SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.
COMPUTER SCIENCE AND BUSINESS SYSTEMS

ACADEMIC REGULATIONS 2020
(R-2020)

CURRICULUM AND SYLLABI

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society

Mission

M1 :	**Quality Education**	**:**	To provide comprehensive academic system that amalgamates the cutting-edge technologies with best practices
M2 :	**Research and Innovation**	**:**	To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues
M3:	**Employability and Entrepreneurship**	**:**	To inculcate the employability and entrepreneurial skills through value and skill-based training
M4 :	**Ethical Values**	**:**	To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society

DEPARTMENT VISION AND MISSION

Vision

To envision the technology and business trends in this domain and to create technically competent professionals for meeting out the needs globally

Mission

M1: To foster knowledge sharing through contemporary curriculum and creative teaching learning process

M2: To impart strong computer and business skills to shine and sustain in the agile IT industry

M3: To promote technocrats with rich expertise in innovation and research

M4: To instill moral values and ethical responsibilities by empowering graduates to be socially responsible

PROGRAMME OUTCOMES (POs)

PO1:Engineering knowledge:

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

PO2:Problem analysis:

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

PO3:Design/development of solutions:

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

PO4:Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:**

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

PO6:The engineer and society:

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

PO7:Environment and sustainability:

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

PO8:Ethics:

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

PO9: Individual and team work:

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

PO10:Communication:

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

PO11:Project management and finance:

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

PO12: Life-long learning:

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To apply computer science and business concepts to solve the real world problems

PEO2: To develop professional skills in contemporary areas of computer science and business systems to obtain employability and pursue higher education

PEO3: To reconcile business demands with state-of-the art technologies by providing innovative solutions and insightful decisions

PEO4: To ensure ample growth with social and ethical responsibilities

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Ability to gain deep knowledge in Computer Science with equal appreciation in humanities, management, sciences and human values.

PSO2: Ability to demonstrate the technical and business skills and provide solutions for the societal needs

PSO3: Ability to engage lifelong learning and bestow innovative contributions toenhance research in the field of computer science and business system

Sl.No	Course Category	Breakdown of Credits
1.	Humanities and Social Sciences (HS)	30
2.	Basic Sciences (BS)	25
3.	Engineering Sciences (ES)	10
4.	Professional core (PC)	57
5.	Professional Electives (PE)	22
6.	Open Electives (PE)	-
7.	Project work/ Internship	12
8.	Employability Enhancement Courses (EEC)*	-
9.	Mandatory Courses (MC)*	-
	Total	**156**

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAMME

SCHEME OF CREDIT DISTRIBUTION - SUMMARY

Sl. No	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	2	4	-	5	7	4	4	4	30
2	Basic Sciences (BS)	10	8	4	3	-	-	-	-	25
3	Engineering Sciences (ES)	7	3	-	-	-	-	-	-	10
4	Professional Core (PC)	-	4	14	12	9	12	6	-	57
5	Professional Electives (PE)	-	-	-	-	4	4	7	7	22
6	Open Electives (OE)	-	-	-	-	-	-	-	-	-
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	0	2	-	02
9	Employability Enhancement Courses (EEC)*	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC)*	-	-	-	-	-	-	-	-	-
Total		**19**	**19**	**18**	**20**	**20**	**20**	**21**	**19**	**156**

**** EEC and MC are not included for CGPA calculation***

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20HST101	Business Communication & Value Science - I	HS	2	0	0	2	25	75	100
2	U20BST102	Discrete Mathematics	BS	2	1	0	3	25	75	100
3	U20BST103	Introductory Topics in Statistics and Probability	BS	3	0	0	3	25	75	100
4	U20BST113	Physics for Computing Science	BS	3	0	0	3	25	75	100
5	U20EST134	Fundamentals of Computer Science	ES	3	0	0	3	25	75	100
6	U20EST136	Principles of Electrical Engineering	ES	2	0	0	2	25	75	100
Practical										
7	U20BSP114	Physics for Computing Science Laboratory	BS	0	0	2	1	50	50	100
8	U20ESP135	Fundamentals of Computer Science Laboratory	ES	0	0	2	1	50	50	100
9	U20ESP137	Principles of Electrical Engineering Laboratory	ES	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20CBC1XX	Certification Course-I **	EEC	0	0	4	-	100	-	100
Mandatory Course										
11	U20CBM101	Induction Program	MC	3Weeks			-	-	-	-
							19	400	600	1000

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20HST202	Business Communication & Value Science – II	HS	2	0	0	2	25	75	100
2	U20HST203	Fundamentals of Economics	HS	2	0	0	2	25	75	100
3	U20BST216	Linear Algebra	BS	3	1	0	4	25	75	100
4	U20BST217	Statistical Methods	BS	3	0	0	3	25	75	100
5	U20EST251	Principles of Electronics	ES	2	0	0	2	25	75	100
6	U20CBT201	Data Structures & Algorithms	PC	3	0	0	3	25	75	100
Practical										
7	U20BSP218	Statistical Methods Laboratory	BS	0	0	2	1	50	50	100
8	U20ESP252	Principles of Electronics Laboratory	ES	0	0	2	1	50	50	100
9	U20CBP201	Data Structures & Algorithms Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20CBC2XX	Certification Course - II**	EEC	0	0	4	-	100	-	100
11	U20CBS201	Skill Development Course 1 – Python Programming	EEC	0	0	2	-	100	-	100
Mandatory Course										
12	U20CBM202	Environmental Sciences	MC	2	0	0	-	100	-	100
							19	600	600	1200

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST328	Computational Statistics	BS	3	0	0	3	25	75	100
2	U20CBT302	Formal Language and Automata Theory	PC	3	0	0	3	25	75	100
3	U20CBT303	Computer Organization & Architecture	PC	3	0	0	3	25	75	100
4	U20CBT304	Object Oriented Programming	PC	3	0	0	3	25	75	100
5	U20CBT305	Database Management Systems	PC	3	0	0	3	25	75	100
Practical										
6	U20BSP329	Computational Statistics Laboratory	BS	0	0	2	1	50	50	100
7	U20CBP302	Object Oriented Programming Laboratory	PC	0	0	2	1	50	50	100
8	U20CBP303	Database Management Systems Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20CBC3XX	Certification Course - III**	EEC	0	0	4	-	100	-	100
10	U20CBS302	Skill Development Course 2 - – R Programming	EEC	0	0	2	-	100	-	100
Mandatory Course										
11	U20CBM303	Physical Education	MC	0	0	2	-	100	-	100
							18	575	525	1100

