environment.
6. Setting up the Local Security Policy.
7. Troubleshooting Resources (Utility Commands).
8. Use of Event Viewer and Performance Monitor
9. Installation of Local and Network Printer.
10. Sharing Files and other resources.
11. Setting up Firewall and Filtering rules.
12. Case Study of recent configuration loop holes.

Text Books:
1. "Principles of Network and System Administration", Mark Burgess, 2000, John Wiley and Sons Ltd

Reference Book:
2. "TCP/IP Protocol Suit", Behrouz A. Forouzan, (2nd Edition), Mc Graw Hill Publications.
3. "Linux Network Administrator's Guide", Olaf Kirch and Terry Dawson, (2nd Edition), O'Reilly and Associates Inc., 2000, (Shroff Publishers and Distributors, Culcutta),
4. "TCP/IP Network Administration" (3rd Edition), Craig Hunt, O'Reilly and Associates Inc., 2002)
5. "Modern Operating Systems", Andrew S. Tanenbaum, (4th Edition), PHI Publications.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	1	-	-	-	-	1	-	1	1
CO2	3	2	2	2	2	1	-	-	-	-	-	-	3	3
CO3	3	2	3	2	3	1	-	-	-	-	2	-	3	2
CO4	3	2	2	2	3	1	-	-	-	-	2	-	3	3
CO5	3	3	2	2	3	2	2	2	2	2	2	3	3	3

Course Title/Code	Software Project Management (CSH307B-T) & (CSH307B-P)
Course Type:	Elective (Department)
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Student would be able to define and develop a software product from requirement gathering to implementation. The course focuses on the fundamentals of management of a software project.

Course Outcome	Mapping
CO1: Describe the principles and components of software project management and its application in real life.	Employability & Skill development
CO2: Apply techniques for requirement, policies and decision making for effective resource management.	Employability & Skill development
CO3: Apply project evaluation techniques for estimating cost, benefit, schedule and risk.	Employability
CO4: Devise a framework for planning project management activities.	Employability
CO5: Apply the tools and techniques used in project monitoring and control, managing people and enhancing software quality.	Employability & Skill development

Section A
Introduction to Software Project Management (SPM): Definition of a Software Project (SP), SP Vs. other types of project's activities covered by SPM, categorizing SPs, project as a system, management control, requirement specification, information and control in organization, Project Management Tools & Techniques, Project success factors, role of project manager.

Stepwise Project planning: Introduction, selecting a project, identifying project scope and objectives, identifying project infrastructure, analyzing project characteristics, identifying project products and activities, estimate efforts each activity, identifying activity risk, allocate resources, review/ publicize plan.

Section B
Project Evaluation & Estimation: Cost benefit analysis, cash flow forecasting, cost benefit evaluation techniques, risk evaluation. Selection of an appropriate project; Choosing technologies, choice of process model, structured methods, rapid application development, water fall-, V-process-, spiral- models. Prototyping, delivery. Albrecht function point analysis, COCOMO Model.

Activity planning & Risk Management: Objectives of activity planning, project schedule, projects and activities, sequencing and scheduling activities, activity recourse estimation, activity duration estimation, , Gantt Charts, network planning model, representation of lagged activities, adding the time dimension, backward and forward pass, identifying critical path, activity throat, shortening project , precedence

networks, Programme evaluation & review technique (PERT) and CPM, concept of slack time, schedule control.

Risk Management: Introduction, the nature of risk, managing risk, risk identification, risk analysis, reducing the risks, evaluating risks to the schedule, calculating the z values, qualitative risk analysis, using probability impact matrixes, expert judgement, qualitative risk analysis, decision trees & expected monetary value, simulation, sensitivity analysis, risk response planning, risk monitoring & control.

Section C

Resource allocation & monitoring the control: Introduction, the nature of resources, identifying resource requirements, scheduling resources creating critical paths, counting the cost, being specific, publishing the resource schedule, cost schedules, the scheduling sequence.

Monitoring the control: Introduction, creating the frame work, collecting the data, visualizing progress, getting the project back to target, change control, cost monitoring, Basis principles of cost management, Cost estimating, type of cost estimate, cost estimate tools & techniques, COCOMO, Putnam/ SLIM model Estimating by Analogy, cost budgeting, cost control, earned value management, project portfolio management.

Managing contracts and people: Introduction, types of contract, stages in contract, placement, typical terms of a contract, contract management, acceptance, Procurement management plans, Managing people and organizing terms: Introduction, understanding behavior, organizational behavior: a back ground, selecting the right person for the job, instruction in the best methods, motivation, working in groups, becoming a team, decision making, leadership, organizational structures, conclusion, further exercises.

Section D

Software quality: Introduction, the place of software quality in project planning, the importance of software quality, defining software quality, ISO 9126, Practical software quality measures, product versus process quality management, Quality Planning, quality Assurance, Quality control, external standards, techniques to help enhance software quality, Tool & techniques for quality control, Pareto Analysis, Six Sigma, CMM, Juran Methodology

Study of Any Software Project Management software: viz Project 2000 or equivalent.

LAB: SOFTWARE TOOLS USED: -PROJECT LIBRE (OPEN SOFTWARE)

With the help of this software, we will draw

1. Work Breakdown Structure
2. Resource Breakdown Structure
3. Activity Networks
4. Gantt chart
5. PERT chart
6. Precedence Network Diagram (Activity on Arrow)
7. Precedence Network Diagram (Activity on Node)
8. Network after the Forward pass and Backward pass.
9. **Calculate** Albrecht function point
10. Calculating Costs-Development costs, Setup costs, Operational costs.

Text Books:
1. Kathy Schwalbe; Information Technology Project Management fourth edition, Thomson Course Technology.
2. Bob Hughes and Mike Cotterell, Software Project Management, Third Edition, Tata McGraw-Hill.
3. Software Project Management, Walker Royce, 1998, Addison Wesley.

Reference Books:

4. Project Management Body Of Knowledge. [PMBOK].
5. Pankaj Jalote, Software Project Management in Practice, Pearson Education.
6. Software Engineering – A Practitioner's approach, Roger S. Pressman (5th edi), 2001, MGH.
7.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	3	2	-
CO2	3	3	3	3	2	1	-	-	-	-	-	2	2	-
CO3	3	3	2	-	-	1	-	-	-	2	3	3	2	-
CO4	3	3	2	2	3	2	-	-	-	-	-	3	2	-
CO5	3	3	2	2	3	2	3	3	3	3	3	2	2	2

Course Title/ Code	Advanced Java (CSW308B)
Course Type	Core (Department)
Course Nature	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5
Objectives	Students will be able to design/Create GUI desktop applications and web applications with database connectivity along with client server architecture and frameworks for solving real life problems.

Course Outcome	Mapping
CO1: Demonstrate programming in Core Java, Swing, Java Database Connectivity API (JDBC)	Employability & Skill development
CO2: Describe the program structure in Client Server network Communication, RMI, JavaBeans	Employability & Skill development
CO3: Classify the various functionalities of Java Servlet	Employability & Skill development
CO4: Compare static and dynamic content by using Java Server Pages	Employability & Skill development
CO5: Analyze the different database problems by using Java Framework: Struts	Employability
CO6: Create new technological heights in Java for own selves	Employability

Section A

GUI Application: Review of Java Basic Features (OOPS concepts, data types), Event Handling: Delegation event model, event interfaces & classes, Swing: Swing containers, Layout Manager, Swing Components (JLabel, JFrame, JPanel, Swign buttons, JList, JComboBox, JRadio buttons, JTextField, JTable ,JTree), Swing Menu. JAR files

Java Database Connectivity: Connectivity model, java.sql package, JDBC Exception classes, Database connectivity steps, Data manipulation and navigation, creating database applications.

Section B

Java Generic: type parameters, methods and classes**, Lambda expression** with single or multiple parameters**, Collection framework:** Collection interface and methods, List, Queue, Set & Map -interfaces and classes, Iterator, ListIterator & Enumeration interface.

Networking: Networking basics, Client/server model, Socket programming using Socket and ServerSocket class, Inet Address class, URL & URL Connection class, create networking applications.

Section C

Java Servlets: Lifecycle & Architecture, ServerletConfig, Servlet Context, Sharing information among servlet, GenericServlet, ServletRequest, and ServletResponse , HttpServletRequest, HttpServletResponse and HttpServlet ,Request-response, headers, GET, POST.

Session Management: Hidden form fields, Cookies, session tracking, Http Session, Exception handling and error pages.

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Section D

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Java Server Pages: Introduction, Architecture, Lifecycle, JSP implicit object, JSP syntax: directives, scripting element, standard action elements, Model View Controller (MVC), Data Sharing among JSP pages.

Frameworks in Java Struts: Introduction to the Apache Struts, MVC Architecture, Struts Architecture, How Struts Works? Introduction to the Struts Controller, Introduction to the Struts Action Class, Using Struts Action From Class, Using Struts HTML Tags, Introduction to Struts Validator Framework, Client Side Address Validation in Struts, Custom Validators Example, Developing Application with Struts Tiles.

LIST OF EXPERIMENTS:
1. GUI using Swings
2. Event Handling in GUI application
3. Java Database Connectivity (JDBC)
4. Java Generic program
5. Java Collection program
6. Networking and Socket Programming
7. Servlet application
8. JSP application
9. Struts framework

Text Books:
1. Core Java, Volume II: Advanced Features 9th Edition by Cay Horstmann
2. Java: The Complete Reference, Ninth Edition
3. Advanced Java Programming by Uttam K. Roy (Oxford university)

Reference Book:
1. O'Reilly Series for JSP and Servlets

2. O'Reilly Series for Swings and AWT

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	-	-	-	2	-	-	-	3	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	-
CO3	3	3	3	-	3	-	-	-	2	-	-	-	3	-
CO4	3	3	3	2	3	-	-	-	2	-	-	-	3	-
CO5	3	3	3	2	3	-	-	-	2	-	-	-	3	-
CO6	3	2	2	-	-	3	3	3	2	3	3	3	3	-

Course Title/Code	ENVIRONMENTAL ETHICS & SUSTAINABLE DEVELOPMENT(CHS234)
Course Type:	Elective (Allied)
Course Nature:	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objectives	The students would be able to describe, explain and analyses the sustainable development concerns and challenges. At the end of the course, the students would be able to • develop an inter-disciplinary understanding of sustainable development concerns; • recognize the challenges of sustainable development; the opportunities and limits in meeting these challenges; and • defend or criticize the sustainability initiatives adopted by different enterprises.

CO STATEMENT	Mapping
CO1: Develop an inter-disciplinary understanding of sustainable development concerns and challenges	Skill development
CO2: Propose and implement sustainable solutions to environmental issues (grow oyster mushrooms, develop a composting bin)	Employability
CO3: Understand the concept of sustainability initiatives & sustainability reporting and defend, criticize or compare the sustainability initiatives adopted by different enterprises	Employability
CO4: Discuss the importance of contemporary issues like consumption, indigenous knowledge, gender issues, population in achieving sustainable development	Skill development

Section A
Introduction to Sustainable Development
Definition of Sustainable Development; Triple Bottom Line, Components of TBL, Changing Perspective & Debates in Sustainable Development - Need for Sustainable Development, Evolution of the concept of Sustainable Development: Stockholm Conference, The Brundtland Commission, Earth Summit, Agenda 21; Millennium Development Goals

Section B

Challenges to Sustainable Development and Sustainable Development Goals (SDGs)
Challenges to Sustainable Development - Agriculture, Population & Food Security, Public Health and Nutrition, Education, Natural Resources (Forests, Energy, Water), Climate Change Sustainable Development Goals (SDGs) - Introduction, Challenges to SDGs, Indian Scenario.

Section C
Sustainability Strategies & Reporting
Sustainability Strategies & Reporting - Introduction, Rationale and Mechanisms, Key Principles, Sustainability Strategies Adopted by Different Enterprises – Case Studies

<div align="center">**Section D**</div>

Sustainable Development and Contemporary Issues
Sustainable Consumption, Indigenous Knowledge, Gender Issues, Population & Sustainable Agriculture, Sustainable Tourism

Tools: Video lecture; research papers or articles, survey, presentations, white board

LAB EXPERIMENTS/ACTIVITIES

1. Survey - Business and non-business students' perception towards TBL (based on the readings listed above); inferences on the basis of survey; http://www.aabri.com/manuscripts/121249.pdf
2. Workshop based - Sustainable agriculture- Mushroom farming
3. Workshop based - Back to nature - DIY composting bin
4. Review - Sustainable Consumption in India: Challenges and Opportunities; Divesh Kumar, Praveen Goyal, Zillur Rahman, Ishwar Kumar; IJMBs Vol. 1, Issue 3, September 2011; http; ://www.ijmbs.com/13/devesh.pdf
5. Calculate Carbon Footprint/Ecological footprint
6. Stimulus Activity (Piece of writing) - Sustainable Consumption
7. CSR - Workshop for Village school children
8. Simulation Activity - Challenges to Sustainable Development
9. Case Studies - Sustainability initiatives @ TATA Motors, CAIRN INDIA, Mahindra & Mahindra, Subaru Isuzu, Disney, Novo Nordisk, etc.

VIDEO LECTURES:

1. Triple Bottom Line (TBL) - https://www.youtube.com/watch?v=2f5m-jBf81Q
2. How Humans Made Malaria So Deadly - https://www.youtube.com/watch?v=64pvlCtH-O
3. Ocean Confetti! - https://www.youtube.com/watch?v=qVoFeELi_vQ&spfreload=5
4. Sustainability explained through animation - https://www.youtube.com/watch?v=B5NiTN0chj0
5. SDGs - https://www.youtube.com/watch?v=uHEfRAooih8
6. Micro-plastics - https://www.youtube.com/watch?v=UpGt5L3GC7o
7. Sustainable Consumption - http://www.ijmbs.com/13/devesh.pdf.

BOOKS/READING MATERIAL

1. Environmental Management for Sustainable Development; C.J. Barrow; Routledge Publishers
2. Roberts, J.T., and Hite, A., 2000, From Modernization to Globalization - Perspectives on Development and Social Change, Blackwell Publishing
3. Sachs, J., 2004, Stages of Development, Speech at the Chinese Academy of Arts and Sciences
4. Giddings, B., Hopwood, B., and Geoff O'Brien, 2002, Environment, Economy and Society: Fitting Them Together into Sustainable Development, Published online in Wiley Inter Science (www.interscience.wiley.com). DOI: 10.1002/sd.199
5. IPCC, Adaptation to Climate Change in the context of Sustainable Development and Equity, www.ipcc.ch/ipccreports/tar/wg2/pdf/wg2TARchap18.pdf
6. Brundtland Commission, 1987, "Our Common Future", Oxford University Press
7. Food Insecurity Atlas of Rural India (2001) MS Swaminathan Research Foundation and World Food Programme.
   http://home.wfp.org/stellent/groups/public/documents/ena/wfp076968.pdf.

8. Maternal and Child Undernutrition 1 Maternal and child undernutrition: global and regional exposures and health consequences http://www.who.int/nutrition/topics/Lancetseries_Undernutrition1.pdf.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	3	-	2	1	-	-	1	-
CO2	-	-	-	-	-	2	3	-	2	1	-	-	-	-
CO3	-	-	-	-	-	2	3	-	2	1	-	-	2	-

Course Title/Code	E-Waste Management (ECS306B)
Course Type:	Domain Elective (Allied)
Course Nature:	Hard
L-T-P Structure	1-0-2
Credits	2
Course Objectives	1. Gain a better understanding and appreciation for the challenges related to waste management. 2. Create awareness about environmental impacts of e-waste. **3.** Identify various components of e-waste

CO STATEMENT	Mapping
CO1: Analyze and demonstrate the scale of the e-waste problem and the legal framework for managing e-waste in your geographical or professional context.	Skill development
CO2: Identify the environmental, health and climate-related risks posed by e-waste as well as the potential value of e-waste.	Employability
CO3: Develop a project proposal to address an e-waste problem or opportunity that demonstrates some positive impact on environment, health, and climate change	Skill development
CO4: Apply practical actions from your learning of the course into the real world and help to raise public awareness.	Employability

SECTION A

INTRODUCTION: E-Waste; Indian and global scenario of e-Waste; Growth of Electrical and Electronics industry in India; E-waste generation in India; Composition of e-waste; Possible hazardous substances present in e-waste; Environmental and Health implications;

SECTION B

E-WASTE LEGISLATION: Regulatory regime for e-waste in India; The hazardous waste (Management and Handling) rules 2003; E- waste management rules 2015; Regulatory compliance including roles and responsibility of different stakeholders – producer; manufacturer; consumer etc;; Proposed reduction in the use of hazardous substances (RoHS) & REACH; Extended producer responsibility (EPR);

SECTION C

END OF LIFE MANAGEMENT OF E-WASTE: Historic methods of waste disposal – dumping; burning; landfill; Recycling and recovery technologies – sorting; crushing; separation; Life cycle assessment of a product – introduction; Case study – optimal planning for electronic waste;

SECTION D

ENVIRONMENTALLY SOUND E-WASTE MANAGEMENT: Emerging recycling and recovery technologies; Guidelines for environmentally sound management of e-waste; Environmentally sound treatment technology for e-waste; Guidelines for establishment of integrated e-waste recycling and treatment facility; Case studies and unique initiatives from around the world;

LAB EXPERIMENTS:

1. Identify the hazardous materials present in printed circuit boards.
2. Extraction of copper of printed circuit boards in etching solution.
3. Demo of recycling process through videos.
4. Extraction of precious metal from e Waste.
5. Invited guest lecture.
6. Field visit to a waste management initiative in NCR.
7. Activity based learning: survey of the household practice of e-waste disposal and awareness.
8. Case study – presentation and group discussion.

Websites/ Apps/ Models for E-waste management awareness and proper disposal and reduction

REFERENCE BOOKS:

1. Electronic Waste Management, R E Hester, R M Harrison, RSC publishing.
2. E Waste: Implications, Regulations and Management in India and current global practices, Rakesh Johri, TERI PRESS.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	3	3	3	1	2	-	2	2	2
CO2	3	3	2	2	-	3	3	3	3	2	-	2	3	3
CO3	3	3	2	2	-	3	3	3	3	2	-	2	3	3
CO4	3	3	2	2	-	3	3	3	3	3	-	2	2	3

Course Title/Code	Green Computing (CSS325B)
Course Type:	Elective (Department)
Course Nature:	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objective	Students shall be able to understand and apply green computing concepts on real life problems.

CO STATEMENT	Mapping
CO1: Acquire and remember knowledge of basic green computing concepts	Employability
CO2: Understand environmental problems being caused by computers and their solutions	Skill development
CO3: Learn and apply power management techniques in computers and datacenters	Employability
CO4: Learn techniques of how to follow an environment-friendly lifestyle at work	Skill development
CO5: Understand techniques of recycling e-waste	Employability
CO6: Analyze how to make information systems green	Skill development

Section A

Overview and Issues: Problems: Toxins, Power Consumption, Equipment Disposal; Company's Carbon Footprint: Measuring, Carbon Footprint Calculator (online); Plan for the Future; Cost Savings: Hardware, Power.

Initiatives and Standards: Global Initiatives: United Nations, Basel Action Network, Basel Convention; WEEE Directive, Restriction on Hazardous Substances Directive, the Paris Climate Agreement.

Section B

Minimizing Power Usage: Power Problems, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Virtualization, Management, Low Power Computers, PCs, Linux, Components, Servers, Computer Settings, Storage, Monitors, Power Supplies, Wireless Devices, Software.

Green Data Centers: The benefits of a green data center, developing a strategy, Energy optimization with IT equipment.

Section C

Changing the Way of Work: Old Behaviours, starting at the Top, Process Reengineering with Green in Mind, Analyzing the Global Impact of Local Actions, Recycling, Energy, Pollutants, Teleworkers, Telecommuting, Outsourcing, how to Outsource, Ethics of Green Computing in Daily Life.

Recycling: Problems: China, Africa; Materials, Means of Disposal, Recycling, Refurbishing, Recycling Life Cycle, Life of a Product, Cost, Green Design, Recycling Companies, Certifications, Hard Drive Recycling, Consequences, cleaning a Hard Drive, Pros and cons of each method, CDs and DVDs, good and bad about CDs and DVDs disposal, Change the mind-set.

Section D

Greening Your Information Systems: Initial Improvement Calculations, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling.

Green Computing in Ancient India: Balance of life in Indian villages with nature: Use of biomass as fuel, no electricity; devices made of natural materials, absence of e-waste.

Applications of Green Computing: Energy Efficiency of algorithms, Green Networks, Green Cloud Computing, Green Internet of Things, Green Artificial Intelligence, Relevance to Industry 4.0.

Text books:

1. Green IT, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill, 2008.

2. Green Data Center: Steps for the Journey Alvin Galea, Michael Schaefer, Mike Ebbers, Shroff Publishers and Distributers, 2011.

Reference Books:

3. Green Computing and Green IT Best Practice, Jason Harris, Emereo.

Online Content:

1. www.footprintcalculator.com

2. Living in Balance with Nature, Sachin Lakra, Kindle Desktop Publishing (online e-book only available at www.amazon.com).

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	2	2	-	3	-	-	-	-
CO2	2	3	3	-	-	3	3	2	-	3	-	-	-	2
CO3	-	3	3	-	-	-	3	-	-	-	-	-	-	2
CO4	-	-	-	-	-	3	3	3	-	-	-	-	-	2
CO5	-	3	-	-	-	-	3	-	-	3	-	-	-	-
CO6	-	3	2	-	-	-	3	-	-	3	-	-	1	2

Course Title/ Code	Cyber Law (LWS323)
Course Type:	Elective
Course Nature:	Soft
L-T-P Structure	(2-0-0)
Objectives	The Objective is this paper is to focus on basic concepts of Cyber Law relevant for understanding evolution of Cyber law and its conformity in any changing society.
Credits	2

CO STATEMENT	Mapping
CO1: Describe the concept of Cybercrimes and cyber-Law	Skill development
CO2: Critically analyses the problems arising out of online transactions and find solutions	Employability
CO3: Identify Intellectual Property issues in the cyber space and apply relevant laws to protect or fight infringement	Skill development
CO4: Critically analyses various sections of the Information Technology Act 2000 to apply such laws appropriately	Employability

Section A

Computer and its impact in society: - (Contact Hours - 4)

    A. Need for Cyber Law in 21st Century.
    B. Development of Cyber Law in India.

Section B

Privacy Issues & Access Rights: - (Contact Hours -6)

    A. Freedom of speech and expression in Cyberspace.
    B. Right to Privacy and Right to Data Protection.

Section C

Cybercrimes and Legal framework: - (Contact Hours -3)

    A. Kinds of Cyber Crimes: Hacking, Digital Forgery, Phishing, Spam, Malware etc.
    B. Cyber Stalking, Cyber Pornography, Cyber Vandalizing etc.
    C. Concept of Property in Cyberspace.