SEMESTER – IV										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20HST404	Business Communication & Value Science – III	HS	1	0	2	2	100	-	100
2	U20HST405	Introduction to Innovation, IP Management & Entrepreneurship	HS	3	0	0	3	25	75	100
3	U20BST440	Operations Research	BS	2	0	0	2	25	75	100
4	U20CBT406	Operating Systems	PC	3	0	0	3	25	75	100
5	U20CBT407	Software Engineering	PC	3	0	0	3	25	75	100
6	U20CBT408	Design And Analysis of Algorithms	PC	3	0	0	3	25	75	100
Practical										
7	U20BSP441	Operations Research Laboratory	BS	0	0	2	1	50	50	100
8	U20CBP404	Operating Systems(Unix) Laboratory	PC	0	0	2	1	50	50	100
9	U20CBP405	Software Engineering Laboratory	PC	0	0	2	1	50	50	100
10	U20CBP406	Design And Analysis of Algorithms Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20CBC4XX	Certification Course - IV**	EEC	0	0	4	-	100	-	100
12	U20CBS403	Skill Development Course 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20CBM404	NSS	MC	0	0	2	-	100	-	100
							20	725	575	1300

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20HST507	Fundamentals of Management	HS	2	0	0	2	25	75	100
2	U20HST508	Business Strategy	HS	2	0	0	2	25	75	100
3	U20HST509	Design Thinking	HS	2	0	2	3	25	75	100
4	U20CBT509	Software Design with UML	PC	3	0	0	3	25	75	100
5	U20CBT510	Compiler Design	PC	3	0	0	3	25	75	100
6	U20CBE5XX	Professional Elective I#	PE	2	1	0	3	25	75	100
Practical										
7	U20CBP507	Software Design with UML Laboratory	PC	0	0	2	1	50	50	100
8	U20CBP508	Compiler Design Laboratory	PC	0	0	2	1	50	50	100
9	U20CBP509	Mini Project	PC	0	0	2	1	50	50	100
10	U20CBEP5X	Professional Elective I# Laboratory	PE	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20CBC5XX	Certification Course-V**	EEC	0	0	4	-	100	-	100
12	U20CBS504	Skill Development Course 4: Foreign Language/ IELTS-I	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20CBM505	Indian Constitution	MC	2	0	0	-	100	-	100
							20	650	650	1300

 # Professional Electives are to be selected from the list given in Annexure I
**** Certification courses are to be selected from the list given in Annexure II**
*** Skill Development Course 3 is to be selected from the list given in Annexure III**

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20HST610	Business Communication & Value Science – IV	HS	1	0	2	2	100	-	100
2	U20HST611	Financial and Cost Accounting	HS	2	0	0	2	25	75	100
3	U20CBT611	Computer Networks	PC	3	0	0	3	25	75	100
4	U20CBT612	Information Security	PC	3	0	0	3	25	75	100
5	U20CBT613	Artificial Intelligence	PC	3	0	0	3	25	75	100
6	U20CBE6XX	Professional Elective II#	PE	2	1	0	3	25	75	100
Practical										
7	U20CBP610	Computer Networks Laboratory	PC	0	0	2	1	50	50	100
8	U20CBP611	Information Security Laboratory	PC	0	0	2	1	50	50	100
9	U20CBP612	Artificial Intelligence Laboratory	PC	0	0	2	1	50	50	100
10	U20CBEP6X	Professional Elective II# Laboratory	PE	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20CBC6XX	Certification Course - VI**	EEC	0	0	4	-	100	-	100
12	U20CBS605	Skill Development Course 5: NPTEL/MOOC-I	EEC	0	0	0	-	100	-	100
Mandatory Course										
13	U20CBM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							20	725	575	1300

SEMESTER – VII										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20HST712	Financial Management	HS	2	0	0	2	25	75	100
2	U20HST713	Human Resource Management	HS	2	0	0	2	25	75	100
3	U20CBT714	Usability Design of Software Applications	PC	2	0	0	2	25	75	100
4	U20CBT715	IT Workshop Scilab / Matlab	PC	2	0	0	2	25	75	100
5	U20CBE7XX	Professional Elective III#	PE	2	1	0	3	25	75	100
6	U20CBE7XX	Professional Elective IV#	PE	3	0	0	3	25	75	100
Practical										
7	U20CBP713	Usability Design of Software Applications Laboratory	PC	0	0	2	1	50	50	100
8	U20CBP714	IT Workshop Scilab / Matlab Laboratory	PC	0	0	2	1	50	50	100
9	U20CBEP7X	Professional Elective IV# Laboratory	PE	0	0	2	1	50	50	100
Project Work										
10	U20CBW701	Internship/ Industrial Projects	PC	0	0	0	2	100	-	100
11	U20CBW702	Project Evaluation I	PC	0	0	4	2	100	-	100
Mandatory Course										
12	U20CBM707	Professional Ethics	MC	2	0	0	-	100	-	100
							21	600	600	1200

SEMESTER – VIII										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20HST814	IT Project Management	HS	3	0	0	3	25	75	100
2	U20CBE8XX	Professional Elective V#	PE	2	1	0	3	25	75	100
3	U20CBE8XX	Professional Elective VI#	PE	3	0	0	3	25	75	100
Practical										
4	U20HSP801	IT Project Management Laboratory	HS	0	0	2	1	50	50	100
5	U20CBEP8X	Professional Elective VI# Laboratory	PE	0	0	2	1	50	50	100
Project Work										
6	U20CBW803	Project Evaluation II	PC	0	0	16	8	40	60	100
Employability Enhancement Course										
7	U20CBS806	Skill Development Course 6: NPTEL / MOOC-II	EEC	0	0	0	-	100	-	100
							19	315	385	1000