Section D

Information and Technology Act & Intellectual Property Rights: - (Contact Hours - 3)

    A. Historical Background & Objectives etc.
    B. Legal Recognition of Electronic Record & Procedures.

C. Offences and Penalties etc.

Tutorial activities 1 Hr/Week
- Quiz on Cyber Law and Cyberspace
- Discussion on Different types of Cyber Crimes and its negative effects on the Society
- Study about the various implementations of Information technology act,2000
- Any other suitable activity

Reference Books:

1. Cyber Law - Law of Information Technology and Internet – Anirudh Rastogi
2. Cyber Law in India(Law on Internet) – Dr. Farooq Ahmad

Course Outcome:-

1. The student will be able to understand the concepts and development of Cyber law in India.
2. The student will be able to examine the practical aspect of the existence of Cyber Crimes from Historic to Present Phase.
3. The Student will try to understand and deduce the various factors attributing to the rise of Cyber Crime and its impact on society.
4. The Student will understand the development of Legal Reforms in Present day society and what factors impact such legal reforms.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	-	-	1	-	3	-	-
CO2	3	2	-	-	-	-	-	-	2	-	-	1	-	-
CO3	3	1	2	-	-	-	-	1	-	-		2	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	3	-	-

Course Title/Code	Law Relating to Intellectual Property Rights (LWS325)
Course Type:	Elective
Course Nature:	Soft
L-T-P Structure	(2-0-0)
Credits	2
Objectives	The objective of this paper is to orient students to legal studies. The paper focuses on generally about law and legal system.

CO STATEMENT	Mapping
CO1: Understand the basics of Intellectual Property Rights	Employability
CO2: Categorize different types of intellectual properties	Skill development
CO3: Recognize the crucial role of intellectual property in different industries.	Employability
CO4: Understand the procedural aspect pertaining to application and grant of patent, trademark, geographical indication etc.	Skill development

Section A
Introduction to IPRs and Trademark and Trade Secrets (Contact Hours 4)
a. Introduction to various types of IPR Laws
b. Protection of Trademarks under Trademarks Act – Basic legal Framework
c. Trade Secrets and protection thereof

Section B
Protection of Copyright, Traditional Knowledge, Design and Integrated Circuits (Contact hours 4)
a. Legal Framework relating to Copyright protection in India
b. Protection of Industrial Designs under Designs Act
c. Protection of integrated circuits

Section C
Law relating to Patents (Contact Hours - 4)
a. Legal Framework for registration and protection of patents and related rights

Section D
IT Law and Cyber Offencesand other IPRs (Contact Hours – 4)
1. Introduction to Information Technology Act, 2002
2. **Cyber** Offences
3. Geographical Indicators and PPVFBR

Tutorial activities 1 Hr/Week
a. Statutes and Case Laws
b. Case studies from India and abroad

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	-	-	-	2	1	2	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	1	-	-	
CO3	3	1	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	-	-	-	-	-	-	-	-	-	-	-	-	-

Course Title/ Code	Professional Competency Enhancement-III(CDO301)
Course Type:	Allied Core
Course Nature:	Soft
L-T-P Structure	(0-0-1)
Credits	0.5
Objective	Students will become better in analytics, problem solving and reasoning

Course Outcome	Mapping
CO1: Students will describe basic knowledge about aptitude	Employability & Skill development
CO2: Students will be able to apply analytical reasoning to problem solving	Employability & Skill development
CO3: Students will demonstrate enhanced concentration & thinking ability and demonstrate a higher level of reasoning, numerical skills and speed	Employability & Skill development
CO4: Students will be able to solve aptitude problems quickly utilizing short cuts and will have the ability to quickly think on their feet.	Employability & Skill development

Section A

Unit-1: Percentages

Increase & Decrease Concepts, Time Saver Tricks, Concepts of Population, Marks, Examinations & Exams.

Unit-2: Profit, Loss & Discount

Buying & Selling, Dishonest Dealers, Successive Discounts, Marked Price Concepts

Section B

Unit-3:Ratio & Proportion

Combined Ratio, Division of Values, Proportion, Bags & Money and Partnership

Unit-4: Alligations or Mixtures

Rule of Alligation, Successive Replacement & Mixing

Section C

Unit-5: Time & Work

Combined Work, Efficiency & Wages, Alternative, Changing Man Power

Unit-6: Pipes & Cisterns

Inputs & Leaks, Capacity of Tank

<div align="center">Section D</div>

Unit-7: Time, Speed & Distance

Average Speed, Relative speed, Trains, Boats & Streams, Circular Motion

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	-	-	2	-	2
CO2	2	2	2	-	-	-	-	-	2	-	-	2	-	3
CO3	-	-	-	-	-	-	-	-	2	-	-	2	-	2
CO4	-	1	-	-	-	-	-	2	2	2	-	2	-	3
CO5	2	2	-	-	-	-	-	2	1	2	-	2	-	2

Course Title/Code	Research & Innovation-II (RDO601)
Course Type:	Research Type
Course Nature:	Hard
L-T-P Structure	(0-0-1)
Credits	0.5
Objective	To apply the contextual knowledge of designing techniques and technologies in research.

Course Outcome	Mapping
CO1: The students will be able to apply the contextual knowledge to describe techniques and technologies	Employability
CO2: To analyze and interpret the research outcomes	Employability
CO3: To describe new techniques/technologies/methodologies	Employability & Skill development
CO4: To describe current research available in the literature	Employability & Skill development

SECTION A

Unit-1 Setting up the simulation/experiment environment

1.1 To conceptualize simulation/verifying experimental set up

1.2 Measurements on experimental system/simulations of the model

1.3 Choosing the appropriate research methodology

1.4 Finding the resources for performing experiments/simulations

SECTION B

Unit-2 Planning of experiments

2.1 Formulate experimental procedures with Modification of the experimental set-up, if required

2.2 Procurement of materials

SECTION C

Unit-3 Execution of experiments/simulations

3.1 Conduct experiments/ build prototype

3.2 Tabulating and recording data

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3.3 Analysis and interpretation of the data

3.4 Comparison of the results with other reported experiments

3.5 Interpretation of observations

SECTION D

Unit-4 Documentation and presentation

4.1 Integration of relevant theory, findings in a structured way and draw appropriate conclusions

4.2 Review and modification of the draft

4.3 Seminar presentation

4.4 Communication to conference/Journal

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	1	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	2	3	-	-	-	-	-	1	3	3
CO3	3	3	3	3	2	3	-	-	-	-	-	2	3	3
CO4	3	-	3	3	3	-	2	-	-	3	-	3	3	3

Course Title/Code	Advanced Neural Networks (CSH323B-T) & (CSH323B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	The course objective is to help students learn, understand, and practice Deep Learning approaches.

Course Outcome	Mapping
CO1: Demonstrate the understanding of neural networks.	Employability
CO2: Demonstrate the understanding of advance neural networks and preliminary deep learning approach	Employability
CO3: Apply advance neural networks algorithms to real world datasets	Employability
CO4: Evaluate the performance of learning algorithms	Employability & skill development
CO5: Design solutions to a range of real-world problems using learning techniques	Employability & skill development

SECTION A RNN
Gradient Descents, Recurrent Neural Network, Predicting the next character using RNNs, Hopifield Network, Gated Recurrent Unit (GRU), Bidirectional RNN

SECTION B Deep Learning:
Introduction to Deep Learning, Introduction to TensorFlow, creating a Deep Learning Network using TensorFlow

SECTION C Boltzmann Machines
Introduction to Boltzmann Machines, Restricted Boltzmann Machines, Collaborative Filtering using Boltzmann Machines, Markov Random Fields, Deep Boltzmann Machine

SECTION D Deep Belief Networks
Introduction to Deep Belief Network, Stacking RBM to create Deep Belief Network, Wake Sleep Algorithm

SECTION E Modern Statistical Concepts
Learn about confidence intervals, define jackknife regression, explain graphical models, Describe tetter goodness of fit and yield metrics

Advanced Neural Networks Lab

List of Programs

1. Build a perceptron model from Scratch
2. Write a program to visualize different activation functions and their derivative
3. Write a program for Hyperparameter Tuning and Optimization in TensorFlow
4. Write a program for simulation of Jackknife estimation of mean and median
5. Write a program for understanding different TensorFlow syntax and different operations.
6. Write a program to understand Keras in TensorFlow
7. Write a program for Linear Regression in TensorFlow
8. Write a program for Logistic Regression with TensorFlow
9. Write a program for Next character prediction using RNN in TensorFlow
10. Write a program for next character prediction using Bidirectional RNN in TensorFlow
11. Write a program for next word prediction using RNN in TensorFlow
12. Write a program for Collaborative Filtering using RBM in TensorFlow
13. Write a program for Classification using DBN
14. Write a program for A/B Testing using Bayesian Method in TensorFlow

Course Learning Outcomes (CLOs)

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

1. Understand Regression with TensorFlow
2. Learn Keras concepts

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	2	3
CO2	3	2	3	2	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	2
CO4	3	3	1	3	3	3	3	3	3	3	3	3	3	3
CO5	3	1	1	-	-	-	-	-	-	-	-	-	2	3

Course Title/Code	DEVOPS AND TEST AUTOMATION (CSH321B-T) & (CSH321B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	Student will be able to understand concept of DevOps and Test Automation.

Course Outcome	Mapping
CO1: Know the fundamentals and characteristics of DevOps and Test Automation that make is useful to solve real world problems	Employability
CO2: Demonstrate the understanding of Version Control System.	Employability
CO3: Implement the functionality of version control.	Employability & skill development
CO4: Design solutions to a range of complex real world problems using Version control and Test Automation	Employability & skill development

SECTION A Typical Toolkit of DevOps

DevOps: An Overview, Achieving DevOps, Continuous Practices, How does CI Work?, Continuous Integration Practices, Commit Code Frequently, Maintain a Single Source Repository, Don't commit code, Keep the Build Fast, Every Commit Should Build the Mainline, Fix Broken Builds Immediately, Write Automated Developer Tests, Automated deployment helps, Benefits of Continuous Integration, Continuous Delivery, Continuous Delivery Process, Benefits of continuous delivery practices.

SECTION B Version Control System

Brief History of Version Control Systems, Basic Operations in a VCS, Examples of Version Control Systems, Concurrent Versions System (CVS), Subversion (SVN), Mercurial, Git, The Making – History of Linux and Git, Advantages of Git

SECTION C Version Control System vs Distributed Version Control System

Local Repository, Centralized Version Control System (CVCS), Distributed Version Control System (DVCS), Advantages of Distributed Version Control System, Private Workspace, Easier Merging, Easy to

Scale Horizontally, Disadvantages of Distributed Version Control System, vs Distributed Version Control Systems, Comparison of CVCS and DVCS, Multiple Repositories Model, Multiple Repositories for Different Services, Resetting the Local Environment, Revert - Canceling out the Changes

SECTION D DevOps Automation

The Software Delivery Pipeline, Overview of the Continuous Delivery Pipeline, Fully Automated Software Delivery Process, The Build Process, Automated build, Automated Test, Automated Deployment, Benefits of Automated Deployment, Automated Deployment and DevOps Adoption, Automated Deployment and DevOps Adoption, Overview of Rapid Application Development (RAD), Phases in RAD, Essential Aspects of RAD, Code generation, Categories of Code Generators

SECTION E Test Automation

Introduction to Test Automation, what to automate, Test Scenario, Test Case Design, Test Basis, Traceability Matrix

Automation Lab

1. Introducing Version Control System -Installing Git CLI on Linux, Mac & Windows

2. Setting up a Git Repository & Initialization

3. Cloning an Existing Repository

4. Introducing GitHub & Exploring GitHub

5. Fork and Push an Existing Repository

6. Working with Git- File States, Project Section, Workflow,

7. Working with Git Operations- git status, git add, git commit, git stage

8. Git Configuration Files -.gitattributes

9. Identifying Binary Files, Diffing Binary Files

10. Working with Git History

11. Merge Resolution in Git
12. Working with Git Branching

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	-	-	1	-	2	2	2
CO2	3	1	-	-	-	1	-	-	1	2	3	1	3	3
CO3	3	3	2	2	3	1	-	-	3	2	3	1	3	3
CO4	2	3	1	2	3	-	-	-	2	2	3	3	3	3

SEMESTER VI

Course Code	Course Name	Offering Department	Course Type (Core/ Elective)	L	T	P	Credits
CSH310B-T&P	COMPUTER GRAPHICS & MULTIMEDIA	CS	CORE	3	1	2	5
CSH311B-T&P	THEORY OF AUTOMATA & COMPILER DESIGN	CS	CORE	3	1	2	5
CSH312B-T&P/ CSH313B-T&P/ CSH314B-T&P/ CSH315-B-T&P/ CSH316B-T&P/ MOOC	ADVANCED ANDROID DEVELOPMENT/DATA WAREHOUSE & DATA MINING/MACHINE LEARNING/ N/W SECURITY & CRYPTOGRAPHY/ OBJECT ORIENTED SOFTWARE ENGINEERING/ MOOC	CS	ELECTIVE	3	0	2	4
CSH401B-T&P/ CSH402B-T&P/ CSH403B-T&P/ CSH404B-T&P/ CSH405B-T&P/ MOOC	PROGRESSIVE WEB APPLICATIONS/ BIG DATA/IMAGE PROCESSING/ CLOUD COMPUTING/ SOFTWARE TESTING/ MOOC	CS	ELECTIVE	3	0	2	4
ECW312B/MEW315B/CSW317B/ MOOC	ELECTRONIC DESIGN WORKSHOP/ 3-D SOFTWARE/ AGILE TECHNOLOGIES/ MOOC	ME/CS/EC	ELECTIVE	0	0	3	1.5
ECW310B/MEW318B/CSW318B/CSW207B/ MOOC	SENSORS & IOT/ 3 D PRINTING/ R PROGRAMMING / IMAGE EDITING & ANIMATION/ MOOC	EC/ME/CS	ELECTIVE	0	0	3	1.5
EDH422	BIOLOGY	ED	CORE	2	0	0	2
CDO302	PROFESSIONAL COMPETANCY ENHANCEMENT-IV	CDC	CORE	0	0	1	0.5
TOTAL (L-T-P) /CREDITS)				14	2	15	23.5
SPECIALIZATION ELECTIVE BASKET							
CSH324B-T&P	NATURAL LANGUAGE PROCESSING	CS	ELECTIVE	3	1	2	5
CSH322B-T&P	MODERN ARCHITECTURE PATTERNS	CS	ELECTIVE	3	1	2	5

DETAILED SYLLABUS
CSU01- Semester-VI

Course Title/ Code	Computer Graphics and Multimedia (CSH310B-T) & (CSH310B- P)
Course Type:	CORE (Department)
Course Nature:	HARD
L-T-P Structure	3-1-2
Credits	5
Objectives	The student will be able to apply the Computer Graphics algorithms and techniques to generate graphical outputs and to examine applications of modeling, design and visualization.

Course Outcome	Mapping
CO1: Describe knowledge of basic primitives of computer graphics, multimedia building blocks and their application.	Employability & Skill development
CO2: Explain the concepts and techniques used in 2D and 3D graphics.	Employability
CO3: Demonstrate and examine interactive computer graphics Objects.	Employability & Skill development
CO4: Outline and illustrate digital portfolio and other independent and team projects.	Employability & Skill development
CO5: Apply and evaluate these techniques in real life scenarios.	Employability

Section A

Introduction: Concepts and Application of Graphics, Display Devices: CRT, Raster, And Random, Flat Panel displays. **Basics Primitives**: Scan conversion, Point representation, Line representation: DDA, Bresenham's Line Algorithm (1stOctant, Integer, General), Circle representation: Generalized Circle generating Algorithm, Bresenham's Circle, Midpoint Circle. **Filled area algorithms**: Flood Fill, Boundary Fill, Scan Line Fill, Edge Fill.

Section B

2-D Transformation: Basic Transformations (Translation, Rotation, Scaling, Reflection, Shearing), Matrix representation and Homogeneous Coordinates, Coordinate transformation, Composite transformations.**3-D Transformation:** Basic Transformations, Matrix representation, Coordinate transformation, Composite transformations. **Viewing and clipping**: 2-D Viewing, Pipeline, Window to viewport mapping, Clipping: Point, Line and Polygon Clipping.

<div align="center">**Section C**</div>

3-D Projections- Parallel and Perspective. **Hidden Surface removal**: Introduction to hidden surface removal, Z-buffer Algorithm, Scanline Algorithm, Area subdivision method.
Representing Curves & Surfaces: Parametric representation, Bezier curve, B-Spline curve, Interpolation method. **Illumination**: Shading, Image manipulation, Illumination model, shading models for polygons, shadow, and transparency.

<div align="center">**Section D**</div>

Multimedia Fundamentals: Concepts**,** Application & Framework of Multimedia system, Multimedia devices
. **Multimedia building blocks**: Using Text in Multimedia, Still Images: bitmap, vector drawing & 3-D drawing and rendering, Image file formats. Sound: Audio-Speech recognition, Digital Audio MIDI, Multimedia Authoring Tools.
Compression Techniques: JPEG Compression, MPEG Compression, DVI.**Animation:** Introduction to Animation, Principle of Animation, Animation Types, Animation Tools.

LIST OF EXPERIMENTS:

1. Understanding of Basic Graphics Code.
2. Understanding of Basic Graphics Functions.
   a. Line ( );   Cleardevice ( ); Closegraph( ); Getx( ); Gety( );   Getmaxx ();   Getmaxy ( ); Getpixel( ); Putpixel( ); Getcolor( ); Getbkcolor( );   Circle( ); Rectangle ( ); Ellipse( ); Arc ( ) ; Setcolor ( ); Setbkcolor( ); Settext( ); Outtext( ); Outtextxy( ).
3. Program to draw the shape of hut,flag,car.
4. Implement the DDA and Bresenham algorithm to draw a line.
5. Implement the Bresenham and midpoint algorithm to draw Circle.
6. Program to Change the Color and Design of Circle.
7. Program to implement the Flood Fill and Boundary Fill Algorithm.
8. To perform 2D transformations (translation, rotation, scaling, shearing, reflection).
9. To implement composite transformations and clipping algorithm.
10. To perform animations using C.
11. To study the introduction to Flash and Flash tools.
12. To apply animations on various objects using Frames.
13. To study the implementation of animations using layers and guided layers.
14. To implement motion tweening and shape tweening.

Text Books:

1. Computer Graphics by Donald Hearn and M.Pauline Baker, 2nd Edition, 1999, PHIedition, 1996.
2. An introduction, Villamil & Molina, Multimedia Mc Milan, 1997.

Reference Book:

1. Computer Graphics Principles and Practices second edition by James D. Foley, Andeiesvan Dam, Stevan K. Feiner and Johb F. Hughes, 2000, Addision Wesley.
2. Procedural Elements for Computer Graphics – David F. Rogers, 2001, T.M.H Second Edition.
3. Mathematical Elements for Computer Graphics – David F. Rogers, 2001, T.M.H Second Edition.
4. Multimedia: Making it work, Tay Vaughan, fifth edition, 1994, TMH.
5. Multimedia Systems by John .F. Koegel, 2001, Buford.
6.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	-	-	-	2	2	3
CO2	3	2	-	1	2	-	-	-	-	-	-	2	3	2
CO3	2	2	3	2	2	-	-	2	2	-	-	-	2	2
CO4	2	2	3	2	2	-	-	2	3	2	1	-	1	2
CO5	2	2	3	3	3	1	1	2	3	-	2	3	2	2

Course Title/ Code	Theory of Automata & Compiler Design (CSH311B-T) & (CSH311B-P)
Course Type	Core
Course Nature	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	Student will able to understand the principles and techniques of programming language translation.

Course Outcome	Mapping
CO1: Describe various types of Automata (FA, PDA, TM), Regular Expressions and Grammars	Employability & Skill development
CO2: Solve mathematical problems or human logic by using Automata Theory	Employability & Skill development
CO3: Describe the Pushdown automata and Turing machines and how they work.	Employability & Skill development
CO4: Analyze lexical, syntax and semantic analyzer of compiler phases	Employability
CO5: Analyze different techniques for intermediate code and machine code optimization.	Employability

Section A

Finite Automaton: Finite State Systems, Representation of finite automaton, non-Deterministic finite automata (NDFA), Deterministic finite automata (DFA), Equivalence of DFA and NDFA. Removals of ε – moves from finite automata, Minimization of finite Automata, Regular Expressions: - regular expression, Equivalence of finite automata and Regular Expressions, Arden's theorem. The Pumping Lemma for Regular Sets, Closure properties of regular sets and regular language.

Section B

Context free grammar: - Reduced forms, Chomsky Normal Form (CNF), Griebach Normal Form (GNF). Pushdown Automata: - NDPDA, DPDA, LBA. Turing Machines: - Deterministic and Non-Deterministic Turing Machines, universal Turing machine, Design of TM Chomsky hierarchy.

Section C
Compilers and translators, structure of compiler. Lexical Analyzer: Lexical Analysis, recognition of tokens, Syntax Analysis: parsing, Parsing Technique: Top-down approach (Recursive Descent, Recursive Predictive and Non-Recursive Predictive Parsing Techniques). Bottom-Up approach: Shift- reduce parsing, operator precedence parsing, LR parsers, SLR, LALR and Canonical LR parser.

Section D

Syntax Directed Translations: Syntax directed definition, construction of syntax trees, syntax directed translation scheme, and implementation of syntax directed translation, three address code, quadruples and triples. Code Optimization & Code Generation: Code generation, forms of objects code, machine dependent code, optimization, register allocation for temporary and user defined variables. Peephole optimization.

List of Experiment:
1. Regular expression,
2. Finite Automaton,
3. Identify and remove Left Recursion
4. Pushdown Automaton Lexical Analyzer
5. First and Follow
6. Parsing algorithm: SLR, CLR, and LALR,
7. Optimization: common subexpressions
8. dead code elimination
9. Create basic block.

Text Books:

1. Compilers Principle, Techniques & Tools - Alfread V. AHO, Ravi Sethi& J.D.Ullman; - 1998 Addison Wesley.
2. Compiler Design by O.G. Kakde, 1995, Laxmi Publ.

Reference Books:

1. Theory and practice of compiler writing, Tremblay & Sorenson, 1985, Mc. Graw Hill.

Course Outcomes	Program Outcomes													Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	1	3	-	2
CO2	3	-	3	-	-	-	-	-	-	-	2	3	-	2
CO3	2	3	-	3	2	-	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO5	2	-	-	-	-	-	-	-	-	-	-	-	-	2

Course Title/ Code	Advance Android Development (CSH312B-T) & (CSH312B-P)
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Students would be able to develop advance android application.

Course Outcome	Mapping
CO1: Describe general programming knowledge to develop android mobile applications and recall acquired skills of using Android studio, AVD development tools.	Employability
CO2: Describe specific requirements, possibilities, and challenges when developing for a mobile context and describing their ability to create applications with localization of different language support.	Employability & Skill development
CO3: Demonstrate the interaction of user and with android application to create fragment on or over activity, creating application widget for home screen, sensor data.	Employability & Skill development
CO4: Apply a plan to carry out design work including developing a prototype that can be evaluated with a specified user group and illustrating the deployment of the app on various mobile API levels.	Employability & Skill development
CO5: Develop an application for GPS service, multimedia files and justify their ability to debug program/application running on android mobile devices.	Employability
CO6: Demonstrate the ability to reflect over possibilities and demands in collaborative Advanced Android mobile application development.	Employability & Skill development

Section A

Fragment: Creating a fragment and its layout, adding a fragment to an activity, Fragment lifecycle, Communication between a Fragment and an Activity. App widgets: creating widget to an app, updating the widget provider-info. Sensors: Discovering sensors and sensor capabilities, sensor configuration. Device orientation and rotation. Motion and position sensor.

Section B

Performance: Good performance, performance test, frame rate, minimize overdraw, Garbage collection, Memory leak and memory churn, memory profiler tool, Network and battery best practices, Optimizing images and serializing data. Localization: Understanding language and locale settings, using the Translation Editor, Formatting date and time, numbers, currencies.

Section C

Location: Places: Using the place-picker UI, Getting the device's current place, using the place-autocomplete service. Mapping: Google Map objects, Map types, Configuring the initial map state, Lite mode, Map style.

Section D

Custom views: Creating and drawing the custom view, using custom view in a layout, using property accessories and modifiers. **Canvas:** Canvas object, creating and drawing canvas object, drawing shapes and text, Transformations, Clipping, saving and restoring a canvas. **Animation:** View animation, Property animation, Drawable animation, Physics-based animation.

LIST OF EXPERIMENTS:

1. Lab: Creating a Fragment with a UI and communication with a fragment
2. Lab: Building app widgets
3. Lab: Working with sensor data
4. Lab: Working with sensor-based orientation
5. Lab: Using the profile GPU Rendering tool
6. Lab: Using the Debug GPU Overdraw and Layout Inspector tools
7. Lab: Using the Systrace and dumpsys tools, memory profiler tool
8. Lab: Using resources for languages
9. Lab: Using the device location
10. Lab: Using the places API
11. Lab: Adding a Google Map to your app
12. Lab: Creating a custom view from scratch and View subclass
13. Lab: Creating and drawing a canvas object
14. Lab: Creating property animations

Text Books:

1. Advanced Android Application Development byJoseph Annuzzi (Jr.), Lauren Darcey, Shane Conder, Addison-Wesley.
2. https://developers.google.com/training/courses/android-advanced
3. Android Developer Advance – Concepts by Developed by Google Developer Training

Reference Book:
1. Professional Android 2 Application Development by Reto Meier, Wiley.

Course Outcomes	Program Outcomes													Program Specific Outcomes
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	3	2	-
CO2	-	3	-	3	-	-	2	-	2	-	-	-	-	2
CO3	-	-	2	-	-	-	2	3	2	-	3	-	2	-
CO4	-	3	-	-	3	2	-	-	3	3	-	-	2	-
CO5	-	-	2	-	-	3	-	3	-	2	3	-	-	2
CO6	2	-	-	3	2	-	-	-	-	-	-	3	-	-

Course Title/Code	Data Warehousing and Data Mining (CSH313B-T) & (CSH313B-P)
Course Type:	ELECTIVE (Departmental)
Course Nature:	HARD
L-T-P Structure	(3-0-2)
Credits	4
Objectives	The student will be able to design and represent multi-dimensional models and obtain business intelligence from them.

Course Outcome	Mapping
CO1: Describe the basic knowledge of data warehouse, data mining and Data Decision.	Employability & skill development
CO2: Illustrate the types of Data warehouses.	Employability
CO3: Differentiate different types of database systems.	Employability & skill development
CO4: Apply analytical processes to handle data warehousing issues	Employability & skill development
CO5: Describe the classification of data mining systems.	Employability

Section A

Introduction to data ware house and decision making: Need for data warehousing, Escalating Need for strategic information, Decision making, failures of past decision-support systems, operational versus decision-support systems, data warehousing – the only viable solution. Applications of Data ware house**:** Operational System and Business Intelligence.
Data ware house: Data warehouse definition, types of data warehouses and data marts, types of data marts, ETL process, 3 – Tier data warehouse architecture, Meta data, role of meta data repository in data warehouse, distributed and virtual data warehouses.

Section B

Multidimensional Data Model: Difference between Database System and Data Warehouse, Multidimensional data model, Facts, Dimensions, Measures, Data cubes, Schemas for Multidimensional Database (Stars, snowflakes and fact constellations) defining schemas. OLAP Technology: Starnet query model, Concepts Hierarchies, Partitioning strategies, OLAP operations: Slice, Dice. Roll up, Drill down, Pivot etc., Types of OLAP servers: ROLAP, MOLAP, HOLAP. Data warehouse implementation: Computation of data cubes, Partial Materialization, Indexing OLAP data, and Efficient Processing of OLAP queries. Tuning and testing of data warehouse.

Section C

Data Mining: Data mining definition & task, KDD versus data mining, Data Mining Applications, Data preprocessing, Classification of data mining systems, Data mining task primitives, data mining techniques, Data mining query languages. Data mining techniques: Mining frequent Patterns, Association, and correlation.

Section D

Classification & Prediction: Decision tree knowledge discovery, Bayesian Classification, Neural Networks (MLP) &Support Victor Machines (SVM). Classification Accuracy and error measures, evaluating the accuracy of Classifier.

Clustering Analysis: K-means and K-Medoids, outlier analysis. Mining complex data object: (Spatial databases, Multimedia databases, Time series and Sequence data mining Text Databases and mining Word Wide Web).

LIST OF EXPERIMENTS:

1. To generate a data table in MS Access and perform various tasks on the data.
2. To Implement Pivot Table, Report Generation for the table data.
3. To study /implementation of various task on data using MS Excel.
4. To implement Pivot Chart, Pivot table of a given Data in table using MS Excel.
5. Introduction to data mining tool.
6. To implement Classification.
7. To Implement Association rule.
8. To implement Clustering.
9. To study PDI (Pentaho Data Integration) IDE.
10. To Create new repository in PDI and performing various tasks.

Text Books:
1. Data Warehousing In the Real World; Sam Anahory& Dennis Murray; 1997, PearsonNo .of copies in the Library.
2. Data Mining- Concepts & Techniques; Jiawei Han &Micheline Kamber- 2001, Morgan K aufmann.No.of copies in the Library.
3. Data Mining Techniques; Arun Pujari; 2001, University Press; Hyderabad.No.of copies in the Library.

Reference Book:

1. Paul Raj Poonia, "Fundamentals of Data Warehousing", John Wiley & Sons, 2003. No. of copies in the Library.
2. Sam Anahony, "Data Warehousing in the real world: A practical guide for building decision support systems", John Wiley, 2004.
3. W. H. Inmon, "Building the operational data store", 2nd Ed., John Wiley, 1999.
4. Mattison R., Web Warehousing and Knowledge Management, Tat McGraw-Hill .
5. Ponniah P., Data Warehousing, Wiley.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	3	2	-	-	-	-	1	1	1	3
CO2	2	2	1	3	2	1	-	-	-	-	-	3	1	3
CO3	2	2	3	1	3	-	-	-	-	1	-	3	3	2
CO4	2	3	2	1	1	1	-	-	2	-	2	3	3	3
CO5	2	3	2	1	1	1	-	-	3	-	3	3	3	3

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Course Title/ Code	Machine Learning (CSH314B-T) & (CSH314B-P)
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	1. To learn the concept of how to learn patterns and concepts from data 2. To design and analyze various machine learning algorithms and techniques 3. Explore supervised and unsupervised learning paradigms of machine learning 4. To explore Deep learning technique and various feature extraction strategies.

Course Outcome	Mapping
CO1: Describe the basics of Machine Learning Algorithms.	Employability
CO2: Demonstrate the concepts of exploratory Data Analytics.	Employability
CO3: Apply machine learning techniques to perform predictive analytics	Employability & Skill development
CO4: Develop solutions to real life problems using ML Techniques.	Employability & Skill development

Section A

Supervised Learning (Regression/Classification)
Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Section B

Unsupervised Learning
Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

Section C

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, and Random Forests). Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Section D

Scalable Machine Learning (Online and Distributed Learning)

A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

LIST OF EXPERIMENTS:
1. Study and Implement Logic Regression
2. Study and Implement k-mean clustering
3. Study and Implement k-nearest neighbor classification
4. Study and Implement the Naive Bayes learner
5. Study and Implement the Decision Tree learners
6. Study and implement the Ada boost algorithm
7. Study and Implement PCA
8. A minor project based on Pattern Recognition.

Text Books:

1. [T1] Tom M Mitchell, Machine Learning, McGraw Hill Education
2. [T2] Bishop, C. (2006). Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.
3. [T3] Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: WileyInterscience, 2000. ISBN: 9780471056690.
4. [T4] Tom M. Mitchell, Machine learning .ISBN – 9781259096952, McGraw-Hill Series, Edition – First

Reference Books:

1. [R1] Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
2. [R2] Introduction to Machine Learning - Ethem Alpaydin, MIT Press, Prentice hall of India.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	2	3	-	-	-	1	1	1	3	3	-
CO2	1	1	-	3	2	1	-	-	1	1	1	3	3	1
CO3	3	2	3	1	3	3	-	-	3	2	2	3	3	2
CO4	2	3	2	-	2	2	-	-	2	3	3	3	3	3

Course Title/Code	Network Security and Cryptography (CSH315B-T) & (CSH315B-P)
Course Type:	**Elective (Departmental)**
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Prerequisite	Computer Networks
Objectives	Students will be able to understand different security methods and issues and will be able to secure their data from attacks.

Course Outcome	Mapping
CO1: Describe the theory of fundamental cryptography, encryption and decryption algorithms	Employability
CO2: Demonstrate various data encryption techniques	Employability & Skill development
CO3: Implement Hashing and Digital Signature techniques	Employability & Skill development
CO4: Demonstrate the understanding of various security methods.	Employability
CO5: Compare and contrast real time security threats	Employability

Section A

INTRODUCTION: Need of security, Security approaches, Principles of Security, Types of attacks, Encryption, Decryption, Symmetric and asymmetric key cryptography, Diffie-Hellman key exchange algorithm and man in the middle attack, programs that attack, Introduction to Steganography.

Section B

Cryptographic techniques and authentication: Substitution and transposition techniques, DES (Data Encryption Standard), Double DES and Meet in the middle attack, Tripple DES, AES (Advanced Encryption Standard), IDEA (International Data Encryption Algorithm), RSA algorithm, Digital signature, Knapsack algorithm, Authentication and authorization, Authentication techniques: What you know, what you have, what you are, Mutual authentication, Reflection attack.

Section C

Message Digest and internet security protocols: Introduction to Message Digest, Requirements of message digest, Birthday attack, MD5, SHA (Secure Hash Algorithm), SSL (Secure Socket layer), TSP (Time Stamping Protocol), SSL (Secure Socket Layer), SET (Secure Electronic Transaction).

Advanced security: Firewalls, IP security, VPN (Virtual Private Network), Denial of Service (DOS) attack, electronic money, Single Sign On (SSO)

Case study of Phishing and Pharming attack, Case study of unbreakable codes.

LIST OF EXPERIMENTS:

1. Exercise to perform passive attacks.
2. Exercise to perform active attacks.
3. Exercise to Encrypt and decrypt a text using DES
4. Exercise on substitution techniques.
5. Exercise on transformation techniques.
6. Exercise on authentication techniques.
7. Exercise to create message digest.
8. Exercise to break unbreakable codes.

Text Books:
1. KahateAtul, "Cryptography and Network Security", Tata McGraw-Hill Education Pvt. Ltd, New Delhi.
2. Stallings William, "Cryptography and Network Security", Pearson Education Inc.

Reference Book:
1. Forouzan Behrouz A.,"Cryptography and Network Security",McGraw Hill Companies Inc., New York.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	3	-	2	-	-	-	-	3	2	1	2
CO2	1	2	1	3	-	1	-	-	-	-	3	3	2	1
CO3	2	2	-	3	-	1	-	-	-	-	3	-	2	1
CO4	1	2	-	1	-	-	-	2	-	-	-	2	-	-
CO5	2	2	-	3	-	-	-	2	-	-	-	2	-	-

Course Title/Code	**Object Oriented Software Engineering (CSH316B-T) & (CSH316B-P)**
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Students will be able to understand different security methods and issues and will be able to secure their data from attacks.

Course Outcome	Mapping
CO1: Describe basic concepts of object-oriented software engineering	Employability & Skill development
CO2: Describe the Objectory software development process.	Employability & Skill development
CO3: Create models of different aspects of a software system using the Object-Oriented approach.	Employability
CO4: Create models of real-life software development problems using the Unified Modelling Language.	Employability

Section A

Introduction: Review of the Traditional Methodologies, Advantages of Object-Oriented Methodologies over Traditional Methodologies, Classes, Objects, Encapsulation, Association, Aggregation, Inheritance, Polymorphism, States and Transitions.

Visual Modelling using Unified Modelling Language (UML): What is Visual Modelling? Object Oriented Modelling, Introduction to Unified Modelling Language (UML): History of UML, Overview of UML – Capabilities, Usage of UML.

Introduction to Rational Rose CASE tool: Introduction – Importance of Rational Rose, Capabilities of Rational Rose Case Tool.

Section B

Introduction to Objectory Software Development Process: Introduction, Benefits, Phases and Iterations, Elaboration Stage, Construction Stage, Transition Stage.

Creating Use Case Diagrams: Actors and Use Cases, Use Case Relationships, Types of Relationships, Use Case Diagrams: Creating Main Use Case -, Relationships - , And Additional Use Case - Diagrams in Rational Rose, Activity Diagrams Activities, Transitions, Decision Points, Swimlanes.

Section C

Identifying Classes ,Packages and drawing a Class Diagram: State, Behaviour, Identity of Objects, Stereotypes and Classes, Creating and Documenting Classes in rational Rose, Packages, Drawing a Class Diagram Specifying Relationships : The Need of Defining Relationships, Association and Aggregation Relationships, Naming Relationships, Role Names, Multiplicity Indicators, Reflexive Relationships, Package Relationships, Inheritance, Finding Relationships, Creating Relationships in Rational Rose

Discovering Object Interactions: Documenting Scenarios using Interaction Diagrams, Types of Interaction Diagrams, Adding Behaviour and Structure: Representing Behaviour and Structure, Creating Attributes & operations and documenting them, displaying attributes and operations, Association Classes, Analysing Object Behaviour: Modelling Dynamic Behaviour, States

Section D

Checking the Model: Making the Model Homogeneous, Combining Classes, Splitting Classes, Eliminating Classes, Consistency Checking, Scenario Walk-through, Event Tracing, Documentation Review, Designing the System Architecture: The need for Architecture, The "4+1" view of Architecture, The Logical view, The Component View, The Process View, The Deployment View, The Use Case view.

The Iteration Planning Process: Benefits, Goals, Design the User Interface, Adding Design Classes, The Emergence of Patterns, Designing Relationships, Designing Attributes and Operations, Designing for Inheritance, Coding, Testing, and Documenting the Iteration.

Text Books:

1. "UML User Guide", Grady Booch, James Rumbaugh, Ivar Jacobson, 2000, Addison Wesley.
2. Visual Modeling with Rational Rose 2000 and UMLBy Terry Quatrani Foreword by Grady Booch, 2000

Reference Books:

1. "UML Reference Guide", James Rumbaugh, Ivar Jacobson, Grady Booch, 2000, Addison Wesley.
2. "The Objectory Software Development Process", Ivar Jacobson, Grady Booch, James Rumbaugh, 1999, Addison Wesley.
3. UML Distilled by Maxtin Fowler with Kendall Scott,2000, Second Edition
4. Sams Teach Yourself "UML" In 24 Hours By Joseph Schmuller ,2000

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	2	-	-	-	1	-	2	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	2	-	-	2
CO3	3	3	3	-	3	-	-	-	3	2	2	3	-	2
CO4	3	3	3	-	3	-	-	-	3	2	2	3	-	2

Course Title/ Code	Progressive Web Applications (CSH401B-T) & (CSH401B-P)
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Students would be able to develop progressive web applications.

CO STATEMENT	Mapping
CO1: Demonstrate the understanding of identifying general programming knowledge to develop progressive web application and recall application development of native apps as compare to progressive web apps.	Employability
CO2: Demonstrate the understanding of the specific requirements of using Service worker, and lighthouse tool. And, use of promises to handle offline app features.	Employability
CO3: Demonstrate the interaction of user with progressive web application to handle fetch api, caching of information within app, and handle user database with IndexedDB and Live data.	Employability & Skill development
CO4: Classify the plan and carry out a design work including developing a prototype that can be evaluated with a specified user group and illustrate the deployment of progressive web app on various platforms.	Employability & Skill development
CO5: develop applications for push notification, payment api and justify progressive web app task automation with Gulp tool.	Employability & Skill development
CO6: Have the ability to reflect over possibilities and demands in use and development of Progressive web app and analysis using Google analytics tool on PWA apps.	Employability

Section A

Introduction to Progressive Web App Architectures: Components, PWA Architecture pattern, migrating existing site to PWA, Application Shell, Create and build App shell.
Service Worker: Introduction, Service worker lifecycle, Events in service worker.
Lighthouse: PWA Analysis Tool, running Lighthouse as Chrome extension and command line.

Section B

Offline application: Why and How, **promises:** Introduction, using promise, states of promise, use promise, and Promise chains. **Fetch API:** Making a request, Reading the response object, Custom request, Cross-origin request. **Caching:** Cache API in the service worker, serving files from the cache.

Section C

Indexed DB: Introduction, opening database, working with object stores and with data, fetch all data, using database versioning. **Live data:** Storing data with Indexed DB and storing assets in the cache interface. **Gulp tool:** set up gulp, creating tasks and automation. Automate creation of service worker with sw-precache and sw-toolbox.

Section D

Push Notification: Introduction and terminology, Notification API, Push API, Web Push Protocol. **Payment Request API:** Introduction, how and using payment request API. **Google Analytics:** adding analytics to site, dashboard, Analytics and service worker, Offline analytics.

LIST OF EXPERIMENTS:

1. Lab: Scripting the Service Worker
2. Lab: Auditing with Lighthouse
3. Lab: Responsive Design and Images
4. Lab: Promises
5. Lab: Fetch API
6. Lab: Caching Files with Service Worker
7. Lab: IndexedDB
8. Lab: Gulp setup
9. Lab: Integrating Web Push
10. Lab: Integrating Analytics
11. Lab: E-commerce project

Text Books:

1. Beginning Progressive Web App Development: Creating a Native App Experience on the Web by Dennis Sheppard, Apress.
2. https://developers.google.com/web/progressive-web-apps/
3. Progressive Web Apps ILT – Concepts by Developed by Google Developer Training

Reference Book:
1. Building Progressive Web Apps: Bringing the Power of Native to the Browser, By Tal Ater, O'Reilly.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	3	2	-
CO2	-	3	-	3	-	-	2	-	2	-	-	-	-	2
CO3	-	-	2	-	-	-	2	3	2	-	3	-	2	-
CO4	-	3	-	-	3	2	-	-	3	3	-	-	2	-
CO5	-	-	2	-	-	3	-	3	-	2	3	-	-	2
CO6	2	-	-	3	2	-	-	-	-	-	-	3	-	-

Course Title/ Code	BIG DATA(CSH402B-T) & (CSH402B-P)
Course Type:	ELECTIVE (Departmental)
Course Nature:	HARD
L-T-P Structure	3-0-2
Credits	4
Objectives	Student will be able to do Big Data Programming and Analytics using Hadoop.

CO STATEMENT	Mapping
CO1: Express the fundamentals of big data Frameworks that makes it useful to solve real world problems	Employability
CO2: Demonstrate the understanding of big data programming using Hadoop	Employability
CO3: Apply the knowledge to perform big data analytics using NoSQL Databases	Employability & Skill development
CO4: Analyze the performance of various frameworks for Python	Employability & Skill development
CO5: Design solutions to a range of complex real-world problems	Employability & Skill development

Section A
Introductory Concepts (Digital Data and Big Data): Digital Data Basics, Types of Digital Data (Structured, Semi-Structured, Unstructured), Introduction to Big Data, Why Big Data? Dimensions of Big Data, Challenges with Big Data, Big Data Stack, ScalingProblems.Big data processing tools (AWS).
Hadoop overview:
Brief history of Hadoop, Hadoop 1.0 vs. Hadoop 2.0, Hadoop Components, High level architecture of tools (Compression.

Section B

Big data programming using Hadoop: Hadoop Distributed File System: Architecture, Daemons related to HDFS, working with HDFS command, Special features of Hadoop, Introduction to functional programming, How Map Reduce Works, MapReduce on YARN, Map Reduce Joins, Map Reduce Work Flows. HDFS and Hadoop Ecosystem.

Section C

Big Data Analytics: Analytics 1.0, Analytics 2.0, Analytics 3.0, Traditional BI vs. Big Data Environment, Big Data technology Landscape, NoSQL Databases, NoSQL Vs. RDBMS, New SQL.

Section D

Frameworks: APACHE HIVE: History of HIVE, HIVE architecture, Hive Primitive Data Types and Collection Types, Hive File Formats, Hive Query Language – Statements DML, Fundamentals of APACHE PIG & HBASE, Business Intelligence on Hadoop.

LIST OF EXPERIMENTS:
1. To Install and set up of Hadoop along with Start up and shut down process
2. Introduction to (Hadoop Distributed File System) labs

- Loading data
- Viewing the cluster contents
- Getting data out of the cluster
3. To write basic map reduce program
    - Driver code
    - 3Mapper
    - Reducer
4. To Creating Input and Output formats in Map Reduce Jobs
    - Text Input format
    - Key value input format
    - Sequence file input format
5. To implementing Latin commands on pig/ How to use basic pig commands
6. Introduction to processing data with Hive
    - Creating tables with Hive
    - Managing hive table data location and lifetime
    - Loading data into hive tables
    - Partitioning the data
    - Querying tables with Hive QL

Text Books:

1. Tom White " Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
2. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
3. Michael Minelli (Author), Michele Chambers (Author), AmbigaDhiraj (Author) , Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses,Wiley Publications,2013.

Reference Book:

1. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill Publishing, 2012.
2. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley &sons, 2012.
4. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.
5. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
6. Paul Zikopoulos , Dirk deRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications, 2012.
7. Zikopoulos, Paul, Chris Eaton, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Tata McGraw Hill Publications, 2011.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	-	3	2	-	-	-	-	-	-	1	3	-
CO3	3	2	2	1	3	-	-	-	-	1	-	3	2	2
CO4	3	1	3	1	3	-	2	-	2	2	2	3	2	3

CO5	3	3	-	-	-	-	-	-	-	-	-	2	2	-

Course Title/Code	Image Processing (CSH403B-T) & (CSH403B-P)
Course Type	Elective (Departmental)
Course Nature	Hard
Credits	4
L-T-P Structure	(3-0-2)
Objective	The course objective is (A)to help students learn the basic concepts, (B)understand the image computing, and (C) image restoration procedures and (D) image compression procedures.

CO STATEMENT	Mapping
CO1: Study the fundamental concepts of an image processing system.	Employability & Skill development
CO2: Understand standard methods to image creation and demonstrating.	Employability
CO3: Evaluate the techniques for image enhancement and image restoration.	Employability & Skill development
CO4: Categorize various compression techniques.	Employability & Skill development
CO5: Interpret image segmentation and representation techniques.	Employability
CO6: Develop and evaluate solutions to real life problems using image processing techniques.	Employability

Section A

Overview to Digital Image Processing: The nature of Digital Image Processing and Applications, Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems.
Image Sampling and Quantization: Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels, Linear and Non-Linear Operations.
Image Enhancement in the Spatial Domain: Histogram Processing, Arithmetic and Logic operations, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

Section B

Filtering in the Frequency Domain: Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters.
Image Restoration: Introduction and types of Image Degradation, Noise Modeling- Noise Category base on distribution, correlation, source and nature. Image Restoration in the presence of Noise Only- Mean Filters, Order Static Filters.
Image Restoration Techniques: Unconstrained, Constrains, iterative and Blind image Restoration Methods.