ANNEXURE I
PROFESSIONAL ELECTIVE COURSES (18 CREDITS)

Professional Elective – I (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBE501	Conversational Systems
2	U20CBE502	Cloud, Micro services& Application
3	**U20CBE503**	**Machine Learning Techniques**
4	**U20CBCM01**	**Business Intelligence and Applications**
5	U20CBE505	Business Process
Professional Elective – II (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBE606	Robotics and Embedded Systems
2	U20CBE607	Modern Web Applications
3	U20CBE608	Data Mining and Analytics
4	U20CBE609	E- Commerce and E- Payment Systems
5	U20CBE610	Big Databases
Professional Elective – III (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBE711	Cognitive Science & Analytics
2	U20CBE712	Introduction to IoT
3	U20CBE713	Cryptology
4	**U20ITCM04**	**Robotic Process Automation**
5	U20CBE715	Digital Marketing
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBE716	Quantum Computation & Quantum Information
2	U20CBE717	Advanced Social, Text and Media Analytics
3	**U20CBE718**	**Mobile Computing Techniques**
4	U20CBE719	Block chain
5	**U20CSCM04**	**Virtual Reality**
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBE821	Behavioral Economics
2	U20CBE822	Computational Finance & Modeling
3	U20CBE823	Psychology
4	U20CBE824	Marketing Research & Marketing Management
5	U20CBE825	Smart Systems
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBE826	Enterprise Systems
2	U20CBE827	Services Science & Service Operational Management
3	U20CBE828	Image Processing and Pattern Recognition
4	**U20ITCM08**	**Automation Techniques and Tools - Devops**
5	**U20CSCM03**	**Augmented Reality**

PROFESSIONAL ELECTIVE PRACTICAL COURSES (4 CREDITS)

Professional Elective – I (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBEP51	Conversational Systems Laboratory
2	U20CBEP52	Cloud, Micro services & Application Laboratory
3	**U20CBEP53**	**Machine Learning Techniques Laboratory**
4	**U20CBEP54**	**Business Intelligence and Intelligence Laboratory**
5	U20CBEP55	Business Process Laboratory
Professional Elective – II (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBEP61	Robotics and Embedded Systems Laboratory
2	U20CBEP62	Modern Web Applications Laboratory
3	U20CBEP63	Data Mining and Analytics Laboratory
4	U20CBEP64	E- Commerce and E- Payment Systems Laboratory
5	U20CBEP65	Big Databases Laboratory
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBEP71	Quantum Computation & Quantum Information Laboratory
2	U20CBEP72	Advanced Social, Text and Media Analytics Laboratory
3	**U20CBEP73**	**Mobile Computing Techniques Laboratory**
4	U20CBEP74	Block chain Laboratory
5	**U20CBEP75**	**Virtual Reality Laboratory**
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20CBEP81	Enterprise Systems Laboratory
2	U20CBEP82	Services Science & Service Operational Management Laboratory
3	U20CBEP83	Image Processing and Pattern Recognition Laboratory
4	**U20CBEP84**	**Automation Techniques and Tools –Devops Laboratory**
5	**U20CBEP85**	**Augmented Reality Laboratory**

ANNEXURE-II

EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl.No.	Course Code	Course Title
1	U20CBCX01	3ds Max
2	U20CBCX02	Advance Structural Analysis of Building using ETABS
3	U20CBCX03	Advanced Java Programming
4	U20CBCX04	Advanced Python Programming
5	U20CBCX05	Analog System Lab Kit
6	U20CBCX06	Android Medical App Development
7	U20CBCX07	Android Programming
8	U20CBCX08	ANSYS -Multiphysics
9	U20CBCX09	Artificial Intelligence
10	U20CBCX10	Artificial Intelligence and Edge Computing
11	U20CBCX11	Artificial Intelligence in Medicines
12	U20CBCX12	AutoCAD for Architecture
13	U20CBCX13	AutoCAD for Civil
14	U20CBCX14	AutoCAD for Electrical
15	U20CBCX15	AutoCAD for Mechanical
16	U20CBCX16	Azure DevOps
17	U20CBCX17	Basic Course on ePLAN
18	U20CBCX18	Basic Electro Pneumatics
19	U20CBCX19	Basic Hydraulics
20	U20CBCX20	Bio Signal and Image Processing Development System
21	U20CBCX21	Blockchain
22	U20CBCX22	Bridge Analysis
23	U20CBCX23	Building Analysis and Construction Management
24	U20CBCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20CBCX25	CATIA
26	U20CBCX26	CCNA (Routing and Switching)
27	U20CBCX27	CCNA (Wireless)
28	U20CBCX28	Cloud Computing
29	U20CBCX29	Computer Programming for Medical Equipments
30	U20CBCX30	Corel Draw
31	U20CBCX31	Creo (Modeling and Simulation)
32	U20CBCX32	Cyber Security
33	U20CBCX33	Data Science and Data Analytics
34	U20CBCX34	Data Science using Python
35	U20CBCX35	Data Science using R
36	U20CBCX36	Deep Learning
37	U20CBCX37	Design and Documentation using ePLAN Electric P8
38	U20CBCX38	Design of Biomedical Devices and Systems
39	U20CBCX39	Digital Marketing
40	U20CBCX40	Digital Signal Processing Development System
41	U20CBCX41	DigSILENT Power Factory
42	U20CBCX42	Electro Hydraulic Automation with PLC
43	U20CBCX43	Embedded System using Arduino
44	U20CBCX44	Embedded System using C
45	U20CBCX45	Embedded System with IoT
46	U20CBCX46	ePLAN Data Portal
47	U20CBCX47	ePLAN Electric P8
48	U20CBCX48	ePLAN Fluid
49	U20CBCX49	ePLAN PPE
50	U20CBCX50	Fusion 360
51	U20CBCX51	Fuzzy Logic and Neural Networks
52	U20CBCX52	Google Analytics