Section C

Image Compression: fundamentals of compression, coding redundancy, Lossy and lossless compression algorithms, Spatial and temporal redundancy, Image compression models. Some basic compression methods.
Image Segmentation: Detection of Discontinuities, Edge and boundary detection, Types of Edge detector, Region Oriented and Motion based segmentation.

Image Representation and Description: Introduction, Boundary Representation & Descriptors, Component Labeling & regional descriptors, Introduction to Morphological operators with examples.
Object Recognition: Patterns and Pattern Classes, Decision-Theoretic Methods, Structural Methods.
Text Books:

1. Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", 3rd edition, Pearson, 2008.
2. S. Sridhar, "Digital Image processing", 2nd edition, Oxford 2016.
3. A.K. Jain, "Fundamental of Digital Image Processing", PHI, 1989.

Reference Books:

1. Bernd Jahne, "Digital Image Processing", 5th Ed., Springer, 2002.
2. William K Pratt, "Digital Image Processing: Piks Inside", John Wiley & Sons, 2001.
3. Lavanya Sharma, "Object Detection with Background Subtraction", LAP LAMBERT Academic Publishing, SIA OmniScriptum Publishing, 2018.

List of Experiments (Using MATLAB or ImageJ Tools):

1. Convert an RGB image of size 256X256 pixel's into greyscale and binary image.
2. Implement the spatial image enhancement functions on a bitmap image –Mirroring (Inversion).
3. Implement the spatial image enhancement functions on a bitmap image –Rotation (Clockwise).
4. Implement (a) Gaussian Low Pass Filter (b) Butterworth High Pass Filter (c) Gradient and Laplacian filters
5. Implement (a) Harmonic Mean Filter (b) Yp- Mean Filter (c) Median Filter.
6. Implement Smoothing and Sharpening of an eight-bit color image
7. Implement (a)Wavelet transformation Algorithm (b) Graham's Scan Algorithm
8. Implement (a) Edge Detection using Canny, Prewitt, and Sobel operators
9. Display an image size of 512X512 and its histogram
10. Perform shrinking and cropping of an image
11. Perform blurring and de-blurring operation on an image(256X256).
12. Removal of Poisson, Salt and Pepper noise.
13. Implement a function for image segmentation using second order derivative.
14. Implement a function for image morphology using Morphological tools such as dilation, erosion and imfill operators.
15. Implement a function for Image Restoration Model for representing the color and methods of processing the color plane.
16. Implement a code to detect contour of an input image of size 512X512.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	1	2
CO2	2	-	-	3	-	-	-	-	-	-	-	-	-	1
CO3	-	-	3	2	-	-	-	-	-	-	-	-	-	2
CO4	-	-	-	-	2	2	-	-	2	-	-	-	2	-
CO5	-	-	-	-	-	-	-	2	2	-	2	-	3	2
CO6	-	-	3	-	-	-	-	-	-	2	3	2	2	2

Course Title/Code	Cloud Computing (CSH404B-T) & (CSH404B-P)
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Students will be able to learn the concepts, techniques and implementation of clouds.

CO STATEMENT	Mapping
CO1: Describe fundamental ideas behind Cloud Computing, the evolution of the paradigm and its applicability.	Employability
CO2: Analyze the key dimensions of the current and future challenges of Cloud Computing	Employability
CO3: Analyze the assessment of the economics, financial, and technological implications for selecting cloud computing for an organization.	Employability & Skill development
CO4: Develop cloud application and assess Cloud security, the risks involved, its impact	Employability & Skill development
CO5: Demonstrate the understanding to know the impact of engineering on legal and societal issues involved in addressing the security issues of cloud computing.	Employability

Section A

Overview of Cloud Computing: Brief history and evolution - History of Cloud Computing, Evolution of Cloud Computing, Traditional vs. Cloud Computing. Why Cloud Computing, Cloud service models (IaaS, PaaS & SaaS). Cloud deployment models (Public, Private, Hybrid and Community Cloud), Benefits and Challenges of Cloud Computing.
Working with Private Cloud: Basics of virtualization, Virtualization technologies, Server virtualization, VM migration techniques, Role of virtualization in Cloud Computing. Business cases for the need of Cloud computing environment, Private Cloud Definition, Characteristics of Private Cloud, Private Cloud deployment models, Private Cloud Vendors, Private Cloud Building blocks
namely Physical Layer, Virtualization Layer, Cloud Management Layer, Challenges to private Cloud, Virtual Private Cloud. Implementing private cloud (one out of CloudStack, OpenStack, Eucalyptus, IBM or Microsoft)

Section B

Working with Public Clouds: Public Cloud, Public Cloud Service Models, and Public Cloud Players. Infrastructure as a Service Offerings, IaaS Vendors, PaaS offerings, PaaS vendors, Software as a Service. Implementing public cloud (one out of AWS, Windows Azure, IBM or Rackspace).

Application Development: Service creation environments to develop cloud-based applications. Development environments for service development; Amazon, Azure, Google App.

Section C

Cloud Services Management: 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.

Cloud Infrastructure: Architectural Design of Compute and Storage Clouds - Layered Cloud Architecture Development –Design Challenges. Inter Cloud Resource Management System – Resource Provisioning and platform Deployment- Global Exchange of Cloud Resources.
Future directions in Cloud Computing: Future technology trends in Cloud Computing with a focus on Cloud service models, deployment models, cloud applications, and cloud security. Migration paths for cloud, Selection criteria for cloud deployment. Current issues in cloud computing leading to future research directions.

Section D

Business Clouds: Cloud Computing in Business, Various Biz Clouds focused on industry domains (Retail, Banking and Financial sector, Life Sciences, Social networking, Telecom, Education). Cloud Enablers (Business Intelligence on cloud, Big Data Analytics on Cloud)

Programming Cloud IT Model: Parallel and Distributed Programming Paradigms, Twister and Iterative MapReduce, Hadoop Library from Apache- Mapping Applications – Programming Support of Google App Engine, Cloud Software Environments – including Eucalyptus, Open Nebula, OpenStack, Aneka and Cloud Sim.

LIST OF EXPERIMENTS:

1. Creation of EC2 Instance on Amazon.
2. Implementation of Load Balancing.
3. Deployment of various services on Amazon.
4. Design, development and implementation of a given business application.
5. Management of one application using multi-cloud management.

Text Books:
1. A Practical Approach Cloud Computing: By Anthony T Velte, Toby J Velte, Robert C Elsenpeter.
2. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, *Kai Hwang, Jack Dongarra and Geoffrey Fox*, Morgan Kaufmann, 2011.

Reference Book:
1. Cloud computing: Implementation, management and security By Rittinghouse, John, W.
2. Cloud Computing Bible, By Barrie Sosinsky, Wiley, 2011.
3. Cloud Computing Architected: Solution Design Handbook by Rhoton, John.
4. Cloud Security, A comprehensive Guide to Secure Cloud Com puting by Krutz, Ronald L.; Vines, Russell Dean
5. Cloud Computing: Principles and paradigms By Raj Kumar Buyya, James Broberg, AndrezeiM.Goscinski, 2011

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	2	-		-	-	-	-	-	1	2
CO2	3	2	3	2	2	-	-	-	-	-	-	-	1	2
CO3	3	1	3	3	-	-	3	-	-	-	-	-	2	1
CO4	2	2	1	3	3	-	-	-	-	2	-	-	3	2
CO5	3	3	3	3	3	-	-	3	2	3	2	3	2	3

Course Title/Code	Software Testing (CSH405B-T) & (CSH405B-P)
Course Type:	Domain Elective (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Student will be able to implement software testing skills to test any given software based on the requirements specification.

CO STATEMENT	Mapping
CO1: Describe software testing and infer mastery of the testing techniques.	Employability
CO2: Demonstrate the fundamental characteristics of good test case design and apply contemporary testing principles and techniques.	Employability
CO3: Apply Test Driven Development (TDD) to help construct software without code smells by choosing manual and automated testing approaches.	Employability & Skill development
CO4: Utilize the learnt principles and techniques of software testing to evolve further.	Employability & Skill development

Section A

INTRODUCTION: Software Testing Techniques, software testing fundamentals: objectives, principles, testability; Test case design, V Model.

CODE TUNING TECHNIQUES: Use of Correct Data Type, ordering statements in switch, stop testing in a loop when result is known, minimizing array references, Jamming and Un-switching of Loops, Minimizing Computations in loop.

FUNCTIONAL TESTING TECHNIQUES: BLACK BOX TESTING: Exploratory Testing, Logic Coverage: Interface Testing, Boundary Value Analysis, Robustness Testing, Worst Case Testing, Equivalence Class Testing.

Section B

FUNCTIONAL/STRUCTURAL TESTING TECHNIQUES: Decision Table based Testing, Cause Effect Graphing Technique, and White box testing, Basis Path Testing, DD Paths and Cyclomatic Complexity.

STRUCTURAL TESTING TECHNIQUES: WHITE BOX TESTING: Graph Matrices, Data Flow Testing, Mutation Testing, Unit Testing, Integration Testing.

REDUCING THE NUMBER OF TEST CASES: Regression Testing, Regression Test Process, Selection of Regression Tests, Prioritization Guidelines, Slice based testing.

Section C

OBJECT ORIENTED TESTING: Issues in OO Testing, Class Testing: Random Testing, Class Testing: Partition based Testing, Object Oriented Integration and System Testing, System Testing.

DEBUGGING AND DEFECT TRACKING REPORT: Debugging Techniques, debugging through Code Inspection, Debugging using Logs, Debugging using IDE, Creating Defect Tracking Reports.

TEST MANAGEMENT: Test Planning, Test Management, Test Automation, Testing Tools, Static vs. Dynamic Testing Tools.

Section D
TEST AUTOMATION USING SELENIUM: INTRODUCTION: Why Selenium? Selenium Vs other tools (HP etc.), Selenium Components, Selenium RC vs Web driver, Selenium Core, Selenium IDE, Remote Control (Selenium1), Web driver (Selenium2), Grid, Locators & types, Test Automation, Getting started with Selenium IDE, Useful Tools for Writing Test Cases Firefox Add-ons, Basic Html Theory.

TEST AUTOMATION USING SELENIUM: RECORDING TESTS: Selenium Commands – SELENESE, Pattern Matching, Element Locators, Selenium RC Overview, Install and Run Selenium RC, Recording and Playing Back Test Cases, Test Case Verification, Working with Test Suites, Test Case HTML Reports.

TEST AUTOMATION USING SELENIUM: RECORDING TESTS: The Eclipse IDE, running a Test Using the JUnit Export from Selenium-IDE, Running a Test Using the TestNG Export from Selenium-IDE, Data Driven Testing using TestNG.

Text Books:
1. William Perry, "Effective Methods for Software Testing", John Wiley & Sons, New York, 1995.
2. Louise Tamres, "Software Testing", Pearson Education Asia, 2002.
3. CemKaner, Jack Falk, Nguyen Quoc, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 1993.
4. David Burns, "SELENIUM 2 TESTING TOOLS : BEGINNER'S GUIDE", Packt Publishing.

Reference Books:
1. K.K. Aggarwal&Yogesh Singh, "Software Engineering", 2nd Ed., New Age International Publishers, New Delhi, 2005.
2. Boris Beizer, "Software Testing Techniques", Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.
3. AdityaGarg, "A Practitoner's Guide To Test Automation Using Selenium", 1st Edition, McGraw Hill Education (India) Private Limited.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	3	-	-	2	-	-	-	-	-	-
CO4	3	3	3	-	3	-	-	2	2	3	2	3	1	2

Course Title/Code	**ELECTRONIC DESIGN WORKSHOP (ECW312B)**
Course Type:	WORKSHOP (Departmental)
Course Nature:	Hard
L-T-P Structure	0-0-3
Credits	1.5
Course Objectives	Design, implement and test the prototype in order to solve the conceived problem.

Course Outcome	**Mapping**
CO1: Design the circuits in orcad.	Employability
CO2: Simulate the circuits.	Employability & Skill development
CO3: Analyze the results.	Employability & Skill development
CO4: Implement the circuit & test it.	Employability

Experiment List:

1.   Simulate and study V-I characteristics of a Diode using PSPICE windows.

2.   Simulate and study Half-wave and Full-wave Rectifier using PSPICE windows

3.   Simulate and study Diode Clipper and Clamper circuit using PSPICE windows.

4.   Simulate and study V-I characteristics of a NPN – BJT using PSPICE windows.

5.   Simulate and study Darlington pair amplifier circuit using PSPICE windows and determine quiescent condition.

6.   Simulate and study transient & frequency response of a BJT amplifier in common-emitter configuration using PSPICE windows.

7.   Simulate and study active low-pass, high-pass & band-pass filter using PSPICE windows.

8.   Simulate and study Integrator using PSPICE windows.

9.   Simulate and study Differentiator using PSPICE windows.

10. Simulate and study basic AND, OR, NOT, NOR, NAND, EX-OR gates using PSPICE windows.

Course Outcomes	Program Outcomes													Program Specific Outcomes
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	2	1	3	3	2	2	3	-	2
CO2	3	2	3	2	3	2	2	3	2	2	3	3	1	2
CO3	3	2	2	3	3	2	3	3	3	3	3	2	1	2
CO4	3	2	3	3	2	3	3	2	3	3	3	2	-	2

Course Title/Code	3D SOFTWARE (MEW315B)
Course Type	OPEN ELECTIVE (Allied)
Course Nature	Workshop
L-T-P Structure	0-0-3
Credits	1.5
Course Objective	To give better visualization and future forecasting capabilities of the component. Ability to understand various international codes and standards as they are included in the design software. Integration of drawing with CNC machines and 3D printers for manufacturing purpose. Can do the analysis of various components in order to find out the design statistics.

Course Outcome	Mapping
CO1: Demonstrate the Concept of CAD software.	Employability
CO2: Create the basic Engineering Drawings in the Sketcher Module.	Employability
CO3: Measure the 3D CAD Models in the CAD Software.	Employability & Skill development
CO4: Design the 3D Model of Components as per the Engineering Drawings.	Employability & Skill development

Section A

Introduction to design software: a solid modeler, Feature-Based, Parametric, and Associative. The design software interface: screen layout, Main Window, Pull-Down Menus Toolbar, Display Area, Message Area, working with models, Using Dialog Boxes Retrieving Models, Retrieving Multiple, Models, Saving Changes, Closing Windows, Deleting Files, pick and place features: Creating the Straight Hole Feature, Creating the Simple Round, Specifying Radius Values for a Simple Round, Creating an Edge Chamfer
Sketcher basics: The sketcher environment, the sketcher interface, intent manager, pop-up menus sketcher mode functionality, sketcher menus, specifying references, creating geometry, dimensioning, constraining, additional sketcher tools, setting sketcher preferences sketcher philosophy, rules of thumb, laboratory practical.

Section B

Sketched features: Two sketched features, specifying extruded and revolved forms, sketching and reference planes, The Sketching Plane's Default Orientation
Datum planes: Using base features and datum planes, the base feature and its importance, datum plane, using default datums as the base feature, creating additional datum planes, defining a datum plane, internal datums.

Section C

Parent/child relationships: Parent/child relationships with pick-and-place features, parent/child relationships with a sketched feature, changing the parents of a feature, order of feature regeneration, using feature insert mode
Sweeps and blends: Swept features, defining a sweep, sweep sections and trajectories, blend features, creating parallel blends
Duplicating features: patterns and copy: Creating a pattern, benefits of patterning, types of patterns, pattern options, the copy feature, specifying location, choosing features, establishing dependence

Section D

Drawings and views: Drawing fundamentals, creating a drawing, adding drawing views, types of views, adding a cross section, manipulating views, laboratory practical

Creating assemblies Assembly creation: the surface normal vector, constraint options, packaging or under-constrained, components, assembly modification, changing design intent of the assembly, other assembly options, extracting a bill of materials, creating exploded views.

TEXT BOOKS & REFERENCES
1. Design Software: Tutorial and Multimedia CD

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-	1	-	2	-	-
CO2	3	-	2	-	2	-	-	-	-	1	-	2	2	-
CO3	3	-	-	-	2	-	-	-	-	-	-	2	1	2
CO4	2	-	2	-	3	-	-	-	-	1	1	2	2	2

Course Title/ Code	Agile Technologies (CSW317B)
Course Type	Elective
Course Nature	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5
Objectives	To introduce the practical applications of agile software development tools.

Course Outcome	Mapping
CO1: Students should be able to describe Agile Methodology with two frameworks: SCRUM, Extreme Programming (XP) and Test-Driven Development (TDD) Practice of XP and other Agile Models: Feature Driven Development and Lean Software Development.	Employability
CO2: Students should be able to apply TDD approach using JUnit Tool in IDE Eclipse and Git for Software Configuration Management in Agile Software Development	Employability & Skill development
CO3: Students should be able to design Use Cases, Agile Stories, Acceptance tests for Agile Stories, User Interface with Specification by Example approach, Product Backlog out of Requirement Analysis and task breakdown structure for Agile stories based on Agile Story Estimation.	Employability & Skill development
CO4: Students should be able to apply the approach of Continuous Integration & Continuous Development with Jenkins & Mavens tools for Agile software design & development in iterative way and approach of Behavior Driven Development for acceptance tests required for End-to-End Testing with Cucumber tool	Employability
CO5: Students should be able to perform Agile Process Management, Project Management, Backlog Management using Agile ant Tool through release planning, Agile story estimation, Agile project effort and progress tracking through Burn down Charts creation.	Employability & Skill development

Section A

Agile Programming Tools: UNIX, Eclipse, Git, jUnit,Processes: Stories, End-to-end Testing, Unit Testing, TDD, Refactoring. Reading: Scrum, Extreme Programming, Features Driven Development, Lean Software Development

Section B

Agile Design Tools: Use Cases, PowerPoint Design, Requirements/Story Extraction, Test Case Management. Processes: Use cases to Design, Design to Backlog, Backlog to Tasks, End to End Testing, Estimation

<div align="center">**Section C**</div>

Agile Architecture/Design and Continuous Integration Tools: Jenkins, Maven, Cucumber. Processes: Scrum, Architecture, Iterative Refinement, Agile Design.

<div align="center">**Section D**</div>

Agile Process Management Tools: Agilefant. Processes: Agile Process Management, Estimation, Burndown, Release Planning, Multi-team coordination, Distributed teams

List of Experiments

1. Test Driven Development on Eclipse using jUnit
2. Software Configuration Management using Git
3. Backlog development from use cases and user interface designs using Specification by Example
4. End-to-end/Acceptance tests using Cucumber
5. Continuous Integration using Jenkins
6. Agile Process Management using Agilefant.

Text Books:
1. Robert C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship, available at http://www.it-ebooks.info/book/1441/.

Reference Links:
1. Agile software development, http://en.wikipedia.org/wiki/Agile_software_development
2. Scrum, http://en.wikipedia.org/wiki/Scrum_%28software_development%29
3. Extreme Programming, http://en.wikipedia.org/wiki/Extreme_programming
4. Feature-drive development, http://en.wikipedia.org/wiki/Feature-driven_development
5. Lean Software development, http://en.wikipedia.org/wiki/Lean_software_development
6. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
7. Unit testing, http://en.wikipedia.org/wiki/Unit_testing
8. Specification by example, http://en.wikipedia.org/wiki/Specification_by_example
9. Behavior-driven development, http://en.wikipedia.org/wiki/Behavior-driven_development
10. Code refactoring, http://en.wikipedia.org/wiki/Code_refactoring
11. User Experience, http://en.wikipedia.org/wiki/User_experience

Tool Web Sites:

1. Ubuntu, http://www.ubuntu.com/desktop
2. Eclipse, https://eclipse.org/users/
3. jUnit, http://junit.org/
4. Git, http://git-scm.com/
5. Jenkins, https://jenkins-ci.org/
6. Ant, http://ant.apache.org/
7. Maven, https://maven.apache.org/
8. Cucumber, https://cukes.info/
9. Fitnesse, http://www.fitnesse.org/
10. Agilefant, http://agilefant.com/

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	3	-	-	-	-	-	-	1	3	3
CO3	3	3	2	2	1	-	-	-	2	2	-	-	3	3
CO4	3	-	3	-	3	-	-	-	2	-	-	3	3	3
CO5	3	2	2	-	3	-	-	-	2	2	2	3	3	3

B.Tech(CSE)200

Course Title/Code	**SENSORS & IOT (ECW310B)**
Course Type:	WORKSHOP (Departmental)
Course Nature:	Hard
L-T-P Structure	0-0-3
Credits	1.5
Course Objectives	Design, implement and test the prototype in order to solve the conceived problem.

Course Outcome	Mapping
CO1: Apply App Inventor as a tool within the design process and to apply concepts & skills that will eventually allow building out of an app idea.	Employability & Skill development
CO2: Demonstrate the concepts of Arduino as IDE, programming language & platform using different Sensors.	Employability
CO3: Build projects using Raspberry Pi.	Employability

LIST OF EXPERIMENTS:

1) Basic Calculator using MIT App Inventor 2
2) Screen Swapping, Web opening MIT App Inventor 2
3) Accelerometer MIT App Inventor 2
4) Led Blinking and Led Pattern using Arduino Uno
5) Ultrasonic Sensors using Arduino Uno
6) LCD display using Arduino Uno
7) Wi-Fi Module using Arduino Uno
8) Micro servo Motor and DC Motor using Arduino Uno
9) Temperature Sensor with Arduino Uno
10) Humidity and Pressure sensor with Arduino Uno

Course Outcomes	Program Outcomes													Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	2	1	2	-	-	-	1	1	1	1	-	-	
CO2	2	2	2	-	2	-	-	-	1	1	1	2	2	-	
CO3	2	2	2	3	2	-	-	-	1	1	1	1	1	2	

B.Tech(CSE)201

Course Title/Code	3D Printing (MEW318B)
Course Type:	OPEN ELECTIVE (Departmental)
Course Nature:	WORKSHOP
L-T-P Structure	(0-0-3)
Credits	1.5
Course Objective:	To increase knowledge on modelling & characterizations and develop specific tools for that Explain current and emerging 3D printing applications in a variety of industries Evaluate real-life scenarios and recommend the appropriate use of 3D printing technology Identify opportunities to apply 3D printing technology for time and cost savings Design and print objects containing moving parts without assembly

Course Outcome	Mapping
CO1: Demonstrate the differences and the applications of a range of additive manufacturing processes.	Employability
CO2: Apply correct CAD formats in the manufacture of a 3D printed part.	Employability
CO3: Describe the operating principles, capabilities, and limitations of liquid and solid based additive manufacturing system, including fused deposition modeling and stereo lithography.	Employability & Skill development
CO4: Describe the operating principles, capabilities and limitations of powder based additive manufacturing system (3D Printing).	Employability Skill development

- Introduction of 3D Printing
- Evolution of 3D Printing
- What is additive manufacturing?
- General procedure of 3D Printing
- 3D CAD file formats
- Stereo lithography (stl) files
- Various Printing technologies (SLA, SLS, FDM, Poly jet printing,
- Color jet Printing, SHS, SLM, LOM, Multi jet Printing, DLP)
- FDM in detail
- Operating Plasto 200 - Live demonstration
- STL principles
- Object placement
- Object analysis
- Slicing and printing
- Print settings

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	-	2	-	2	-	-	-	-	-	-	2	2	1
CO3	3	-	2	-	3	-	-	-	-	-	-	2	2	1
CO4	3	-	2	-	3	-	-	-	-	-	-	2	2	-

Course Title/ Code	R Programming (CSW318B)
Course Type	Core (Departmental)
Course Nature	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5
Objectives	To introduce the practical applications of R development tools.