53	U20CBCX53	Hydraulic Automation
54	U20CBCX54	Industrial Automation
55	U20CBCX55	Industry 4.0
56	U20CBCX56	Internet of Things
57	U20CBCX57	Introduction to C Programming
58	U20CBCX58	Introduction to C++ Programming
59	U20CBCX59	IoT using Python
60	U20CBCX60	Java Programming
61	U20CBCX61	Machine Learning
62	U20CBCX62	Machine Learning and Deep Learning
63	U20CBCX63	Machine Learning for Medical Diagnosis
64	U20CBCX64	Mechatronics
65	U20CBCX65	Medical Robotics
66	U20CBCX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20CBCX67	Mobile Edge Computing
68	U20CBCX68	Modeling and Visualization using Micro station
69	U20CBCX69	MX Road
70	U20CBCX70	Photoshop
71	U20CBCX71	PLC
72	U20CBCX72	Pneumatics Automation
73	U20CBCX73	Project Management
74	U20CBCX74	Python Programming
75	U20CBCX75	Revit Architecture
76	U20CBCX76	Revit Inventor
77	U20CBCX77	Revit MEP
78	U20CBCX78	Robotics
79	U20CBCX79	Search Engine Optimization
80	U20CBCX80	Software Testing
81	U20CBCX81	Solar and Smart Energy System with IoT
82	U20CBCX82	Solid Works
83	U20CBCX83	Solid Works with Electrical Schematics
84	U20CBCX84	Speech Processing
85	U20CBCX85	STAAD PRO V8i
86	U20CBCX86	Structural Design and Analysis using Bentley
87	U20CBCX87	Total Station
88	U20CBCX88	Video and Image Processing Development System
89	U20CBCX89	VLSI Design
90	U20CBCX90	Web Programming - I
91	U20CBCX91	Web Programming - II

ANNEXURE-III

EMPLOYABILITY ENHANCEMENT COURSES-(B) SKILL DEVELOPMENT COURSES

Sl. No.	Course Code	Course Title
1.	U20CBS201	Skill Development Course 1 : Python Programming
2.	U20CBS302	Skill Development Course 2 : R Programming
3.	U20CBS403	Skill Development Course 3 *
		1) Graphic Design
		2) Exploring GITHUB Platform
		3) Aptitude Basics
4.	U20CBS504	Skill Development Course 4 : Foreign Language/ IELTS -I
5.	U20CBS605	Skill Development Course 5 : NPTEL / MOOC - I
6.	U20CBS806	Skill Development Course 6 : NPTEL / MOOC-II

**** Choose any one skill development course in the list for SDC 3***

U20HST101	BUSINESS COMMUNICATION & VALUE SCIENCE - I	L	T	P	C	Hrs
		2	0	0	2	30

Course Objectives

- To understand what life skills are and their importance in leading a happy and well-adjusted life
- To develop the basic grammar skills
- To motivate students to look within and create a better version of self
- To introduce them to key concepts of values, life skills and business communication
- To comprehend the varied features of communication

Course Outcomes

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

CO1 - Recognize the need for life skills and values **(K1)**
CO2 - Apply the knowledge of grammar in oral and written communication **(K3)**
CO3 - Recognize own strengths and opportunities **(K1)**
CO4 - Understand the basic tenets of communication **(K2)**
CO5 - Apply the basic communication practices in different types of communication **(K3)**

UNIT – I PEOPLE SKILLS AND SELF-INTROSPECTION (6 Hrs)

Presentation on favourite cricket captain and the skills and values they demonstrate- Interviewing a maid, watchman, sweeper, cab driver, and beggar and narrate the values that drive them- Overviewing business communication- Writing Newspaper Report on football, hockey match, accident report or current political scenario- Record conversation between a celebrity and an interviewer- - Self-awareness – identity, body awareness, stress management.

UNIT – II GRAMMAR (6 Hrs)

Essential Grammar: Parts of Speech - Tenses: Applications of tenses on Functional Grammar, Sentence formation : (General and Technical) - Common Errors-Voices -Sentence Sequence

UNIT – III FUNDAMENTALS IN COMMUNICATION (6 Hrs)

Types of communication: Verbal and Non – verbal – Role-play -Importance of Questioning, Listening Skills: Importance, Difference between listening and hearing, Types of listening - Expressing self – connecting with emotions, visualization and experience, Skit based on communication skills- Evaluation on Listening skills: listens to recording and answer questions based on them.

UNIT – IV ORGANISATIONAL COMMUNICATION (6 Hrs)

Email writing: Formal and informal -Verbal communication: Pronunciation, clarity and brevity of speech - Vocabulary Enrichment: General Service List (GSL), Academic word list (AWL) technical terms, phrases, idioms, significant abbreviations, formal business vocabulary - Reading activity: Reading Newspapers, Magazine , Journal etc. and take part in GD, Practice: Table Topics speech - Written Communication: Narrative writing – creating CV –Life skill: Stress management and teamwork - Project: Create a podcast on a topic

UNIT – V INCORPORATING LIFE SKILLS WITH VALUES (6 Hrs)

Life Skills: Movie based learning – identifying skills and values - Critical life skills - Multiple Intelligences - Work with an NGO and makes a presentation – Values: Leadership, Teamwork, Managing Stress, Motivation, and Creativity

Reference Books

1. English vocabulary in use – Alan Mc'carthy and O'dell
2. APAART: Speak Well 1 (English language and communication)
3. APAART: Speak Well 2 (Soft Skills)
4. Business Communication – Dr. Saroj Hiremath, Kindle Edition, Dec 2018
5. Wren, Percival Christopher, and Wren Martin. "High School English Grammar and Composition". S Chand, 2005.

Web References

1. Train your mind to perform under pressure- Simon sinek
2. https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
3. Brilliant way one CEO rallied his team in the middle of layoffs
4. https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
5. Will Smith's Top Ten rules for success
6. https://www.youtube.com/watch?v=bBsT9omTeh0
7. https://www.coursera.org/learn/learning-how-to-learn
8. https://www.coursera.org/specializations/effective-business-communication

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
2	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
5	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20BST102	DISCRETE MATHEMATICS	L	T	P	C	Hrs
		2	1	0	3	45

Course Objectives

- To understand the concepts and significance of Boolean algebra.
- To know the fundamental concepts of Group theory.
- To understand the basic concepts of combinatorics and graph theory.
- To learn the basic of graph theory.
- To extend student's ability to deal with logics and connectives.

.

Course Outcomes

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

CO1 - Understand the basic concepts of Boolean algebra. **(K2)**
CO2 - Recall the basic concepts of sets, groups, ring and field. **(K2)**
CO3 - Understand and apply the basic concepts of mathematical induction. **(K3)**
CO4 - Determine the different types of graphs. **(K3)**
CO5 - Gain knowledge of the concepts needed to test the logic of a program. **(K2)**

UNITI BOOLEAN ALGEBRA **(9 Hrs)**

Introduction of Boolean algebra, truth table, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map.

UNIT II ABSTRACT ALGEBRA **(9 Hrs)**

Set: Definition, simple problems, Relation: types, simple problems, Group: monoid, semigroup, group, Abelian group, simple problems Ring: Definition, simple problems Field: Definition, simple problems.

UNIT III COMBINATORICS **(9 Hrs)**

Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle.

UNIT IV GRAPH THEORY **(9 Hrs)**

Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, trees; Planar graphs, Euler's formula, dual of a planer graph, independence number and clique number, chromatic number, statement of Four-color theorem.

UNIT V LOGIC **(9 Hrs)**

Propositional calculus - propositions and connectives, syntax; Semantics – truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility - natural deduction system and axiom system; Soundness and completeness.

Text Books

1. I. N. Herstein, John Wiley and Sons, "Topics in Algebra".
2. M. Morris Mano," Digital Logic & Computer Design", Pearson. January 2014
3. C. L. LiuMcGraw Hill, "Elements of Discrete Mathematics", (Second Edition) New Delhi.
4. J. A. Bondy and U. S. R. Murty, "Graph Theory with Applications", Macmillan Press, London.
5. L. Zhongwan, "Mathematical Logic for Computer Science", World Scientific, Singapore.

Reference Books

1. Gilbert Strang, "Introduction to linear algebra".5th Edition,2016
2. R. A. Brualdi, "Introductory Combinatorics", 5th Edition,North-Holland, New York,2016.
3. N. Deo, Prentice Hall, Englewood Cliffs, "Graph Theory with Applications to Engineering and Computer Science" Dover Publications Inc.; 1stEdition,2016.

4. E. Mendelsohn, Van-Nostrand, “Introduction to Mathematical Logic”, (Second Edition), London.

Web References

1. https://youtu.be/0Dx7r0PFyUM
2. https://youtu.be/rs5S0Ehp3s8
3. https://youtu.be/aUjq6o0PmjY
4. https://youtu.be/fZqfkJ-cb28
5. https://youtu.be/oaOm2pnKkyY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20BST103	INTRODUCTORY TOPICS IN STATISTICS AND PROBABILITY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the concepts of evaluation using statistical analysis
- To Know the central tendency like mean, median, mode etc.
- To study the basic probability concepts
- To introduce knowledge of standard discrete distributions.
- To acquire knowledge on probability continuous distributions

Course Outcomes

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

CO1 - Understand the types of data and graphical representation in statistics. **(K2)**
CO2 - Apply the concepts of central tendency. **(K2)**
CO3 - Recall the concepts of basic probability. **(K2)**
CO4 - Apply the basic rules of discrete random variables. **(K3)**
CO5 - Apply the fundamentals of probability theory and random processes. **(K3)**

UNIT I INTRODUCTION TO STATISTICS (9 Hrs)

Definition of Statistics. Basic objectives. Applications in various branches of science with examples. Collection of Data: Internal and external data, Primary and secondary Data. Population and sample, Representative sample.

UNIT II DESCRIPTIVE STATISTICS (9 Hrs)

Classification and tabulation of univariate data, graphical representation, Frequency curves. Descriptive measures - central tendency and dispersion. Bivariate data. Summarization, marginal and conditional frequency distribution.

UNIT III BASICS OF PROBABILITY (9 hrs)

Concept of experiments, sample space, event. Definition of Combinatorial Probability. Conditional Probability, Bayes Theorem.

UNIT IV DISCRETE PROBABILITY DISTRIBUTIONS (9 hrs)

Discrete Distributions: Probability mass function – Probability density function- Distribution functions, Binomial, Geometric, Negative Binomial, Poisson.

UNIT V CONTINUOUS PROBABILITY DISTRIBUTIONS (9 hrs)

Continuous Distributions: Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties – Functions of a random variable.

Text Books

1. S.M. Ross, “Introduction of Probability Models”, Academic Press, N.Y.
2. A. Goon, M. Gupta and B. Dasgupta, “Fundamentals of Statistics”, vol. I & II, World Press.
3. Bali N.P. and Dr. Manish Goyal, “Engineering Mathematics”, Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015
4. T. Veerarajan,” Probability and Statistics, Random Process and Queuing Theory”, McGraw Hill Education, 2018.
5. P. Sivaramakrishna Das, C. Vijayakumari, “Probability and Queuing Theory”, Pearson Education, 6th Edition, 2019.
6. G. Balaji, “Probability and Queuing Theory”, Balaji Publication, Revised Edition 2017.

Reference Books

1. S.M. Ross, “A first course in Probability”, Prentice Hall.
2. I.R. Miller, J.E. Freund and R., “Johnson, Probability and Statistics for Engineers”,(Fourth Edition), PHI.
3. A.M. Mood, F.A. Graybilland D.C. Boes, “Introduction to the Theory of Statistics”, McGraw Hill Education.
4. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, New Delhi, 10th Edition, 2019.
5. Ravish R. Singh and Mukul Bhatt, “Engineering Mathematics”, Tata McGraw Hill, 1st Edition, New Delhi, 2016.
6. Ramana B.V.,” Higher Engineering Mathematics”, Tata Mc Graw Hill, New Delhi 2018.