Course Outcome	Mapping
CO1: Describe the basics of R programming concepts and Business Analytics	Employability
CO2: Demonstrate the concepts of Data Analytics	Employability
CO3: Analyze the results using various business Techniques in R	Employability & Skill development
CO4: Apply concepts to perform predictive analysis using R and utilize the learned techniques to evolve further	Employability & Skill development

Section A
Introduction to R, Understand the use of 'R' in the industry, Compare R with other software in analytics, Install R and the packages useful for Business Analytics, Using the R console, getting help, learning about the environment, Saving your work. R Vectors, Data Frames

Section B
Variables: Variables and Assignment, Decision Making, Loops in R, Classes & Objects in R, Reading CSV, Excel and Text files. Writing and saving data objects to file, the various steps involved in Data Cleaning, Functions used in Data Inspection.

Section C

Tackling the problems faced during Data Cleaning, Uses of the functions like grepl (), grep (), sub (), Packages installation used for database import, connect to RDBMS from R using ODBC and basic SQL queries in R.

Section D
Understanding Data Visualization, Graphical functions present in R, Plot various graphs like tableplot, Scatter Plot, Histogram, Box plot, Line graph, Bar charts, Pie charts. Customizing Graphical Parameters to improvise the plots, R Mean, Median, Mode, Linear Regression, Logistic Regression, Poission Regression, Normal Distribution and Binomial Distribution. Time Series Analysis, Decision Tree, Random Forest, Dimensionality reduction of Data: PCA, SVD, Predictive Analysis. Time series Decomposition, Time series clustering and classification.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	-	-	-	-	-	-	-	-	-
CO2	1	1	1	2	1	-	-	-	-	-	-	-	2	-
CO3	1	1	1	1	1	-	-	-	-	1	-	-	1	2
CO4	2	2	2	2	2	-	-	-	-	2	-	-	2	2

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Course Title/ Code	Image Editing & Animation (CSW207B)
Course Type:	**Elective**
Course Nature:	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5
Objectives	The students will learn the skills to edit an image & create animation.

Course Outcome	Mapping
CO1: Demonstrate the major regions of the Photoshop workspace and understand the function of each.	Employability
CO2: Apply the concept of Layers in Photoshop	Employability
CO3: Describe the fundamentals and underlying theories of Multimedia and animation.	Employability & Skill development
CO4: Develop 2D/3D animations, film-making, visual effects for the creative media.	Employability & Skill development

Section A

Understanding Photoshop: Images & Types of Images, Image Size and Resolution, creating a Digital Collage, Working with Files, Rulers and Guides, Changing Print Size of an Image. Working with Colors, Selections, Shapes and Painting, Adjusting Monitor Display, converting between Color Modes, Softening and Refining Selections, Saving, Loading, Deleting, Moving, Copying Pasting and Extracting Selections, Drawing with Pen Tool, Creating Brush, Filling and Stroking Selection and Layers. Transforming and Typing: Rotating, Cropping, and Flipping Images, Transforming Objects, Retouching and Liquefying, Leading and Kerning, Type Selection, Pasteurization, Text Wrapping.

Section B

Working with Layers: Creating and Deleting Layers, Selecting, Grouping and Linking Layers, Moving Copying and Locking Layers, Merging Layers: Layer Effects and Styles, Adjustment and Fill Layers, Masking Layers. Designing Web Pages: Creating Slices, Image Maps, Rollover and Animation, Creating Slices for Rollovers, Applying and Creating Rollover Styles, Animation Twining, Working with Layers, and Optimizing Images.

Section C

Flash: Introduction, Overview of tool, symbols, Simple Animation using Shape, Motion, Guided Twining and Frame by Frame Animation, Layers, Text Effect, Fade in- Fade out, Zooming Effect, Alpha Ripple

Effect, Photo Effects: Simple photo effect, motion photo masking, Special Effect: outline effect, shape effect, onion peel effect, shading effect, masking. Flash Animation Using Text and Voice.

Section D

Basics of Flash: Assigning Actions: Working with Actions Toolbox, working with the Script Navigator, working with the Script Pane, Working with Formatting, Using Code Hinting, Help Panel. Coding, Working with Strings, Numbers and Booleans, Casting Data, Declaring and Naming Variables, Working with Operators, Using Comments: Working with Statements, Control statements, Array, Functions Introduction to Action Script Coding- Variables and its scope in flash, working with data type variables, Arithmetic operations with numbers and string data type, Conditional Logic: If Else, Switch Cases, Loops, Arrays and Functions. Event Handler.

List of Experiments:

· Controlling your image and workflow using Photoshop.
· Implementation of 2-D transformation using Photoshop.
· Design a project using Masking, Image Manipulation and Layer Effects.
· Create a Frame-by-frame animation.
· Implementing the concept of layers.
· Motion & Shape Tweening.
· Guided Motion Tweening Concept.
· Working with the Flash effects.
· Create a simple animation in Flash with Action script.
· Create a Form using Action Script.
· Design the web page using Action Script.
· Animated Project.

Text Books:

● "Photoshop CS2-In Simple steps" by Shalini Gupta
● "Micromedia Flash 8 Bible" by Robert

Reference Book:

Vikas Gubta & Kogent Solutions Inc.: Multimedia and Web Design.
Paul Marino: 3D Animation and Film making Using Game engines.
● Antony Bolante: Adobe After effects 5 for windows After Indian edition 2002 Published by G.C. Jain for Techmedia.
● Arena Animation: Image Editing using Photoshop.
● Arena Animation: Animation using Flash.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	1	-	-	-	1	1

CO2	3	-	2	-	2	-	-	-	1	-	-	-	3	2
CO3	2	-	2	-	2	-	-	-	2	2	-	-	2	2
CO4	3	2	2	-	-	2	-	2	2	2	2	2	2	3

Course Title/Code	**BIOLOGY (EDH422)**
Course Type	Core (Allied)
Course Nature	Hard
L-T-P Structure	(2-0-0)
Credits	2
OUTCOMES	1. Describe how biological observations that lead to major discoveries. 2.Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological 2. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring 3. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. 4. Identify DNA as a genetic material in the molecular basis of information transfer. 5.Analyse biological processes at the reductionistic level 6. Apply thermodynamic principles to biological systems. 7. Identify and classify microorganisms.

Course Outcome	Mapping
CO1: To apply the knowledge of scientific disciplines of biology to lead to major discoveries	Employability & Skill development
CO2: To describe the concept and understanding of the taxonomic hierarchy.	Employability
CO3: To explain the cell structure and functions.	Employability & Skill development
CO4: To describe classical genetics	Employability & Skill development
CO5: To describe concepts of enzymology	Employability
CO6: To analyze' the basics of molecular biology	Employability/skill

Section A

INTRODUCTION

To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries.

highlight the fundamental importance of observations in any scientific inquiry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline.

Section B

CLASSIFICATION

Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultra-structure- prokaryotes or eukaryotes. Evolution of Life.

Molecular taxonomy- three major kingdoms of life. Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics. Energy and Carbon utilization - Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e)Habitata-acquatic or terrestrial. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae,

Section C

BIOMOLECULES AND MACROMOLECULAR ANALYSIS

Monomeric units and polymeric structures. Sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids. Enzymology: Enzyme classification. Mechanism of enzyme action Macromolecular: Hierarch in protein structure. Primary secondary, tertiary and quaternary structure.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus Endergonic and exergoinc reactions. Energy yielding and energy consuming reactions.

Section D

GENETICS

Mendel's laws, Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Central Dogma, Molecular basis of information transfer. DNA as a genetic material. Concept of genetic code. Concepts of recessiveness and dominance. Discuss about the single gene disorders in humans. Universality and degeneracy of genetic code.

Practical BIOLOGY FOR ENGINEERS (EDH422)
1. Study the contribution of eminent biologists
2. Study the classification and evolution of Life and living organisms
3. Preparation of Bacterial Culture E.coli and S. cerevisiae
4. To study the double helical model of DNA
5. Understanding Mendel's Laws of Genetics

Reference Book:
1. Introduction to Biology, Tata Mc Graw Hills Publications
2. Gardner book of Genetics
3. Stryer : Book of Biochemistry

Course Outcomes	Program Outcomes													Program Specific Outcomes
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	3	-	1	3	-	1	1	2
CO2	3	-	-	-	-	-	3	-	1	3	-	1	-	1
CO3	3	-	-	-	-	-	3	-	1	3	-	1	-	1
CO4	2	-	-	-	-	-	2	-	2	3	-	2	-	1

CO5	3	-	-	-	-	-	3	-	1	3	-	3	-	1
CO6	3	-	-	-	-	-	3	-	1	3	-	1	-	1

Course Title/Code	PROFESSIONAL COMPETANCY ENHANCEMENT-IV(CDO302)
Course Type:	**Allied Core**
Course Nature:	Soft
Credits	0.5
L-T-P Structure/Credits	(0-0-1)
Objective	Students will become better in analytics, problem solving and reasoning

Course Outcome	Mapping
CO1: Students will be able to apply the short tricks on geometry & calculation problems.	Employability
CO2: Students will be able to solve problems on Modern Mathematics & Numbers.	Employability
CO3: Students will be able to solve data related problems.	Employability & Skill development
CO4: Students will be able to demonstrate their vocabulary and grammar to solve complex questions	Employability & Skill development
CO5: Students will be able to write formal text with accuracy and ease	Employability & Skill development
CO6: Students will be able to demonstrate speed reading	Employability/Skill

SECTION A – Quantitative Aptitude

Unit 1: Modern Math

1.1 Permutation and Combination

      1.1.1 Principal of counting and basic formulas

      1.1.2 Arrangements, Selection and Selection + Arrangement.

      1.1.3 Linear/Circular arrangements, Digits and Alphabetic Problems and Applications.

1.2 Probability

      1.2.1 Events and Sample Space, Basic Formulas.

      1.2.2 Problems on Coins, Cards and Dices.

      1.2.3 Conditional Probability, Bayes' Theorem and their Applications.

Unit 2: Advanced Math

2.1 Mensuration 1- Areas

      2.1.1 Different types of Triangles and their area and perimeter.

      2.1.2 Different types of Quadrilaterals and their area and perimeter.

      2.1.3 Circumference and Area of Circle, Area of Sector and length of Sector.

      2.1.4 Mixed Figures and their Applications.

2.2 Mensuration 2- Surface Areas and Volumes

2.2.1 Problems on Cubes & Cuboids, Cone, Cylinder and Sphere.

2.2.2 Prism and Pyramid.

2.2.3 Mixed Figures and their Applications.

SECTION B

Unit 3: ALGEBRA:

3.1 Linear and Quadratic equations.

3.2 Inequalities.

3.3 Integral Solutions and Max and Min values

Unit 4: Professional Writing

4.1. Profiling on Social Sites: LinkedIn, Facebook, Instagram

4.2. Cover Letter/Emails

4.3. Resume Writing

SECTION C

Unit 5: Group Discussions

5.1. Dos and Don'ts of a Group Discussion

5.2. Roles played in a Group Discussion

5.3. Tips for Cracking a Group Discussion

SECTION D

Unit 6: Managing Interviews

6.1. Developing the employability mindset

6.2. Preparing for Self -Introduction

6.3. Researching the employer

6.4. Portfolio Management

6.5. Answering Questions in an Interview

Text Books/Reference Books:

1. Quantitative Aptitude : R S Aggarwal, S Chand & Company Pvt Ltd
2. Quantitative Aptitude for CAT: Arun Sharma
3. Verbal Ability and Reading Comprehension: MVN Enterprises

Weblinks:

http://www.indiabix.com/aptitude/questions-and-answers/

http://www.indiabix.com/non-verbal-reasoning/questions-and-answers/

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	2	-	-	2	-	2

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CO2	2	2	2	-	-	-	-	-	2	-	-	2	-	3
CO3	2	3	2	-	-	-	-	-	2	-	-	2	-	3
CO4	2	2	3	-	-	-	-	-	2	1	-	2	-	2
CO5	2	-	-	-	-	-	-	-	2	1	-	2	-	2
CO6	-	-	-	-	-	-	-	-	3	1	-	2	-	2

Course Title/Code	Modern Architecture Patterns (CSH322B-T) & (CSH322B-P)
Course Type:	Elective
Course Nature:	Hard
Credits	5
L-T-P Structure	3-1-2
Objective	Upon completion of this course the student will attain knowledge of o envisioning architecture, creating and analyzing architecture.

Course Outcome	Mapping
CO1 Student would be able to Recall the role of analyzing architectures.	Employability
CO2 Student would be able to Explain the concepts of the architecture and build the system from the components.	Employability
CO3 Student would be able to Apply his knowledge for creating an architecture for given application.	Employability & Skill Development
CO4. Student would be able to Classify creational and structural patterns.	Employability & Skill Development
CO5 Acquire Solid foundation in the field of designing and documenting software architecture.	Employability & Skill Development

SECTION A

Introduction to Software Architecture:

Software architecture: Overview, Stakeholders, Stakeholders' Areas of Concern, Software Architecture: Definition, Architecture Description, ISO/IEC/IEEE 42010, Architecture Structural Description, Architecture Behavioral Description, Benefits, Architectural Patterns, Architectural Style Vs. Architectural Pattern,

SECTION B

Introduction to Design Patterns

Design Pattern: Overview, Design Pattern Discovery, Elements, Documenting Design Pattern, Design Pattern: Benefits, Criticisms, Design Pattern Classifications, Creational Patterns, Structural Pattern, Behavioral Patterns, Architectural Patterns Vs. Design Pattern, Anti Patterns, Anti Pattern Vs. Bad Habit, God Object, Anti Patterns in Object Oriented Programming (OOP)

SECTION C

Architectural Patterns

Layered Pattern, Layers, Use Cases, Layered Pattern: Advantages, Layered Pattern: Disadvantages, Event-driven Pattern: Definition, Components, Use Cases, Advantages & Disadvantages

SECTION D

Microkernel & Microservices

Microkernel Pattern: Definition, Components, Use Cases, Advantages & Disadvantages, Microservices (MS): Definition, MS: Architecture, MS Principles: Single Responsibility, MS Principles: Loose Coupling, Domain Driven Design, Principles: Service Discovery, Fault Tolerance/Circuit Breaker, Automation, Use Cases, Advantages & Disadvantages, Space–Based Architecture, Use Cases, Advantages & Disadvantages

SECTION E

Design Patterns

Creational Design Patterns, Factory pattern, Builder Pattern, Prototype Pattern, Singleton Pattern, Structural Design Patterns, Adapter Pattern, Bridge Pattern, Composite Pattern, Decorator Pattern, Facade Pattern, Flyweight Pattern, Proxy Pattern, Behavioural Design Patterns, Command Pattern, Iterator Pattern, Mediator Pattern, Memento Pattern, Observer Pattern, Observer Pattern, template pattern, Visitor Pattern

Modern Architecture Patterns Lab

1. Create a Java Project
2. Introduction to the Course
3. Creational Design Patterns- Factory Pattern, Abstract Factory Pattern
4. Builder Pattern, Prototype Pattern
5. Singleton Pattern
6. Structural Design Patterns- Adapter Pattern, Bridge Pattern
7. Composite Pattern, Decorator Pattern
8. Façade Pattern, Flyweight Pattern, Proxy Pattern
9. Chain of responsibility Pattern
10. Behavioural Design Patterns - Command Pattern, Iterator Pattern, Mediator Patter
11. Memento Pattern, Observer Pattern
12. Strategy Pattern, Template Pattern, Visitor Pattern

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14

CO1	2	2	-	-	-	-	-	-	-	-	-	-	1	2
CO2	2	-	2	3	-	-	-	-	-	-	-	-	2	-
CO3	-	-	-	2	-	-	-	-	-	2	-	3	-	2
CO4	-	-	-	1	2	-	-	-	3	-	-	2	1	2
CO5	-	-	-	-	-	-	-	-	-	2	3	3	-	2

Course Title/Code	Natural Language Processing (CSH324B-T) & (CSH324B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	The course objective is to help students learn, understand, and practice Natural Language Processing & Deep Learning approaches.

Course Outcome	Mapping
CO1 To demonstrate the basic concepts and techniques of Deep Learning.	Employability
CO2 Demonstrate the understanding of pre-processing in NLP.	Employability
CO3 Apply deep learning in NLP applications.	Employability
CO4 Analyze the performance of NLP use cases in various real-world problems	Employability & Skill development
CO5 Design Solutions to a range of complex real world problems using NLP techniques.	Employability & Skill development

SECTION A

Natural Language Processing
Introduction to Natural Language Processing

Types of NLP systems, how computer understands text, Terminologies used in NLP, Steps Involved in NLP, Steps involved in preprocessing, Pipeline of NLP Problems o Challenges in NLP

SECTION B

Words & Vectors
Concepts of words and vectors, Techniques of converting words to numbers, GloVe Word Embeddings, Word2Vec and its types, such as Skip Gram, Model and Continuous BOW o Advanced word vectors, limitations of CBOW and Skip Gram

SECTION- C

Processing Techniques

Word window classification, Dependency parsing, Constituency parsing o Machine translation, Attention, End to end models for speech processing, Deep learning for speech recognition, Tree recursive neural networks o RNN for language modelling, Dynamic neural network for question answering

SECTION D

Case Studies

Smart Home Services Provider Uses Natural Language Generation to Create Highly Personalized Website Copy, Online Education Company Improves Customer Support with Autosuggestion of Macros, Using Natural Language for Health care Summaries, Microsoft Gets the Pulse of Customer Sentiment with Natural Language Processing

Natural Language Processing Lab

List of Programs
1. Text Classification using Word Embeddings.
2. Find Synonyms and antonyms using Word Embeddings.
3. Introduction to Topic Modelling.
4. Converting a Foreign Language to English using Machine Translation(German to English).
5. Twitter Sentiment Analysis.
6. Explaining Lemmatization, PoS Tagging,
7. Stemming and Tokenization using an Example.
8. Understanding Dependency Parsing in a given sentence.
9. Perform Speech to Text Conversion using PyAudio and Google Speech Recognition.
10. Creating Custom Speech Recognition Corpus.
11. Introduction to Dynamic Memory Network.
12. Dialog Generation using Deep Learning.

Course Learning Outcomes (CLOs):

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
CO1	2	1			2								2	3
CO2	3	2		1	2								3	2
CO3	2	2	3	2	2			2	2				2	2
CO4	2	2	3	2	2			2	3	2	1		1	2
CO5	2	2	3	3	3	1	1	2	3		2	3	2	2

Semester-VII

Course Code	Course Name	Offering Department	Course Type (Core/ Elective)	Structure			Credits
				L	T	P	
EDS288/EDS289/ EDS290/MOOC	APP. PHILOSOPHY/APP. PSYCHOLOGY/ APP. SOCIOLOGY/ MOOC	ED	ELECTIVE	1	0	2	2
CSH408B-T&P/ CSH409B-T&P/ CSH410B-T&P/ CSH411B-T&P/ CSH412B-T&P/ MOOC	MOBILE APP. ANALYTICS/ BUSINESS INTELLIGENCE & ANALYTICS WITH R/ CONVOLUTIONAL NEURAL NETWORK FOR VISUAL RECOGINITION / CLOUD SECURITY/ SOFTWARE REQUIREMENT ENGINEERING/MOOC	CS	ELECTIVE	3	0	2	4
ECH403B-T&P/ MEH403B-T&P/ CSH414B-T&P/MOOC	WIRELESS SENSOR NETWORK/ OPERATION RESEARCH BY OPTIMISING TECHNIQUE/ INFORMATION RETRIEVAL/MOOC	ECE/ME/CSE	ELECTIVE	3	1	2	5
MCS368B	ENTREPRENEURSHIP	MC	ELECTIVE	1	0	2	2
CSW406B/CSW407B/MOOC	.NET / USER EXPERIENCE/MOOC	CS	ELECTIVE	0	0	3	1.5
MCS232/MCS231/PSE301-P/MCH370/MOOC	INTRODUCTION TO FINANCE/ BASICS OF ECONOMICS/ ESSENTIAL OF PEACE & SUSTAINBILITY/MOOC	MC	ELECTIVE	1	0	2	2
LWS324	INDIAN CONSTITUTION	LW	CORE	1	0	0	0
TOTAL (L-T-P) /CREDITS)				9	1	13	16.5
SPECIALIZATION ELECTIVE BASKET							

CSH416B-T&P	COMPUTER VISION & DATA VISUALIZATION	CS	ELECTIVE	3	1	2	5
CSH422B-T&P	VIRTUALIZATION - CONTAINERS/CLOUD	CS	ELECTIVE	3	1	2	5
CSH415B-T&P	CONTINUOUS INTEGRATION AND CONTINUOUS DELIVERY	CS	ELECTIVE	3	1	2	5

Course Title/Code	**APPLIED PHILOSOPHY (EDS288)**
Course Type	Elective (Allied)
Course Nature	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objectives	To enable students to - confront the philosophical problems implicit in the experience of self, others and the society. - read critically the philosophy of influential philosophers with respect to society, Science and success in life - understand and apply concepts and theories of moral philosophy. - reflect philosophically and ethically on their own personal, professional and civic lives. -formulate for himself or herself a philosophy of life or world-view consistent with the objectives of liberal society.

Course Outcome	Mapping
CO1: Analyze the philosophical problems implicit in the experience of self, others and the society	Employability
CO2: Explain the philosophy of influential philosophers with respect to society, Science and success in life	Employability
CO3: Demonstrate the understanding of the concepts and theories of moral philosophy.	Employability & skill development
CO4: Reflect philosophically and ethically on one's own personal, professional and civic lives.	Employability & skill development
CO5: Formulate a philosophy of life or world-view consistent with the objectives of liberal society.	Employability

SECTION A
INTRODUCTION TO PHILOSOPHY: Philosophy: Meaning, Nature and Scope**,** Practical uses of Philosophy**,** Branches of Philosophy.

SECTION B
THOUGHTS OF PHILOSOPHERS AND THEIR IMPLICATIONS: General Philosophy of John Dewey, Swami Vivekananda and Rabindra Nath Tagore**,** Philosophy of life and success: Steve Jobs, N.R. Narayana Murthi, Dr. A.P.J. Abdul Kalam and Muhammad Yunus, Philosophy of Science and technology- Francis Bacon and Martin Heidegger.
SECTION C

PHILOSOPHICAL PERSPECTIVES OF SOCIO-POLITICAL SCENARIO IN INDIA: Nature of Democracy and its implications, Meaning and requirements of National Integration, Universal Human Rights

SECTION D

PHILOSOPHICAL PERSPECTIVES OF RELIGIOUS SCENARIO IN INDIA: Secularism—its nature and implications, Moral Philosophy of religion with special reference to Hinduism, Jainism, Buddhism, Islam, Christianity, Sikhism. Religious pluralism and religious tolerance.

Reference Books and Readings:

1. Bhatia, K. & Bhatia, B. (1974) The Philosophical and Sociological Foundations of Education. Delhi: Doaba House.
2. Brubacher, John. S. (1969). Modern Philosophies of Education, New Delhi: Tata McGraw-Hill
3. Dewey, J. (1966). Democracy in Education, New York: Macmillan.
4. Ferre, F.(1995). Philosophy of Technology. University of Georgia Press.
5. Gandhi, M. K. (1956). Basic Education. Ahmedabad, Navajivan.
6. Goel, A. & Goel S. L. (2005). Human values and Education. New Delhi: Deep and Deep Publications Pvt. Ltd.
7. Palmer, Joy A. et.al. (2001). Fifty major thinkers on education from confucious to Dewey. New Delhi: Rutledge.
8. Rajput, J.S. (2006). Human Values and Education. New Delhi: Paragon Publications.
9. Walia, J.S. (2011). Philosophical, Sociological and Economic Bases of Education.

LAB: (EDS288)

1. Prepare and present a report on 'philosophy of life' from the perspective of a young adult.
2. Quiz and interactive sessions on various philosophical perspectives of contemporary philosophers.
3. Organization of and participation in street plays /dramas/ declamation/ debates/ any other suitable activity on any theme of Philosophical perspectives of Socio-Political scenario in India.
4. Group discussions on any suitable topics concerning contemporary society like aggression among youth, Over-ambitiousness in young generation, misuse of democracy, implications of secularism etc. and to reflect upon different viewpoints.
5. Preparation of quotation boards to display quotes of great philosophers in the college premises.
6. Picture interpretation and philosophical reflection on social themes like juvenile crime, begging in India, Social networking etc.
7. Readings from the autobiographies and other publications of great philosophers e.g. 'Wings of Fire' followed by discussion session.
8. Showing Videos on Unique personalities: life and philosophies followed by reflection exercises.
9. Any other suitable activity.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	-	-	2	-	-
CO2	-	-	-	-	-	-	-	3	2	-	-	2	-	-

CO3	-	-	-	-	-	-	-	3	2	-	-	2	-	-
CO4	-	-	-	-	-	-	-	3	2	2	-	2	-	2
CO5	-	-	-	-	-	-	-	3	2	2	-	2	-	2

Course Title/Code	Applied Psychology (EDS289)
Course Type	Elective
Course Nature	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objectives	-To define psychology and its application across various fields. -To identify major attributes of Personality. -To conceptualize psychology in social and organizational settings. -To understand group dynamics. -To solve conflicts among the group.

Course Outcome	Mapping
CO1: develop critical thinking to understand the application of psychology CO2 identify the impact of Stereotyping, prejudice and discrimination in formation of attitude	Employability
CO2: identify the impact of Stereotyping, prejudice and discrimination in formation of attitude	Employability
CO3: Identify major attributes of Personality	Employability & skill development
CO4: Explain Social Psychology and able to solve conflicts among the group	Employability & skill development
CO5: Demonstrate group dynamics	Employability & skill development
CO6: Analyze organization Psychology and able to blend in work environment	Employability

Section A

PSYCHOLOGY: ATTITUDE FORMATION

Psychology: Meaning, nature, Role of psychology across multi-disciplinary aspects, Introduction: Stereotypes, Prejudice, and Discrimination, Introduction: Attitude, Formation of attitude, Aptitude

Section B

PERSONALITY AND PERSONALITY DEVELOPMENT

Definition of personality and its characteristics, Trait approach to personality (Big five theory of personality), Jung's Theory of personality

Section C

SOCIAL PSYCHOLOGY

Introduction to social identity, social cognition, and social influence, social conflicts and its resolutions, Group dynamics: Introduction, formation, types of groups, cooperation, competition, and conflict in groups.

Section D

ORGANIZATIONAL PSYCHOLOGY

Organizational Psychology: Definition, fundamental concepts and importance, Introduction to job satisfaction, work motivation, and Stress Management. Introduction to teamwork and its benefits.

References Books and Readings:

1. Arrow, K. J. (1995). Barrier to Conflict Resolution. NY: W. W. Norton.
2. Bandra, A., & Walters, R. H. (1963). Social Learning and Personality Development. New York: Holt, Rinehart, & Winston.
3. Bandra, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice- Hall, Inc.
4. Baron, R. A., Byrne, D. (1997). Social Psychology (8th Ed.). Boston, MA: Allyn & Bacon.
5. Baron, R. A. (2001). Psychology (5th ed.). London: Pearson.
6. Cialdini, R. B. (2001). Influence: Science and Practice (4th Ed.). Boston, MA: Allyn & Bacon.
7. Feldman, R. S. (2008). Essentials of Understanding Psychology. New Delhi: Tata McGraw Hill.
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10. Hall, C. S., Lindzey, G. & Campbell, J. B. (2004). Theories of Personality (4th Ed.). New York: Wiley.
11. Hunt, R. R., & Ellis, H. C. (2006). Fundamentals of Cognitive Psychology. New Delhi: Tata McGraw Hill.
12. McDavid, J. M., & Harari, H. (1994). Social Psychology: Individuals, Groups, and Societies. New Delhi: CBS Publishers.
13. Millward, L. (2005). Understanding Occupational and Organizational Psychology. London: Sage Publications.
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15. Woolfork, A. E. (2014). Educational Psychology (12th Ed.). Boston: Allyn & Bacon.

LAB: (EDS289)

1. **The Sentence Completion test** to know the individual's personality and its related aspect.

2. A **Self-concept Scale** to explore the major aspect of personality will be conducted.

3. **Multi variable Personality Inventory** will be conducted to explore the dimensions of personality.

4. **Eysenck Personality Test** will be conducted

5. To know different facet of personality a **Thematic Apperception Test** will be conducted.

6. **Socio-metric test** will be conducted to know the individual's social acceptance and group structure.

7. To explore the dimensions of personality **PIG Personality Test** will be administered.

8. To explore the multiple intelligence of students **My Preference test** is being conducted

9. Administration of **Cohen Perceived Stress** to know the level of stress among students and recording of the strategies to cope with it.

10. A **Career Aspiration Scale** will be conducted to identify different areas of aspirations.

11. **Self-Reflection Activity**
   - Identify different stereotypes present in our Society and your views on them.
   - Write a brief note of any one attitude you desire to change and strategies to accomplish it.
   - Prepare a SWOT Analysis Chart to know your strengths, weaknesses, opportunities and threats.
   - A Brief account of your personality before and after the transaction of course content.

Any other suitable activities.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	2	-	-	-	2	2	2	1	2	-	-
CO2	-	-	-	-	-	-	-	2	2	2	1	2	-	-
CO3	-	-	-	-	-	-	-	2	2	2	1	2	-	2
CO4	-	-	-	-	-	-	-	2	2	2	1	2	-	2
CO5	-	-	-	-	-	-	-	2	2	2	1	2	-	-
CO6	-	-	-	-	-	-	-	2	2	2	1	2	-	2

Course Title/Code	APPLIED SOCIOLOGY (EDS290)
Course Type	Elective (Allied)
Course Nature	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objectives	1. To know and understand about the fundamental concepts of sociology and its applications.
	2. To develop the analytical skills of students about ways in which social processes affect our everyday lives.
	3. To understand the impact of various processes of social change and assess their impact on society.
	4. To understand and analyze the social cultural dynamics that contribute to transformation of Indian reality
	5. To study the various contemporary issues of society.
	6. To develop basic research skills in area of sociology.

Course Outcome	Mapping
CO1: analyze the social cultural dynamics that contribute to transformation of Indian Society	Employability
CO2: develop the necessary skills of social processes which affect our everyday lives.	Employability
CO3: Analyze various contemporary issues of society and able to provide solutions of social barrier and benefiting the masses.	Employability & skill development
CO4: develop basic research skills in the area of sociology and help to find possible solution of specific social barriers of the society	Employability & skill development

Section A

Introduction and Applications of Sociology:
- Society, Community, Social Institutions, Social Groups, Introduction to Applied Sociology
- Sociology and Social Processes
- Sociology and Social Change
- Sociology and Social Problems
- Clinical Sociology

Section B

Sociological Processes:
- Social Stratification, Social Mobility and their impact on society

- Socialization, Agents of Socialization, Assessing the effects of Socialization
- Social Movements: Concept, Impact of Environmental Movements in India: Chipko Movement, Narmada Bachao Andolan

Section C

Processes and Issues of Social Change:
- Social Change: Westernization, Urbanization, Privatization, Globalization, Sustainable development
- Issues in urban development-Population, poverty, unplanned growth and ecological issues
- Conflict management:
    - Intergroup: Causes, Resolutions
    - Organizational Conflict, Conflict Management and Grievance Handling

Section D

Field Survey & Report Writing:
- Need, Meaning of Survey
- Types of Survey
- Steps in Conducting Survey
- Data Collection Methods
- Salient Features of Report Writing

LAB:

1. Showing Videos on the life and philosophies of Famous sociologists and to acquaint the students about their different theories
2. Preparation of quotation board with the help of displaying the pictures and quotes of famous sociologists
3. Choose a theme of your interest- for e.g., crime, technology environmental concerns or any other and look through the Sunday editorials of any national daily of the last 3 months to locate related articles.
4. Role Play: Gender issues in everyday life, students will form small groups and present skits to address this issue creatively; this will be followed by discussions.
5. Students may be given the assignment of taking pro-active role in initiating social change in a local field
6. Visit a shopping mall and observe the interaction between employees and customers/visitors. Identify themes based on your observation and prepare a questionnaire based on this experience.
7. Look at a set of published letters of Gandhi, Nehru, C.F. Andrews and Tagore etc. and identify key social issues that are discussed in the contents of the letters and prepare a report on it.
8. Students will be asked to write a short essay on the pressures they feel of the experience in performing masculinity or femininity, Presentations and discussions based around the essays.
9. Debate or discussion on "Is the family the site of love and care" or "Is the family democratic?"
10. Discuss the impact of modernization, industrialization and globalization on the day-today life.
11. Students may be asked to apply any applied research technique
12. Design a survey on factors effecting marriage choices of young people.
13. Any other suitable activity

References: Books and Readings

1. Andrew, W. (1997) Introduction to the Sociology of Development. New Jersey, Palgrave Macmillan.
2. Berg, L.B. (2001). Qualitative Research Methods for the Social Sciences (4th edition). Boston: Allyn and Bacon
3. Bhatia, H.(1970). Elements of Social Psychology. Bombay: Somaiyya Publications Pvt Ltd.
4. Bhattacharyya D.K (2009). *Organizational Behavior*, Oxford University Press, UK.

5. Dastupta Driskle(2007) : Discourse on Applied Sociology Volume-II, 2007
6. Desai, B Sonalde et al. (2010). Human Development in India: Challenges for a Society in Transition. OUP
7. Deshpande, S.(2003). Contemporary India: A Sociological View. New Delhi: Viking.
8. Hall R.H (2009). *Organizational Structures, Processes & outcomes, Asia*: Pearson Education Publications.
9. Hodegetts R M. (2009). *Organizational Behavior*, Macmillan.
10. Mc Michael.P. (1996). Development and Social change: A global perspective. California Thousand Oaks.
11. Merton, R and Nisbet, (1976) Contemporary Social Problems, New York: Harcourt, Brace and World.
12. Metha, S. (2009). Women and Social Change, Jaipur: Sage.
13. Michael Edwards (2011). Civil Society in India, edited The Oxford Handbook of Civil Society, Oxford, Oxford University Press
14. Mitra et.al. (2009). Democracy, Agency and Social Change in India, New Delhi: Sage
15. Pratt henry Fairchild(2009) : Outline of Applied Sociology, 2009
16. Ranjitkumar : Research Methodology, Person Education, Delhi.
17. Schaefer, R.T (2004). Sociology a Brief Introduction, (5thed.) New York: McGraw-Hill Inc..
18. Sirclaus Moser & G. Kalton: Survey Methods in Social Investigation, Heinemann Educational Books, London.
19. Sanderson. (2010). Social Psychology, New York: John Wiley.
20. Tepperman, L. & Curtis, J. (Eds.) (2009). Principles of Sociology: Canadian perspectives. Don Mills, ON: Oxford University Press.
21. Young, K. (2001). Handbook of Social Psychology, London: Routledge and Kegal Paul Ltd.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						-	1	2	2	2	-	2		
CO2						-	1	2	2	2	-	2		2
CO3				1		-	1	2	2	2	-	2		2
CO4				1		-	1	2	2	2	-	2		

Course Title/Code	Mobile App Analytics (CSH408B-T) & (CSH408B-P)
Course Type	**Hard (Departmental)**
Course Nature	Domain Elective
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Students would be able to analyze market for the mobile application and calculating revenue.

Course Outcome	Mapping
CO1: Understand how to improve the process of application functionality and revenue by applying continuous improvement process and various revenue models.	Employability
CO2: Will be able to demonstrate and configure web and mobile application on Google Analytics and Firebase platform to analyses user activity.	Employability & skill development
CO3: Will be able to build new reports using metrics and dimensions on Google Analytics platform.	Employability & skill development
CO4: Will be able to plan an event tracking using Tag manager tool.	Employability & skill development
CO5: Will be able to analyze the performance of website using A/B testing on different versions of page(s) by setting up flow experiment in Google Optimize platform.	Employability
CO6: Will be able to evaluate the analytics data from demo or real-time application using various report filters on Data Studio platform.	Employability

Section A

Introduction to Mobile App Analytics: Defining Web Analytics :- Quantitative and Qualitative Data ,The Continuous Improvement Process ,Measuring Outcomes ; Marketing and analysis tools, App revenue models, Starting with a measurement plan:- Gather Business Requirements , Analyze and Document Website Architecture, Create an Account and Configure Your Profile , Configure the Tracking Code and Tag Pages ,Tools to set up tracking- The Mobile Tracking Code , App Tracking , The (Very) Old Tracking Code: urchin.js.

Section B

Attracting New Users: Create Additional User Accounts and Configure Reporting Features, Creating a Google Analytics Account :-Creating Additional Profiles ,Access Levels , All About Profiles :- Basic Profile Settings, Profile Name, Website URL, Time Zone, Default Page; Acquisition channels, Acquisition reports, High-value users, Segmentation and user attributes.

Section C

Measuring behavior: Behavior reports overview, Reporting and Analysis Tools ,Juice Concentrate , Google Analytics Report Enhancer , Keyword Trends in Google Analytics, Screen tracking, Event tracking:-

Getting Started with Event Tracking , Pulling It All Together , Implementation , Reporting ,Tracking a Distributed Object, Tracking Email - Email Messages to Complete Conversion Activities, Custom dimensions and metrics tracking:- Custom Variable Implementation ,Custom Variable Reporting ,Segmenting Members from Nonmembers , Custom Variables for E-Commerce , Custom Variables for Publishers, Enhanced Ecommerce tracking:- How It Works , Implementation , Common E-Commerce Problems ,Using E-Commerce Tracking on Non-E-Commerce Sites.

Section D

Increasing revenue: Identifying roadblocks to revenue, Re-engaging existing users, Remarketing to new and existing users

List of Experiments

1. Study of various tools for analytics research
2. Introduction to Google Analytics tool
3. Setting up web tracking code.
4. Decide how to add tracking
5. Add tracking using Google Tag Manager
6. Add the tracking code directly to the site

Text Books:

1. Google Analytics by Jerri L. Ledford, Joe Teixeira, Mary E. Tyler, Wiley.
2. Google Analytics by Justin Cutroni, O'Reilly.

Reference Book:

1. Sams Teach Yourself Google Analytics in 10 Minutes by Michael Miller.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	-	-	-	3	2	3	2	3	3	3
CO2	2	3	2	3	-	-	-	-	1	1	2	1	3	2
CO3	-	-	-	-	2	-	2	-	2	2	3	2	2	2
CO4	3	2	2	-	-	2	2	2	3	3	3	3	2	3
CO5	2	3	3	3	3	3	3	3	3	3	3	3	3	2
CO6	-	1	1	-	-	-	-	-	1	-	1	1	2	3

Course Title/Code	**Business Intelligence & Analytics with R programming (CSH409B-T) & (CSH409B-P)**
Course Type	**Elective**
Course Nature	**Hard**
L-T-P Structure	**(3-0-2)**
Credits	**4**
Objectives	Students will be able to perform business analytics with R programming

Course Outcome	Mapping
CO1: Describe the basic concepts of Business Analytics and R programming	Employability
CO2: Demonstrate the concepts of Data Analytics	Employability
CO3: Apply the learning to perform predictive analytics using R	Employability & skill development
CO4: Analyze the results using various Data Visualization Techniques	Employability & skill development

Section A

Introduction: Introduction to Business Analytics, Understand the use of 'R' in the industry, Compare R with other software in analytics, Install R and the packages useful for Business Analytics, Using the R console, getting help, learning about the environment, Saving your work. Data Structures, Variables: Variables and Assignment, Data types, Indexing, subsetting, Viewing data and summaries, Functions, Naming conventions, Objects, Models, Graphics Control Flow: Branching, Looping, Vectorized calculations

Section B

Data Import : The various steps involved in Data Cleaning, Functions used in Data Inspection, Tackling the problems faced during Data Cleaning, Uses of the functions like grepl(), grep(), sub(), Coerce the data, Uses of the apply() functions. Import data from spreadsheets and text files into R, Import data from other statistical formats like sas7bdat and spss, Packages installation used for database import, Connect to Database from R using SQLdf and basic SQL queries in R.

Section C

Data Visualization & Data Mining in R: Understanding Data Visualization, Graphical functions present in R, Plot various graphs like table plot, Scatter Plot, histogram, box plot, Customizing Graphical Parameters to improvise the plots, Understanding GUIs like Deducer and R Commander, Introduction to Spatial Analysis.

Introduction to data mining, K-means Clustering, Apriori for association rule mining, Linear Regression (Simple & Multiple), Logistic Regression.

Section D

Predictive Analysis and Decision tree – Decision Trees, Algorithm for creating Decision Trees, Greedy Approach: Entropy and Information Gain, Classification Rules for Decision Trees, Concepts of Random Forest, Working of Random Forest, Features of Random Forest. Dimensionality reduction of Data: PCA, SVD, Analysis of Variance (Anova) Technique, Predictive Analysis. Time series Decomposition, Time series clustering and classification.

List of Experiments

2. Installation of Revolutionary R studio.
3. Vectors (logical, character) and their operation,Arrary indexing, Outer product of two array
4. Matrix operations
   - How to name rows and columns of matrix.
   - Program to transpose matrix
   - Singular value decomposition,Cbind and rbind.
5. List creations, Concatenations of two lists, Attach () and detach() functions
6. Data Cleaning using apply () and grep()
7. Data import

   - Load and save data from csv and text file using save and load functions
   - Load data from R packages
   - Load data from database using SQLdf package
8. Visualize the data set using scatter plot, box plot and graph,heapmap,level plot and contour
9. Draw generalized linear model using glm() function and predict function
10. Decision tree of dataset using ctree() in party package
11. Decision tree of dataset using cforest() in party package
12. Implement k-means clustering,pamk() and Pam() function
13. Generate association rules using apriori on titanic dataset
14. Visualize the association rules using arulesViz
15. Time series dcomposition of AirPassengers dataset
16. Time series Forcasting of AirPassengersdataset usingArima()
    - How to name rows and columns of matrix.
    - Program to transpose matrix.
    - Singular value decomposition,Cbind and rbind.

Text Book:

1. "Data mining and Bussiness analytics with R" by JohannesLadolter Willey Publications

Reference Books:

1. "R for Bussiness Analytics" by Ajay Ohri Springer Publications
2. "Customer and Bussiness Analytics Appled Data Mining for Bussiness Decision Making using R" by Daniel S.Putler& Robert E. Krider CRC publications.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO1	PO2	PO9	PO1	PO2	PO12	PO1	PO2
CO1	-	-	-	1	-	-	-	-	2	1	1	1	3	3
CO2	-	1	-	3	-	-	-	-	1	1	-	2	3	1
CO3	3	-	3	1	3	3	2	-	3	1	3	3	3	3
CO4	2	3	2	3	2	2	1	-	3	3	3	3	3	2

Course Title/ Code	Cloud Security (CSH411B-T) & (CSH411B-P)
Course Type:	Domain Elective
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objectives	Students will be able to learn in the course the ground-up coverage on the high-level concepts of cloud landscape, architectural principles, techniques, design patterns and real-world best practices applied to Cloud service providers and consumers and delivering secure Cloud based services. Design security architectures that assure secure isolation of physical and logical infrastructures including compute, network and storage, comprehensive data protection at all layers, end-to-end identity and access management, monitoring and auditing processes and compliance with industry and regulatory mandates

Course Outcome	Mapping
CO1: Describe the fundamentals of Cloud Computing and its security aspects	Employability
CO2: Apply Data Protection for Cloud Infrastructure and Services	Employability
CO3: Implement Policy & Compliance in Cloud Computing	Employability
CO4: Implement Risk Management in Cloud Computing	Employability

Section A

Fundamentals of Cloud Computing and Architectural Characteristics: Understand what is Cloud computing. Architectural and Technological Influences of Cloud Computing☐☐Understand the Cloud deployment models☐☐Public, Private, Community and Hybrid models☐☐Scope of Control☐☐Software as a Service (SaaS)☐☐Platform as a Service (PaaS)☐☐Infrastructure as a Service (IaaS), Cloud Computing Roles, Risks and Security Concerns.

Security Design and Architecture for Cloud Computing: Guiding Security design principles for Cloud Computing, Secure Isolation, Comprehensive data protection, End-to-end access control, Monitoring and auditing, Quick look at CSA, NIST and ENISA guidelines for Cloud Security, Common attack vectors and threats.

Secure Isolation of Physical & Logical Infrastructure: Isolation☐☐Compute, Network and Storage☐☐Common attack vectors and threats☐☐Secure Isolation Strategies☐☐Multitenancy, Virtualization strategies☐☐Inter-tenant network segmentation strategies☐☐Storage isolation strategies

Section B

Data Protection for Cloud Infrastructure and Services: Understand the Cloud based Information Life Cycle☐☐Data protection for Confidentiality and Integrity☐☐Common attack vectors and threats☐☐Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key Management, assuring data deletion☐☐Data retention, deletion and archiving procedures for tenant data☐☐Data Protection Strategies.

Enforcing Access Control for Cloud Infrastructure based Services: Understand the access control requirements for Cloud infrastructure☐☐Common attack vectors and threats☐☐Enforcing Access Control

Strategies□□Compute, Network and Storage□ Authentication and Authorization, Roles-based Access Control, Multi-factor authentication□□Host, storage and network access control options' Hardening and minimization, securing remote access, Verified and measured boot.

Monitoring, Auditing and Management: Proactive activity monitoring, Incident Response□□Monitoring for unauthorized access, malicious traffic, abuse of system privileges, intrusion detection, events and alerts□□Auditing – Record generation, Reporting and Management□□Tamper-proofing audit logs□□Quality of Services□□Secure Management□□User management□□Identity management□□Security Information and Event Management.