Web References

1. https://youtu.be/BceFKnWh68Y
2. https://youtu.be/fjDh4WPTGq4
3. https://youtu.be/Hw8KHNgRaOE
4. https://youtu.be/2CP3m3EgL1Q
5. https://youtu.be/wo_Vag3yls
6. https://swayam.gov.in/nd1_noc20_ma17/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	1
3	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
4	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-
5	3	2	1	1	-	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20BST113	PHYSICS FOR COMPUTING SCIENCE	L	T	P	C	H
		3	0	0	3	45

Course Objectives

- To understand the fundamental concept of oscillations.
- To understand the concepts of optical devices, Lasers and Fiber optics.
- To learn about the basic fundamentals of Interference and Polarization of light.
- To study the fundamental concepts of electromagnetism, crystallography
- To learn about the basic fundamentals of quantum mechanics and Thermodynamics

Course Outcomes

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

CO1 - Explain the concepts of simple harmonic oscillations **(K1)**

CO2 - Describe the basic concepts of Interference, diffraction and polarization **(K2)**

CO3 - Analyse the concept of laser and types of laser and fibre optics **(K1)**

CO4 - Understand the basic concept of crystal system, Bravais lattice, crystal structure, band theory of solids. **(K2)**

CO5 - Demonstrate concepts of quantum mechanics and thermodynamics. **(K1)**

.

UNIT I OSCILLATION (9 Hrs)

Oscillation: Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple spring mass system. Resonance-definition., damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators

UNIT II INTERFERENCE AND POLARIZATION OF LIGHT (9 Hrs)

Interference-principle of superposition-young's experiment: Theory of interference fringes-types of interference-Fresnel's prism-Newton's rings, Diffraction-Two kinds of diffraction-Difference between interference and diffraction-Fresnel's half period zone and zone plate-Fraunhofer diffraction at single slit-plane diffraction grating. Temporal and Spatial Coherence.

Polarization of light: Polarization - Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction..

UNIT III LASER AND FIBER OPTICS (9 Hrs)

Laser and Fiber optics: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO2 and Neodymium lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering. Fiber optics and Applications, Types of optical fibers.

UNIT IV CRYSTALLOGRAPHY, ELECTROMAGNETISMS AND SEMICONDUCTOR PHYSICS (9 Hrs)

Crystallography: Basic terms-types of crystal systems, Bravais lattices, miller indices, d spacing, Atomic packing factor for SC, BCC, FCC and HCP structures.

Basic Idea of Electromagnetisms: Continuity equation for current densities, Maxwell's equation in vacuum and non-conducting medium.

Semiconductor Physics: Conductor, Semiconductor and Insulator; Basic concept of Band theory.

UNIT -V QUANTUM MECHANICS AND THERMODYNAMICS (9 Hrs)

Quantum Mechanics: Introduction - Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box, Heisenberg Picture.

Thermodynamics: Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Engine, entropy, change in entropy in reversible and irreversible processes.

Text Books

1. A Beiser ,"Concepts of Modern Physics",seventh Edition, McGraw Hill International, 2015.
2. David Halliday, Robert Resnick and Jearl Walker,"Fundamentals of Physics", Tenth Edition, Wileyplus ,2015

Reference Books

1. Ajoy Ghatak," Optics", Fifth Edition, Tata McGraw Hill, 2012.
2. Sears & Zemansky," University Physics", Tenth Edition, Addison-Wesley, 1999.
3. Jenkins and White ,"Fundamentals of Optics", Fourth Edition, McGraw-Hill, 2011.

Web References

1. https://nptel.ac.in/courses/122/105/122105023/
2. https://nptel.ac.in/courses/115/105/115105099/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
5	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20EST134	` FUNDAMENTALS OF COMPUTER SCIENCE	L	T	P	C	H
		3	0	0	3	45

Course Objectives

- To understand the basic concepts of problem solving concepts.
- To gain Knowledge about the syntax and semantics about programming language.
- To learn the techniques of Pointers, Arrays and Functions in C.
- To be exposed to user defined data types to handle the files.
- To develop program using pre-processor directives and files.

Course Outcomes

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

CO1 - Recognize the basics of programming concepts **(K1)**
CO2 - Choose appropriate controls and functions to solve the problems **(K1)**
CO3 - Develop and Manage memory with Pointers and Arrays. **(K3)**
CO4 - Explore the various Input and Output functions. **(K2)**
CO5 - Create and Manipulate the Files accessing and storage. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Algorithm and Flowchart for problem solving with Sequential Logic Structure- Decisions and Loops. Introduction to imperative language; syntax and constructs of a specific language (ANSI C)- Variable Names-Data Type and Sizes (Little Endian Big Endian)- Constants- Declarations- Arithmetic Operators- Relational Operators-Logical Operators-Type Conversion- Increment Decrement Operator-Bitwise Operators- Assignment Operators and Expressions- Precedence and Order of Evaluation-proper variable naming and Hungarian Notation

UNIT II CONTROL FLOW AND FUNCTIONS (9 Hrs)

Statements and Blocks- If-Else-If, Switch, Loops – while, do, for, break and continue, goto labels, structured and un- structured programming. Basics of functions- parameter passing and returning type- C main return as integer,-External- Auto- Local- Static- Register Variables- Scope Rules- Block structure- Initialization- Recursion- Pre-processor- Standard Library Functions and return types.

UNIT III POINTERS, ARRAYS AND STRUCTURES (9 Hrs)

Pointers and address- Pointers and Function Arguments- Pointers and Arrays- Address Arithmetic-character Pointers and Functions- Pointer Arrays- Pointer to Pointer- Multi-dimensional array and Row/column major formats- Initialization of Pointer Arrays- Command line arguments- Pointer to functions- complicated declarations and how they are evaluated. Basic Structures- Structures and Functions- Array of structures- Pointer of structures- Self-referral structures- Table look up-typedef,-unions- Bit-fields

UNIT IV INPUT AND OUTPUT (9 Hrs)

Standard I/O, Formatted Output – printf, Formated Input – scanf- Variable length argument list- file access including FILE structure- fopen, stdin, sdtout and stderr,-Error Handling including exit- perror and error.h- Line I/O- related miscellaneous functions.