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Section C
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Introduction to Cloud Design Patterns: Introduction to Design Patterns, Understanding Design Patterns Template, Architectural patterns for Cloud Computing, Platform-to-Virtualization & Virtualization-to-Cloud, Cloud bursting

Introduction to Identity Management in Cloud Computing: User Identification, Authentication, and Authorization in Cloud Infrastructure, be able to understand the concepts of Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, the role of Identity provisioning.

Cloud Computing Security Design Patterns – I: Security Patterns for Cloud Computing□ Trusted Platform, Geo-tagging□□Cloud VM Platform Encryption, Trusted Cloud Resource Pools, Secure Cloud Interfaces□□Cloud Resource Access Control, Cloud Data Breach Protection, Permanent Data Loss Protection, In-Transit Cloud Data Encryption.

<div align="center">

Section D
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Cloud Computing Security Design Patterns – Insecurity Patterns for Cloud Computing – Network Security, Identity & Access Management & Trust, Secure On-Premise Internet Access, Secure External Cloud Connection, Cloud Denial-of-Service Protection, Cloud Traffic Hijacking Protection, Automatically Defined Perimeter, Cloud Authentication Gateway, Federated Cloud Authentication, Cloud Key Management, Trust Attestation Service, Collaborative Monitoring and Logging, Independent Cloud Auditing.

Policy, Compliance & Risk Management in Cloud Computing: Be able to understand the legal, security, forensics, personal & data privacy issues within Cloud environment, Cloud security assessment & audit reports, Laws & regulatory mandates, Personal Identifiable Information & Data Privacy, Privacy requirements for Cloud computing (ISO 27018), Metrics for Service Level Agreements (SLA), Metrics for Risk Management, ENISA, NIST SP 800, PCI DSS, SAS 70, CSA Security, Trust, and Assurance Registry (STAR), HIPAA compliance Case Study - Protecting PHI in Cloud

List of Experiments:

1. Build a threat model for migrating to cloud.
2. Create a basic cloud instance on public cloud infrastructure and a security baseline
3. Encrypt public cloud data: learn about cloud storage options and encrypt the data for the public cloud deployment.
4. Identity Management for the cloud: Create a basic federated identity infrastructure to support their cloud application and learn additional details on standards like SAML and Oauth.
5. Private Cloud Analysis Risk
6. Create and Secure Private Cloud.

Text Books:

1. Securing The Cloud: Cloud Computing Security Techniques and Tactics by Vic (J.R.) Winkler (Syngress/Elsevier) - 978-1-59749-592-9

2. Cloud Computing Design Patterns by Thomas Erl (Prentice Hall) - 978-0133858563

Reference Book:

1. Cloud computing: Implementation, management and security By Rittinghouse, John, W.
2. Cloud Computing Bible, By Barrie Sosinsky, Wiley, 2011.
3. Cloud Computing Architected: Solution Design Handbook by Rhoton, John.
4. Cloud Security, A comprehensive Guide to Secure Cloud Com puting by Krutz, Ronald L.; Vines, Russell Dean
5. Cloud Computing: Principles and paradigms By Raj Kumar Buyya, James Broberg, AndrezeiM.Goscinski, 2011

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO2	-	3	3	3	-	-	-	-	-	-	3	-	2	-
CO3	3	3	3	3	-	-	-	-	-	-	3	-	1	2
CO4	3	3	3	3	3	-	-	-	-	-	3	-	2	2

Course Title/ Code	**Software Requirement Engineering (CSH412B-T) & (CSH412B-P)**
Course Type:	**Domain Elective**
Course Nature:	Hard
L-T-P Structure	(3-0-2)
Credits	4
Objective	Students will be able to understand and apply requirement engineering

Course Outcome	Mapping
CO1: Describe about processes, tools and techniques used in requirements engineering;	Employability
CO2: Demonstrate the concepts of software requirements elicitation, modeling, validation and verification;	Employability
CO3: Design the software requirements for the Software Requirements Process in agile contexts;	Employability & skill development
CO4: Analyze and develop the software requirements for the development of cost-effective and efficient technical solutions.	Employability & skill development

Section A

Introduction to Requirement Engineering: Motivation, Requirement versus Goals, Requirement Level Classification, Requirement Specifications Types, Requirement Engineering Activities, Requirement Engineering Paradigms, Problems with Traditional Requirement Engineering.

Preparing for Requirement Elicitation: Product Mission Statement, Encounter with a Customer, Stakeholders and its Identification, Customer Wants and Needs, Stakeholder Prioritization, Managing and Expectations.

Section B

Requirement Elicitation: Elicitation Techniques Survey, Elicitation Summary and Hazards. Writing the Requirements Document: Requirement Agreement and Analysis, Representation Approaches, IEEE Standard 830-1998, Functional Requirements, Document Requirements.

Requirement Risk Management: Requirement Validation and Verification, Techniques for V&V, Standards for V&V.

Section C

Formal Methods: Motivation, Introduction, Classification, Objections, Myths and Limitations. Requirements specification and Agile Methodologies: Introduction, Principles, Extreme Programming, Scrum, Requirements engineering for Agile Methodologies, Challenges for requirements engineering in Agile Methodologies.

Section D

Tool support for Requirements Engineering: Introduction, Traceability Support, Requirements management tools; Requirements Engineering Tool best practices; Elicitation Support Technologies.

Value engineering of Requirements: What, why, When and How, Estimating using COCOMO and its Derivatives, Estimating using Function Points, Requirements Feature cost Justification.

Text Books:

1. Requirements Engineering for Software and Systems, SecondEdition by Phillip A. Laplante, CRC Press.
2. Software Requirements Engineering by Richard H. Thayer, Merlin Dorfman, Sidney C. Bailin, Wiley, 1997.

List of Experiments:

1. Crowd-centric requirements engineering
2. Agile requirements engineering via user stories
3. Automated reasoning for improving requirements quality
4. Requirements modeling languages, including security
5. Software product management, including next release planning
6. Interactive tools to improve participation in RE (e.g., via gamification)
7. Requirements traceability

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	2	2	-	1	-	2	2	-	-	-
CO2	2	1	-	-	3	2	-	1	-	2	1	-	-	-
CO3	2	2	2	-	3	2	-	1	3	2	2	1	2	-
CO4	2	2	2	-	3	2	-	2	2	2	2	1	2	2

Course Title/Code	WIRELESS SENSOR NETWORK (ECH403B-T) &(ECH403B-P)
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	Students will be able to implement communication network using wireless sensors.

Course Outcome	Mapping
CO1: Design wireless sensor network system for different applications under consideration and understand various challenges and constraints for the same	Employability
CO2: Familiarize with the architectures, functions, and performance of wireless sensor networks systems and platforms.	Employability
CO3: Understand the hardware details of different types of sensors and select right type of sensor	Employability & Skill development
CO4: Handle special issues related to sensors like power handling energy conservation and security challenges	Employability & Skill development
CO5: Explore various protocols for WSN	Employability
CO6: wireless sensor networks for a given application and understand emerging research areas in the field of sensor networks	Employability

SECTION A

Introduction and Overview of WSN: Definitions and Background Sensing and Sensors - Challenges and Constraints- Energy, Self-Management, Wireless Networking, Decentralized Management, Design Constraints, Security, Other Challenges **Applications**: Structural Health Monitoring, Traffic Control

SECTION B

Architecture: Basic sensor network architectural elements, Single node architecture, Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, Network architecture, Sensor network scenarios, Optimization goals and figures of merit, Gateway concepts.

SECTION C

NODE AND NETWORK MANAGEMENT: Power Management, Local Power Management Aspects, Dynamic Power Management Time Synchronization, Time Synchronization Protocols, Localization, Security

SECTION D

ADHOC NETWORKS AND ROUTING PROTOCOLS: Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks,

Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

Text Books

Fundamentals of WSN Waltenegus Dargie and Christian Poellabauer Wiley Publications
Kazem Sohraby,DanielMinoli,TaiebZnati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John wiley& Sons.
Holger Karl, Andreas Willig, "Protocols and architectures for wireless sensor networks", John wiley& Sons.

Reference Books

Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks; An Information Processing Approach", Elsevier.
C. S. Raghavendra, Krishna M. Shivalingam, TaiebZnati, "Wireless sensor networks", Springer Verlag.
H. Edgar, Jr. Callaway, "Wireless Sensor networks, Architectures and Protocols", CRC Press

List of Experiments

1. Use CISCO packet tracer to explore the devices on the network and then add additional wired and wireless sensor devices.
2. Realize the Communication between the nodes and Gateway.
3. Design a smart home network, analyze and control the Communication between the end devices.
4. Design a smart home network with both wired and wireless devices and explore the data transfer between the end devices.
5. Design a gate control mechanism using RFID.
6. Design and analyze a smoke detection system using various sensors.
7. Control the end devices through microcontroller.
8. Integration of sensors through Arduino.
9. Introduction to LORA kits.
10. **Design mini projects related to various applications of WSN.**

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	2	1	-	-	1	1	-	1	3	2
CO2	3	3	3	2	-	1	-	-	1	1	-	1	2	2
CO3	3	3	3	2	-	1	-	-	1	1	-	1	2	1
CO4	3	3	3	2	2	1	-	-	1	-	-	1	3	2
CO5	3	3	3	2	2	2	-	-	1	1	-	1	2	2
CO6	3	3	3	2	2	1	2	-	1	1	-	2	3	2

Course Title/ Code	**OPERATION RESEARCH BY OPTIMISING TECHNIQUE (MEH403B)**
Course Type	**OPEN ELECTIVE**
Course Nature	**HARD**
L-T-P Structure	**3-1-2**
Credits	**5**
Objective	To equip the students with the concepts of operations research required for solving the mathematical problems and their applications.

Course Outcome	Mapping
CO1: Will able to apply concept of forecasting techniques	Employability & Skill development
CO2: Analysis deterministic and probabilistic inventory model	Employability
CO3: Be able to design and solve simple models of CPM and Transportation model	Employability & Skill development
CO4: Skills in the use of Operations Research approaches and computer tools in solving real problems in industry.	Employability

SECTION A

Engineering Economy and Costing**:** Elementary cost accounting and methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements.

Facility Design**:** Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; assembly line balancing; materials handling systems.

Production Planning and Inventory Control**:** Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; concept of JIT manufacturing system;

SECTION B

Inventory: functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

Linear programming: problem formulation, simplex method, duality and sensitivity analysis;

SECTION C

Transportation and assignment models; network flow models, simple queuing models; dynamic programming; simulation – manufacturing applications; PERT and CPM, time-cost trade-off, resource leveling.

SECTION D

Quality Management**:** Quality – concept and costs, quality circles, quality assurance; statistical quality control, acceptance sampling, zero defects, six sigma; total quality management; ISO 9000; design of experiments – Taguchi method.

Management Information System**:** Value of information; information storage and retrieval system database and data structures; knowledge-based systems.

TEXT BOOK & REFERENCES:

1. Production Systems: Planning, Analysis and Control by J.L. Riggs
2. Production, Planning and Inventory Control by S. Narasimhan, D. W. McLeavey, and P. J. Billington
3. Operation Research by D.S.Heera, S. Chand Publication

LIST OF EXPERIMENTS:

1. To prepare a case study for producing a product on shop floor covering areas of PPC, design, Methods Engineering, Operations and Quality Control.

2. To prepare a project report for calculating the total cost (direct and indirect cost) of a product being developed for manufacturing.

3, To prepare a flow chart identifying main steps to be followed by methods engineering in manufacturing a product.

4. To prepare a bar chart for producing a generator/turbine identifying the main sub-assemblies along with their completion schedule.

5. To prepare a document for quality policy, quality systems and procedures required to be followed in the manufacture of a turbine/generator.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	2	2	-	2	2	1	3	2	-
CO2	3	2	3	2	3	1	1	-	2	2	1	3	2	-
CO3	3	2	3	2	2	2	1	-	1	2	2	2	2	-
CO4	3	2	2	2	3	2	2	-	1	2	2	2	3	-

Course Title/ Code	Information Retrieval (CSH414B-T) & (CSH414B-P)
Course Type	Elective (Departmental)
Course Nature	Hard
L-T-P Structure	(3-1-2)
Credits	5
Objectives	Student will be able to Model, Represent and Retrieve the information from web.

Course Outcome	Mapping
CO1: Assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving particular McAleavy engineering problems	Employability & Skill development
CO2: Students would be able to understand concepts related to information retrieval models, retrieval performance evaluation.	Employability & Skill development
CO3: Students would be able to Apply different indexing techniques in data Base systems	Employability & Skill development
CO4: Students would be able to Analyze language models.	Employability
CO5: Acquire Solid foundation in the field of Information retrieval and Language model	Employability

Section A

Knowledge representation - Basics of Prepositional logic- Predicate logic-reasoning using first order logic-unification-forward chaining-backward chaining-resolution- -Production rules-frames-semantic networks-scripts.
Information retrieval problem, an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval, an inverted index, Bi-word indexes, Positional indexes, Combination schemes

Section B

Information Retrieval Modeling- Information retrieval – taxonomy-formal characterization classic information retrieval-set theoretic model-algebraic model-probabilistic model structured text retrieval models-models for browsing-. retrieval performance evaluation keyword-based querying-pattern matching-structural queries-Query operations.

Section C

Index construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes **Index compression:** Statistical properties of terms in information retrieval, Heaps' law: Estimating the number of terms, Zipf's law: Modeling the distribution of terms, Dictionary compression, Dictionary as a string, Blocked storage, Postings file compression.

Ontology Development- Description logic-taxonomies-Topic Maps-Ontology-Definition expressing ontology logically-ontology representations-XML-RDF-RDFS-OWL-OIL ontology development for specific domain-ontology engineering-Semantic web services

Parallel and distributed IR- multimedia IR- data modeling-query languages-. Web Searching Basics-Characterizing the Web-Search Engines-Web crawling and in dexex-link analysis

Section D

Language models, Finite automata and language models, Types of language models, Multinomial distributions over words, the query likelihood model, using query likelihood language models in IR, Estimating the query generation probability, Language modelling versus other approaches in IR, Naïve bayes-vector space classification-support vector machines and machine learning on documents-flat clustering hierarchical clustering

List of Experiments:

1. Rapid Miner tool will be explorer in the lab.

Text Books:

1. Elain Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill, 3rd Edition, 2003.

Reference Books:

1. Stuart Russell-Peter Norvig, "Artificial Intelligence – A modern Approach", Pearson Education, 2nd Edition, 2003. (Unit I)
2. Michael c.Daconta,leo J. Obart and Kevin J Smith,"Semantic Web – A guide to the future of XML,Web Services and Knowledge Management",Wiley Publishers 2003.
3. Christopher D. Manning,PrabhakarRaghavan and HinrichSchutze, "Introduction to Information Retrieval", Cambridge University press, 2008.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	2	-	-	3	1	2	-	2	2
CO2	-	2	-	-	-	-	-	-	-	-	-	-	2	3
CO3	-	2	-	-	-	-	-	-	-	-	-	-	2	3
CO4	-	2	-	-	-	-	-	-	-	-	-	-	2	3
CO5	-	2	-	-	-	-	-	-	-	-	-	-	2	3

Course Title/ Code	**ENTREPRENEURSHIP (MCS368B)**
Course Type:	**Elective (Allied)**
Course Nature:	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objective	To explain concepts of. Entrepreneurship and build an understanding about business situations in which entrepreneurs

Course Outcome	Mapping
CO1: To identify and present the problem worth solving	Employability & Skill development
CO2: To prepare and present the Business Model /Lean Canvas	Employability & Skill development
CO3: To present your prototype/ Minimum Viable Product	Employability
CO4: To present your Potential Real Venture after working on the Team, Financials, Brand positioning and distribution channels.	Employability

SECTION A

Decision to become an entrepreneur

Introduction to entrepreneurship- Defining entrepreneurship, characteristics of successful entrepreneurs, importance of entrepreneurship, Myths about entrepreneurs, corporate entrepreneurship, Self-Discovery & SWOT analysis, Effectuation –Meaning, five principles of effectuation, Defining a Start-up, 4 Ps of a Startup, Reasons of Start-up failure, Basic Model of entrepreneurial process.

SECTION B

Opportunity discovery

Recognizing opportunities and generating Ideas, Validating the market need, identify problem worth solving using Jobs to be done (JTBD) methodology, design Thinking- Meaning, Design Thinking Values, Design Thinking Process, Double diamond approach in design thinking

SECTION C

Customer and Solution-

Customer Vs. Consumer, different market types and their specific requirements, estimate the market size, identify your customer Segment (through STP), Switching costs and psychological biases, understanding Market research for startups, Customer profile, Value proposition Canvas- understanding the jobs, pains and gains.

SECTION D

Business Model & Validation and Business Plan

Business Model- Concept, Elements of Business Model and Lean Approach, Lean canvas template, Blue Ocean Strategy, difference between Solution Demo and MVP, Business plan- definition and importance, components of Business plan- market, technical and financial, legal and ethical aspects in a Start-Up.

Text book:

Entrepreneurship: Successfully Launching New Ventures, 6th edition, Bruce R. Barringer and R Duane Ireland, Published by Pearson Copyright © 2019, 6th edition

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	3	-	-	-	2	-	3	3	-	2	-	-
CO2	-	3	3	3	-	-	2	-	3	3	3	2	2	-
CO3	-	3	3	3	-	-	3	-	3	3	-	3	1	2
CO4	2	3	3	3	3	3	3	3	3	3	3	3	2	2

Course Title/ Code	**Basics of Economics (MCS231)**
Course Type:	**Elective (Allied)**
Course Nature:	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objective	Students will analyze the performance and functioning of government, markets and institutions in the context of social and economic problems

Course Outcome	Mapping
CO1: Understand the scope of digital marketing and how it integrates with overall business and marketing strategy globally.	Employability & Skill development
CO2: To Understand the scope of digital marketing and how it integrates with overall consumers and marketing strategy globally.	Employability
CO3: Assess various digital channels and understand which are most suitable to an idea or solution.	Employability & Skill development
CO4: Understand the fundamentals of a digital marketing campaign and be able to apply it to achieve your business objectives.	Employability

SECTION A

Definition of Economics - various definitions, Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical application and importance.

SECTION B

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, degrees of Price elasticity of demand, factors effecting elasticity of demand, practical importance & applications of the concept of elasticity of demand.

SECTION C

Meaning of production and factors of production, laws of production, various concepts of cost - Fixed cost, variable cost, average cost, marginal cost, money cost, real cost and opportunity cost. Shape of short run cost curves.

SECTION D

Meaning of Market, Types of Market -Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets). Supply and Law of Supply, Role of Demand & Supply in Price Determination and effect of changes in demand and supply on prices.

Course Outcomes	Program Outcomes	Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	3	2	2	2	1	2	2	2	-	-
CO2	2	2	2	2	3	2	2	-	-	-	-	-	2	-
CO3	1	2	2	2	2	3	2	-	-	-	-	-	1	2
CO4	2	2	2	2	3	2		-	-	-	-	-	2	2

TEXT BOOKS:

1. Principles of Economics: P.N. Chopra (Kalyani Publishers).
2. Economics for Engineers- T R Jain & O P Khanna
3. Micro Economic Theory – M.L. Jhingan (S.Chand).
4. Micro Economic Theory - H.L. Ahuja (S.Chand).
5. Modern Micro Economics: S.K. Mishra (Pragati Publications).
6. Economic Theory - A.B.N. Kulkarni & A.B. Kalkundrikar (R.Chand & Co.).
7. Indian Economy: Rudar Dutt & K.P.M. Sundhram

Course Title/ Code	**Essentials of Peace and Sustainability (PSE301)**
Course Type:	**Elective (Allied)**
Course Nature:	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objective	Students will be sensitized on aspects of building and maintaining Peace in World through Sustainable Development

Course Objective

To make participants understand the philosophical underpinnings of "Peace" at Self, Society, Nation and Global level. The course aims at sensitizing participants on aspects of building and maintaining Peace in World through Sustainable Development and creating a mindset to acknowledge the importance of Peace through Collaborative and sustained efforts in personal, social, economic and governance. The course develops sound concepts which participants are made to apply through a series of Projects, Assignments, Group Work and Seminars and helps participants' growth into "Ambassadors of World Peace as Digital Professionals and sensitive Global Social beings".

Course Outcome	Mapping
CO1: Understand the basic concept of Peace and Sustainability	Employability & Skill development
CO2: Understand and apply thoughts on Peace	Employability & Skill development
CO3: Identify the challenges of peace	Employability & Skill development
CO4: Analyze the situation and solve problem	Employability

Course 1: Essentials of Peace and Sustainability

Learning outcomes

After completing this course, the students will be able to

1. Comprehend concept of "Peace and sustainability" and inter linkages

2. Discuss relevance of sustainable development goals to attain Peace

3. Recognize how peace addresses sustainable development goals

4. Construct thoughts and philosophies of Peace Advocacies

5. Compare various Perspectives on Peace

6. Be able to Choose appropriate strategy to face challenges to peace

7. Appreciate different kinds of thoughts in different contexts with reference to peace

8. Summarize understanding of peace based on various perspectives

9. Make decisions in personal, social and professional life aligning to inner peace

10. Envision impact of individual action on society and nation and globe as a whole

11. Develop culture of following netiquettes of a peace-loving citizen in digital era

12. Understand the political, economic, socio-cultural conflict & ecological conflict

Section A: Basic understanding of Peace and Sustainability

i. Concept of Peace and Approaches to Peace

ii. Understanding peace from different perspective: Self, Local Community, National and Global.

iii. Concept of Sustainability and Sustainable Development Goals (2030) as drivers of sustainable, health and social initiatives

iv. Why Sustainability

Assignment:

· Document analysis of Sustainable development goals agenda

· Creative expression based on sustainable development goals

Section B:

i.   Understanding thoughts on Peace
   a) Study of relevant extracts from the writings of Indian thinkers: Gandhi, Tagore, Sri

Aurobindo, Vivekananda
   b) Western thinkers: Russell, Iqbal, Dalai Lama, Nelson Mandela
   (Please follow Annexure A-reading references)

Assignment:
   · *Panel discussion by students*
   · *Discussion forums on different aspects of Peace*

Section C: Understanding challenges to peace

i. Challenges to peace-stress, conflicts, crimes, terrorism, violence and wars

ii. Ongoing conflicts in the political, economic, socio-cultural and ecological sphere at national and international level

iii. Impact of media- The use of perspective, symbols, stereotypes, and rhetoric in analyzing communication and representation of contentious issues in television and other modern media.

Assignment:

·   Case study analysis

Section D: Peaceful and Sustainability conscious individual

Being "Peace Ambassador"

        i.   Role of self in reducing prejudices, biases and stereotypes, nurturing positivity, making choices in response to crises in personal, social and professional life

(These topics should be covered through games and activities)

1. Developing Core competencies and life skills: Negotiation Rational thinking, System thinking, conflict resolution

(These topics should be covered through workshops)

2. Cultivating the skills necessary for peace: Introspection and reflective thinking, Mediation, Dialogue

(These topics should be covered through experiential learning through training and practices)

Assignment

·   *Reflective journaling*

Being Sustainability conscious individual

- 3As of Sustainable development goals-oriented initiatives: Awareness, Appreciation, Action
- Power of One
- Role of Organizations, NGO and Government
- Role of technology –Digital literacy and media literacy

Assignment

·   Project -Students will choose one of the sustainable development goals. Decide the initiative to achieve the goal, execute the initiative. Write a summary report on it and present in symposium.

Some of the suggested areas (But not limited to)

- *Gender stereotyping*
- *Gender equality*
- *Quality education*
- *Carbon footprints*
- *Ecological footprints*
- *Water crisis*
- *Waste water management*
- *Climate change*
- *Biodiversity*

Annexure A: Reading material

- Mahatma Gandhi (Brute Force and Passive resistance)

https://www.mkgandhi.org/hindswaraj/chap16_bruteforce.htm

https://www.mkgandhi.org/hindswaraj/chap17_passiveresistance.htm

Tagore ('Civilization and Progress' and 'Nationalism in India')

http://tagoreweb.in/Render/ShowContent.aspx?ct=Essays&bi=72EE92F5-BE50-40D7-8E6E-0F7410664DA3&ti=72EE92F5-BE50-4A47-2E6E-0F7410664DA3

http://www.swaraj.org/tagorecivilization.htm

Sri Aurobindo ('The Ideal of Human Unity')

http://www.collectedworksofsriaurobindo.com/index.php/readbook/03-the-turn-towards-unity-its-necessity-and-dangers-vol-the-ideal-of-human-unity

Russell ('Knowledge and Wisdom')

https://russell-j.com/1073-KW.HTM

Iqbal ('Is Religion Possible')

http://www.allamaiqbal.com/works/prose/english/reconstruction/07.htm

Dalai Lama ('Universal Responsibility')

https://www.lamayeshe.com/article/global-community-and-need-universal-responsibility

Nelson Mandela ('Alternative politics truth and reconciliation')

http://www.africa.upenn.edu/Govern_Political/Mandel_100.html

Work of Swami Vivekananda

Sustainable development goals

https://sustainabledevelopment.un.org/sdgs

https://www.un.org/sustainabledevelopment/peace-justice/

Sustainable development goals in action by countries, groups and individuals

https://undg.org/wp-content/uploads/2016/12/SDGs-are-Coming-to-Life-UNDG-1.pdf

https://www.un.org/sustainabledevelopment/be-the-change/

https://sdgsinaction.com/

https://sustainabledevelopment.un.org/partnerships/goodpractices

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	3	3	3	3	-	1	2	2	1	1

CO2	1	1	1	1	1	3	3	3	-	-	1	1	1	-
CO3	1	1	1	1	1	3	3	3	-	-	1	1	-	2
CO4	3	3	3	3	1	3	3	3	-	-	1	1	1	-

Course Title/ Code	Introduction to Finance (MCS232)
Course Type:	Elective (Allied)
Course Nature:	Soft
L-T-P Structure	(1-0-2)
Credits	2
Objective	To Provide an in-depth view of the process in financial management of the firm

Course Outcome	Mapping
CO1: To take an overview of financial management and its need to take financial decisions.	Employability & Skill development
CO2: To understand financial statements and distinguishes between profit & loss and Balance sheet of different business organizations.	Employability & Skill development
CO3: To identify the different sources of long-term finance and differentiate amongst equity, preference and Debt	Employability & Skill development
CO4: To elaborate and apply various techniques of capital budgeting and analyses cost of capital and capital structure	Employability

SECTION A

Introduction to Finance; Forms of Business Organization; Overview to financial statements, Balance Sheet, Profit and Loss Account, Cash Flow Statement.

SECTION B

Financial Analysis and Planning; Financial Ratios, Break Even Analysis Sources of Long-term Finance – Equity Capital, Preference Capital, Terms Loans, Debentures; Raising Long term Finance.

SECTION C

Time Value of Money, Capital Budgeting- Techniques of Capital Budgeting, Net Present Value and Payback Period; Capital Structure and Cost of Capital.

SECTION D

Working Capital: Introduction, Components of Current Assets and Current Liabilities, Operating Cycle, Estimation of Working Capital; Operating Income , Earning Before Interest and Tax (EBIT).

Suggested Readings:

1. Pandy, I.M., Financial Management, Vikas Publishing House, New Delhi
2. Khan M.Y, and Jain P.K., Financial Management, Tata McGraw Hill, New Delhi
3. Keown, Arthur J., Martin, John D., Petty, J. William and Scott, David F, Financial Management, Pearson Education
4. Chandra, Prasanna, Financial Management, TMH, New Delhi
5. Van Horne, James C., Financial Management and Policy, Prentice Hall of India
6. Brigham & Houston, Fundamentals of Financial Management, Thomson Learning, Bombay.
7. Kishore, R., Financial Management, Taxman's Publishing House, New Delhi

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	-	1	2	2	1	1
CO2	-	-	-	-	-	-	-	-	-	-	1	1	1	-
CO3	-	-	-	-	-	-	-	-	-	-	1	1	-	2
CO4	-	-	-	-	-	-	-	-	-	-	1	1	1	-

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Course Title/ Code	.NET (CSW406B)
Course Type:	Elective
Course Nature:	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5
Objective	Students shall be able to understand (A) database driven web application concepts using (B) C#, ASP.NET and Microsoft SQL Server and (C) analyse the different scenarios and requirements in order to (D) design and develop websites.

Course Outcome	Mapping
CO1: Code solutions using .NET Framework and develop Console Applications.	Employability
CO2: Describe the basic structure of a C# .NET project and demonstrate the use of the integrated development environment (IDE).	Employability
CO3: Create applications using Microsoft Windows Forms and ADO.Net.	Employability & Skill development
CO4: Solve queries of databases using SQL Server	Employability & Skill development
CO5: Deploy ASP.NET web applications using ADO.NET.	Employability/Skill

Section –A

Introduction to C#: C# Overview, data types, type conversions, Decision making, Loops, Encapsulation, Arrays, Strings, Structures, Exception Handling.

Section –B

Introduction to window forms, Form controls, User defined controls, ADO.NET-connected and disconnected architecture, Connection of form with database: Insert, Delete, Update, Retrieve.

Section-C

Introduction to .NET Technology & Various Control: Overview of .NET Framework, tools available in tool box of the web form, Simple application using web controls, Simple application using custom controls. Master Page, Content Pages and Validating User Input: Implementation of the master page and add the same master page in the main project, Create the various form of specific application and embed the data in the project, implementation of various validations for controls using scripting language

Section –D

Concepts of Database Access and Database Handling: Creating tables in the database, database connectivity,

and Display records by using database, Insertion and deletion of records from the database, View and searching the data on web form. Server Control and Tracing in ASP.NET: Using server control, Adding Event Procedure to web server control, Tracing in ASP.NET web application, Remote debugging.
Deploying a Web Project: Preparing a Website for Deployment, publishing a website, moving database to a remote server, Build real life application with reports.

Text Books:

1. Beginning ASP.NET in C# by Wrox
2. Professional ASP.NET 2.0by BillEvjen

Reference Books:

1. Beginning ASP.NET by ImarSpaanjaars
2. Visual C# 2008: How to ProgrambyPaul J. Deitel, Harvey M. Deitel Prentice Hall, 2009

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	3	-	-	-	1	-	-	-	-	-
CO2	3	1	2	-	3	-	-	-	1	-	-	-	-	-
CO3	3	3	3	-	3	-	-	-	3	2	3	3	3	2
CO4	3	2	3	-	3	-	-	-	1	-	-	-	-	-
CO5	3	3	3	-	3	-	-	-	3	2	3	3	3	2

Course Title/ Code	User Experience (CSW407B)
Course Type:	Elective (Departmental)
Course Nature:	Workshop
L-T-P Structure	(0-0-3)
Credits	1.5
Objectives	Students will be able to learn the ability to design good interface. To make clear distinction between good design and better design.

Course Outcome	Mapping
CO1: Students will be able to comprehend and apply the foundational fundamentals of user experience design	Employability
CO2: Students will be able to analyze and evaluate the elements that make a great user experience.	Employability
CO3: Students will be able to recognize how the elements of user experience work together.	Employability
CO4: Students will be able to demonstrate how strategy is an element of user experience.	Employability & Skill development
CO5: Students will be able to design a user interface in a way that supports and enhances the cognitive and affective processes that learning involves.	Employability & Skill development

Section A

HCI: Introduction to HCI, Goals of System Engineering, Goals of User-Interface Design, Usability of Interactive Systems Motivations for Human Factors in Design, Guidelines, Principles and Theories, Conceptual, Semantic, Syntactic and Lexical Model, GOMS (Goals, Operators, Methods, and Selection) and Keyboard-level model, HCI, Object-Action Interface Model. Interaction Styles: Introduction to interaction Devices, Keyboards and Function Keys, Pointing Devices, Speech and Auditory Interfaces, Speech Recognition, Image and Video Displays, Printers, Response Time and Display Rate with Respect to Display, Goals of Collaboration, Asynchronous and Synchronous Interfaces, Face-to-Face Interfaces.

Section B

Design Processes: Three Pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Expert Reviews. Tools and Testing: Usability Testing and Laboratories, Acceptance Testing, Evaluation during Active Use, Specification Methods, Interface Building Tools, Evaluation Tools.

Section C

Direct Manipulation (examples, explanations), Visual Thinking and Icons, 3D Interfaces, Virtual Reality, Introduction to Menu Selection, Form Fill-in and Dialog Boxes, Task Related Organizations, Fast Movement through Menus, Item Presentation Sequences, Response Time and Display Rate, Data Entry with

Menus, Menu Layout, Command-Organizational Strategies, Naming and Abbreviations, Command Menus, Natural language in Computing.

Section D

Presentation Design Issues: Error Messages, Display Design, Individual-Window Design, Multiple Window Design and Coordination by Tightly-coupled Windows, Color. Information Search & Visualization: Introduction, Search in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Search Interfaces, Information Visualization, OAI Model for Website Design.

LIST OF EXPERIMENTS:

1. Introduction to PENCIL Tools and its Controls.
2. To study the process of creating an animation with 2D objects, motion and sound.
3. To draw the Path and resizable shapes.
4. To draw the images and special constraints for Dimension and Handle.
5. Using external SVG.
6. Drawing sketchy lines.
7. Designing a model for website development.
8. Designing a User Interface.
9. Creating a PENCIL based Presentation with UI Controls.
10. Project based on PENCIL.

Text Books:
1. Schneiderman, Ben and Catherine Plaisant, Designing the User Interface (DTUI), Fifth edition, (Addison-Wesley, 2010)
2. Dix, Alan, Janet Finlay, Gregory D Abowd, Russell Beale, Human-Computer Interaction (HCI), Third edition (Pearson, 2004)
Reference Book:
1. Bill Buxton, Sketching User Experiences: Getting the Design Right and the Right Design (Interactive Technologies) , Elsevier, 2007.
2. Bill Moggridge, Designing Interactions, MIT Press, 2008.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO1	PO2	PO6	PO1	PO2	PO9	PO1	PO2	PO12	PO1	PO2
CO1	2	1	-	1	1	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	2	2	-	-	-	-	-	-	-	-
CO3	3	2	-	2	2	-	-	-	-	-	-	-	1	1
CO4	3	2	2	-	-	2	-	-	-	-	-	-	-	1
CO5	3	3	-	-	1	2	-	-	-	-	-	-	1	-

Course Title Code	Indian Constitution (LWS324)
Course Type:	Audit (Allied)
Course Nature:	Basic
L-T-P Structure	2-0-0
Credits	0
Objectives	The objective of this paper is to orient the students about the Basic features and fundamental principles on the Constitution of India.

Course Outcome	Mapping
CO1: Explain the historical perspective and salient features of constitution of India	Employability & Skill development
CO2: Distinguish between the fundamental rights, directive principles of state policies and fundamental duties	Employability & Skill development
CO3: Describe the governance system, roles and responsibilities of the State	Employability & Skill development
CO4: Explain the amendment and emergency provisions applicable in India	Employability & Skill development

SECTION A

- Meaning of the constitution law and constitutionalism
- Historical perspective of the Constitution of India
- Salient features and characteristics of the Constitution of India

SECTION B

- Scheme of the fundamental rights
- The scheme of the Fundamental Duties and its legal status
- The Directive Principles of State Policy – Its importance and implementation

SECTION C

- Federal structure and distribution of legislative and financial powers between the Union and the States
- Parliamentary Form of Government in India – The constitution powers and status of the President of India
- Local Self Government – Constitutional Scheme in India

SECTION D

- Amendment of the Constitutional Powers and Procedure
- The historical perspectives of the constitutional amendments in India
- Emergency Provisions: National Emergency, President Rule, Financial Emergency

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	1	-	3	1	3	-	-	-	1	-	-
CO2	-	-	-	1	-	3	2	3	-	-	-	1	-	-
CO3	-	-	-	1	-	3	2	3	-	-	-	1	-	-
CO4	-	-	-	1	-	3	1	3	-	-	-	1	-	-

Course Title/Code	Computer Vision& Data Visualization CSH416B-T & CSH416B-P
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	The course objective is (A)to help students learn the basic concepts, (B)understand the image computing, and (C)practice computer vision techniques and (D)data visualization approaches.

Course Outcome	Mapping
CO1-Able to establish fundamental concept and understanding of computer vision and data visualization systems	Employability
CO2-Understand standard methods to image creation and demonstrating	Employability & Skill development
CO3-Analyze and design a variety of algorithms for computer vision and data visualizations	Employability & Skill development
CO4-Develop and evaluate solutions to real life problems using computer vision techniques	Employability & Skill development

Section A

Introduction to Computer Vision and Image Processing

Image Processing, Elements of Image Processing System, Computer Vision, Computer Graphics, Application Areas, Imaging Geometry, Image Sampling, Mathematical Tools, Image transformations: 2D and 3 D Transformation, Image Enhancements-Intro, Image Segmentation-Intro, Cognitive Aspects of Color, VR/AR, Object Recognition, Object Tracking

Section B

Introduction to Open CV

Introduction, GUI Features, Operations: Pixel Editing, Geometric Transformations, Feature Detection, Video Analysis and Tracking, Stereo Imaging, Calibration, OpenCV-Python, Visualizations, Image Denoising, Object Detection, Transformation and Spatial Filtering Introduction, Functions, Histogram, Histogram Equalization, Histogram Matching (Specification), Local Histogram Processing, Using Histogram Statistics for Image Enhancement Introduction to Spatial Filtering, Smoothing & Sharpening Image Filters

Section C

Image compression & Segmentation

Fundamentals, Coding Redundancy, Spatial Redundancy, Irrelevant Information, Models, Compression Methods, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-Length Qlding, Symbol-Based Coding, Bit-Plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding, Human Vision, Applications, Point Line and Edge Detection, Shot Boundary Detection, Interactive Segmentation, Visual Appearance, Image Segmentation by Clustering Pixels, Basic Clustering Methods, The Watershed Algorithm, Segmentation Using K-means, Graphs, Fitting, Motion Segmentation, Model Selection, Case Studies

Section D

Object Recognition & Tracking

Shape correspondence and shape matching, Sliding Window Method, Patterns, Structural Methods, Deformable Objects, Tracking, Strategies, Matching, Tracking with Filters, Data Association, Particle Filtering

Section E

Motion Estimation

Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion

Computer Vision & Data Visualization Lab

List of Objectives

1. Discuss about important transformations used in imaging.
2. Write a code to detect car from image.
3. Write a program that will detect a change in the video feed.
4. Explain the 4 variations of image denoising in OpenCV, using Python.
5. How to perform histogram matching using OpenCV?
6. Compress an image without losing the quality of the image.
7. Analyze an image using histogram and enhance the image using Histogram statistics.
8. Detect Lane lines from images or video, primarily by using edge detection.
9. Implement image segmentation using edge detection segmentation and python.
10. Implement image segmentation using clustering and python.
11. Implement image segmentation using CNN.
12. Write a program to calculate the distance from an object to the camera using stereo vision.
13. Perform motion estimation in videos.

Course Learning Outcomes (CLOs):

On completion of this course, the students will be able to:-
- Understand the computer Vision Techniques
- Learn image Segmentation using Python

Computer Vision & Data Visualization Lab

List of Objectives

14. Discuss about important transformations used in imaging.
15. Write a code to detect car from image.
16. Write a program that will detect a change in the video feed.
17. Explain the 4 variations of image denoising in OpenCV, using Python.
18. How to perform histogram matching using OpenCV?
19. Compress an image without losing the quality of the image.
20. Analyze an image using histogram and enhance the image using Histogram statistics.
21. Detect Lane lines from images or video, primarily by using edge detection.
22. Implement image segmentation using edge detection segmentation and python.
23. Implement image segmentation using clustering and python.
24. Implement image segmentation using CNN.
25. Write a program to calculate the distance from an object to the camera using stereo vision.
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Course Learning Outcomes (CLOs):

On completion of this course, the students will be able to:-
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Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	-	-	-	-	-	-	-	-	2	2
CO2	3	2	3	2	3	-	-	-	-	-	-	-	3	3
CO3	3	1	3	3	3	-	-	-	-	-	-	-	3	2
CO4	3	2	1	3	3	-	-	-	-	-	-	-	3	3

Course Title/Code	Virtualization - Containers/Cloud (CSH422B-T) & (CSH422B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	Students shall be able to understand and apply the techniques of virtualization &containerization in real time scenarios.

Course Outcome	Mapping
CO1-Students will be able to understand the need of Containers	Employability
CO2-Understand the concept of virtualization and containerization	Employability
CO3-Creating and deploying virtual machines	Employability
CO4-Analyze containers using Docker, Kubernetes	Employability

Section A
Application Containerization

Understanding Containers: Transporting Goods Analogy, Problems in Shipping Industry before Containers, Shipping Industry Challenges, Container: The Saviour, Solution by Containers in the Shipping Industry, Challenges in the Software Industry, Problems in Software Industry Before Containers, Put that in Container! Solution by containers in the Software Industry

Section B
Virtualization & Containerization

Introduction, Hypervisor, Scope of Virtualization, Containers vs Virtual Machines, Understanding Containers, Containerization Platform, Runtime and Images, Container Platform, Container Runtime, The Chroot System, FreeBSD Jails, LinuX Containers (LXC), Docker, Docker architecture, Docker Daemon (Container Platform), Docker Rest API , CLI Different environments: (Dev, QA and Prod), Overcoming issues with different environments, Development Environment , Testing Environment, Staging Environment, Production Environment, Virtual machines for dev/deployments, Containers for dev/deployments, Advantages and drawbacks of containerization

<h2>Section C</h2>

<h3>Orchestration Tools on Cloud</h3>

What is orchestration? Need of orchestration, Case study: Need of Orchestration, Need of Orchestration: Container and Microservices, Docker Swarm and Kubernetes, Architecture, AWS (ECS, EKS), AWS Elastic Container Services Architecture, Azure Kubernetes Services, OpenShift, KUBERNETES ON CLOUD, monitoring of container, how to monitor?

<h2>Section D</h2>

<h3>System Provisioning</h3>

What is Provisioning – Basic Definition, Software Definition, Concepts of Provisioning, Why Provisioning Should be Exclusive, Configuration Management, Configuration Management Tools, Why Provisioning is not Configuration Management, Provisioning Tools, Test Machines for Provisioning, Deployment, Relationship between Deployment and Provisioning

<h2>Section E</h2>

<h3>Provisioning on Cloud</h3>

Introduction, Cloud Providers, Benefits of Cloud Computing, Types of Cloud Computing, Types of Deployment Model, Types of Service Model, Life Cycle of Provisioning on Cloud, Automated Provisioning on Cloud, what is Cloud Automation? Benefits of Cloud Automation, what is Sonarqube? Code Quality Checks Performed

<h3>Virtualization & Cloud Lab</h3>

1. Playing with Vagrant
2. Understanding Vagrant File and Configuration of Sandbox
3. Installation and Configuration of Docker Machine
4. Working with Docker Images and running Docker Containers
5. Dockerfile: Working with Containerization Application
6. Docker Extras – Docker Pot Binding, Docker Volumes, Docker Linking, Monitoring
7. DTR : Working with Docker Hub and Publishing Images
8. Working with Docker Compose
9: Docker-Swarm : spin up 3 virtual machines (vagrant in our case) and setup swarm cluster with one manager and 2 node.
10. Working with Kubernetes -Minikube
11. Deploying Pods and Services on Minikube

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	1	2	-	-	-	-	1	1	1	2
CO2	3	2	1	3	2	2	-	-	-	-	-	1	1	2
CO3	3	2	3	1	3	-	-	-	-	1	-	3	3	2
CO4	3	1	3	1	3	-	2	-	2	2	2	1	3	2

Course Title/Code	Continuous Integration & Continuous Delivery (CSH415B-T) & (CSH415B-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P Structure	3-1-2
Credits	5
Objective	The students will be able to Identify the practices associated with CI and the working mechanism

Course Outcome	Mapping
CO1-Students would be able to Identify the practices associated with CI and the working mechanism	Employability
CO2-Student would be able to Explain the core CI process and advanced CI process	Employability
CO3-Students would be able to deploy an application to production	Employability
CO4-Students would be able to Continuous test and deploy an application before sending it for production	Employability

Section A

Overview

Introduction to CI, Continuous Integration Workflow, Benefits of Continuous Integration, How CI Benefits Distributed Teams, Continuous Delivery, Steps Involved in CICD, Pipelines, Prerequisites, Checklist, Business Drivers for Continuous Deployment, Benefits of Continuous Deployment, CD – The HP Laserjet Case Study

Section B

Stages of Continuous Integration and Continuous Delivery
Core CI Process, VCS, Merging Local Changes to Integration Branch, Fork & Pull, Code Review, Automated code builds – Key metrics, Static Code Analysis, Snapshot, Sample Bug Report, Automated Unit Testing- JUNIT, Test Frameworks, Automated Unit Testing Process

Section C

Stages Extended

Code Coverage analysis, Code Coverage Methods, Condition Coverage, Line Coverage, Publishing Code Coverage reports to Jenkins, uploading build artifact to a repository, Advanced CI process, Automated Functional Testing, Publish Report to the Development Team, Google Canary release Case study

Section- D

Anatomy of a Continuous Delivery Pipeline

Simple Delivery Pipeline, Continuous Deployment Pipeline, releasing an application to Production, Zero-Downtime Releases, Rolling back deployments, Blue-Green Deployments, Canary Releasing, Emergency Fixes, Continuous Delivery engineering practices, Continuous Development/Integration

Section- E

Continuous Testing

Deploying and Promoting your Application, Modeling Your Release Process and Promoting Builds, Continuous Deployment to successive environments until before Production, Continuous monitoring for the delivery pipeline, Nagios sampler report, Continuous Feedback rules

Continuous Integration and Continuous Delivery Lab

1. Introduction to Jenkins and setup/configuration
2. Installation and Configuration of git/Java/maven on Build server (Windows)
3. Jenkins job, parameters, build, post-build actions and Pipeline
4. Jenkins Agent/Slave configuration with Windows/Ubuntu master hosts
5. Configuring Jenkins with git plugin
6. Create a new Jenkins pipeline
7. Merging local changes to the version control system (Git)
8. Installing/Configuring Nexus
9. Use Jenkins as a Continuous Integration server
10. Deploying the application to staging/prod environment
11. Merging feature branch code (V 2.0) to existing application created in step 1.6
12. Uploading plugins manually in Jenkins
13. Backup Management in Jenkins Server

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	3	-	2	-	3	-	-	-	-	3	3
CO2	3	2	3	2	1	-	-	-	3	3	-	-	-	-
CO3	3	3	3	-	-	3	-	3	-	-	3	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3