UNIT -V UNIX SYSTEM INTERFACE (9 Hrs)

File Descriptor- Low level I/O – read and write- open,-create- close and unlink- Random access – lseek- Discussions on Listing Directory- Storage allocator.

Programming Method: Debugging, Macro, User Defined Header, User Defined Library Function, makefile utility.

Text Books

1. B. W. Kernighan and D. M. Ritchi , “The C Programming Language”, Second Edition, PHI.
2. B. Gottfried, Schaum ,”Programming in C”, Second Edition, Outline Series, 2017
3. E Balagurusamy ,”Programming in ANSI C”, Fourth Edition, , TMH, 2007

Reference Books

1. Herbert Schildt ,”C: The Complete Reference”, Fourth Edition , McGraw Hill, 2017.
2. Yashavant Kanetkar “Let Us C” , BPB Publications 14th Edition,2019
3. Pradip dey and Manas Ghosh ,”Computer fundamentals and Programming in C” ,Oxford University Press,2013

Web References

1. https://codeforwin.org/
2. https://www.geeksforgeeks.org/c-programming-language/
3. http://learn-c.org/
4. https://www.cprogramming.com/
5. https://www.linuxtopia.org/online_books/programming_books/gnu_c_programming_tutorial/index.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
3	3	2	1	-	-	-	-	-	-	-	-	-	3	1	-
4	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
5	3	2	1	-	-	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20EST136	PRINCIPLES OF ELECTRICAL ENGINEERING	L	T	P	C	Hrs
		2	0	0	2	30

Course Objectives

- To explain the basic definitions and laws used to solve the DC and AC circuits.
- Make the students to become familiar in applying circuit theorems for electrical circuits.
- To understand the construction and working principle of electrical machines.
- To impart knowledge on sensors and electrical wirings.
- To introduce the concept of electrical safety and power system.

Course Outcomes

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

CO1 - Analyse the various laws and theorems used in DC circuits. **(K4)**

CO2 - Analyse and solve the AC circuits and develop resonance circuits for transmitter and receiver circuits. **(K4)**

CO3 - Explain the concepts of Electrostatics and Electro-Mechanics. **(K2)**

CO4 - Demonstrate the operation of transformers, DC/AC rotating machines and their performance characteristics. **(K2)**

CO5 - Develop the various wiring diagrams for house and to study the characteristics of sensors. **(K3)**

UNIT-I DC CIRCUITS (6 Hrs)

Concept of Potential difference, voltage, current, work, Power, Energy, Conversion of Energy - Electric networks, voltage source and current sources, linear passive and active elements, current-voltage relation, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Simplifications of networks using series-parallel, Star/Delta transformation. Theorem – Superposition, Thevenin's, Norton's and Maximum Power Transfer.

UNIT-II AC CIRCUITS (6 Hrs)

AC waveform- definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, Resonance in series and parallel circuits, bandwidth and quality factors,3 phase Balanced AC Circuits (Y-Δ and Y-Y).

UNIT-III ELECTROSTATICS AND ELECTRO-MECHANICS (6 Hrs)

Coulomb's law, Electrostatic field, electric field strength, permittivity in dielectrics, Electric potential, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors, Principle of batteries, types, construction and application. Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic Circuits, Magnetic material and B-H Curve.

UNIT IV TRANSFORMER AND ROTATING MACHINES (6 Hrs)

Single Phase transformer-principle of operation – EMF equation – voltage ratio and current ratio – KVA rating – efficiency and regulation – Autotransformer – Electromechanical energy conversion – Flemings right and left hand rule – principle, construction and working of DC generator and DC motor - single phase/three phase induction motor , Alternator and synchronous motor (Qualitative approach only)

UNIT-V MEASUREMENTS AND SENSORS (6 Hrs)

Block diagram of measurement system, Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, construction and working principle of PMMC and MI type instruments, single phase dynamometer type wattmeter and induction type energy meter-introduction to display devices. Electrical Wiring and Illumination system: One line diagram of power system - Components of AC transmission and distribution systems, Types of Wiring System &Wiring Accessories, Necessity of earthing, Types of earthing, Safety devices and system. Principle of electrical heating –laws of illumination – Electric lamps – Electroplating.

Text Books

1. A.E.Fitzgerald, Charles Kingsley, Stephen. D. Umans, “Electric Machinery”, Tata Mcgraw Hill, New Delhi, 7th Edition, 2013.
2. Theraja B. L and Theraja A. K., “A Textbook of Electrical Technology”, Vol. II, S Chand & Co. Ltd., New Delhi, 2009
3. D.P.Kothari and I.J. Nagrath, “Electric Machines”, Tata McGraw Hill, New Delhi, 5th Edition, 2017.
4. Sudhakar.A and Shyam Mohan.S.P, “Circuits and Networks Analysis and Synthesis”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th edition, 2010.
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, “Basic Electrical Engineering”, McGraw Hill Education (India) Private Limited, 2009.

Reference Books

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Introduction to Electrodynamics, D. J. Griffiths, (Fourth Edition), Cambridge University Press.
3. William H Hayt, J E Kemmerly and Steven M Durbin, “Engineering Circuit Analysis”, McGraw Hill, 7th Edition, 2007.
4. Fundamentals of Electrical and Electronics Engineering, Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.
5. Kothari D.P. and Nagrath I.J., ‘Power System Engineering’, Tata McGraw-Hill Education, Second Edition, 2008.

Web References

1. https://www.electronics-tutorials.ws/
2. https://nptel.ac.in/courses/108/108/108108076/
3. https://www.gopracticals.com/basic-engineering/electrical/
4. https://link.springer.com/book/10.1007/978-3-319-21173-2
5. https://www.electrical4u.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	2	2	-	-	-	-	-	-	-	2	1	1
2	2	3	2	2	2	-	-	-	-	-	-	-	2	1	1
3	2	3	2	2	2	-	-	-	-	-	-	-	2	1	1
4	2	3	2	2	2	-	-	-	-	-	-	-	2	1	1
5	2	3	2	2	2	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20BSP114	PHYSICS FOR COMPUTING SCIENCE LABORATORY	L	T	P	C	H
		0	0	2	1	30

Course Objectives

- To learn the fundamental Practical Knowledge in light, heat and Hall effect
- To study the fundamental concepts of interference, diffraction and crystallography
- To learn the basic fundamentals Practical Knowledge laser and optical fibre
- To provide a practical understanding of some of the concepts learnt in the theory course on Physics.
- Evaluate the process and outcomes of an experiment quantitatively and qualitatively.

Course Outcomes

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

CO1 - Determine the horizontal components of earth magnetic field **(K1)**
CO2 - Analyze the basic properties of semiconductors via Hall Effect. **(K2)**
CO3 - Demonstrate the use of Plank constant and stefan's constant **(K3)**
CO4 - Demonstrate wavelength of light and laser by diffraction and interference method **(K2)**
CO5 - Analyse the basic properties of Laser and optical fiber parameters **(K1)**

LIST OF EXPERIMENTS

1. Magnetic field along the axis of current carrying coil – Stewart and Gee
2. Determination of Hall coefficient of semi-conductor
3. Determination of Plank constant
4. Determination of wave length of light by Laser diffraction method
5. Determination of wave length of light by Newton's Ring method
6. Determination of laser and optical fiber parameters
7. Determination of Stefan's Constant.

Reference Books

1. Adrian C. Melissinos , Jim Napolitano ,"Experiments in Modern Physics", 2nd Edition, Kindle Edition-
2. B Mallick S Panigrahi "Engineering Practical Physics", 1st Edition, Cengage Learning
3. Singh Harnam , Hemne P.S ,"B.Sc. Practical Physics, S.Chand ,2000.

Web References

1. https://lo-au.vlabs.ac.in/
2. https://hmw-au.vlabs.ac.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
5	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20ESP135	FUNDAMENTALS OF COMPUTER SCIENCE LABORATORY	L	T	P	C	H
		0	0	2	1	30

Course Objectives

- To understand the basic concepts of problem solving concepts.
- To gain Knowledge about the syntax and semantics about programming language.
- To learn the techniques of Pointers, Arrays and Functions in C.
- To be exposed to user defined data types to handle the files.
- To develop program using pre-processor directives and files.

Course Outcomes

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

CO1 - Develop Algorithm and Flowcharts **(K3)**
CO2 - Develop program using tricky codes and parameter passing **(K3)**
CO3 - Analyse problems and implement those using functions **(K3)**
CO4 - Design applications using Files concepts **(K3)**
CO5 - Analyse and discover searching programs **(K3)**

LIST OF EXPERIMENTS

1. Algorithm and flowcharts of small problems like GCD
2. Develop a Small but tricky codes
3. Develop a program with Proper parameter passing
4. Write a C program using Command line Arguments
5. Write a Program to understand about Variable parameter
6. Develop a program to illustrate the use of Pointer to functions
7. Write a program to explain the concept of User defined header
8. Write a program to analyze the importance of Make file utility
9. Develop a program to elucidate Multi file program and user defined libraries
10. Develop a program with Interesting substring matching / searching programs
11. Write programs with Parsing related assignments

Text Books

1. B. W. Kernighan and D. M. Ritchi , “The C Programming Language”, Second Edition, PHI.
2. B. Gottfried, Schaum ,”Programming in C”, Second Edition, Outline Series, 2017
3. E Balagurusamy ,”Programming in ANSI C”, Fourth Edition, , TMH, 2007

Reference Books

1. Herbert Schildt ,”C: The Complete Reference”, Fourth Edition , McGraw Hill, 2017.
2. Yashavant Kanetkar “Let Us C” , BPB Publications 14th Edition,2019
3. Pradip dey and Manas Ghosh ,”Computer fundamentals and Programming in C” ,Oxford University Press,2013

Web References

1. https://codeforwin.org/
2. https://www.geeksforgeeks.org/c-programming-language/
3. http://learn-c.org/
4. https://www.cprogramming.com/
5. http://cse02-iiith.vlabs.ac.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20ESP137	PRINCIPLES OF ELECTRICAL ENGINEERING LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce practical knowledge on domestic wiring and analysis of electrical circuits.
- To gain practical experience to analyze series and parallel resonance circuits
- To understand the steady state and transient behaviour of networks
- To simulate various electric circuit using simulation software.
- To provide the methods to test and evaluate the performance of electrical machines.

Course Outcomes

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

CO1 - Prepare line diagram and understand the domestic and industrial wiring **(K5)**
CO2 - Analyze series and parallel resonance circuits **(K4)**
CO3 - Analyse the steady state and transient behaviour of networks **(K4)**
CO4 - Evaluate various electric circuits and validate the results through simulation. **(K5)**
CO5 - Analyze the performance of DC and induction motor **(K4)**

LIST OF EXPERIMENTS

1. Domestic Wiring Practice
    a. Staircase wiring
    b. Doctor's room wiring
    c. Godown wiring
    d. Ceiling fan and fluorescent lamp wiring
2. Verification of Network Theorems - Superposition, Thevenin's, Norton's and Maximum Power Transfer.(simulation and experimental)
3. Determination of resistance temperature coefficient
4. Determination of Characteristics of LDR
5. Simulation of R-L-C Series Circuit for $X_L > X_C$, $X_L < X_C$
6. Simulation of Time response of RC circuit
7. Load test on single phase transformer.
8. Measurement of 3-phase power using two wattmeter methods.
9. Load test on DC shunt motor.
10. Load test on single phase induction motor.
11. Load test on three phase induction motor.
12. Calibration of single phase phase Energy meter using loading method.

Reference Books

1. Sudhakar.A and Shyam Mohan.S.P, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4 th edition, 2010.
2. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education (India) Private Limited, 2009.
3. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
4. Smarjith Ghosh ,"Fundamentals of Electrical and Electronics Engineering" , Prentice Hall Pvt. Ltd, Second Edition, 2007.

Web References

1. https://www.electronics-tutorials.ws/
2. https://nptel.ac.in/courses/108/108/108108076/
3. https://www.gopracticals.com/basic-engineering/electrical/
4. https://link.springer.com/book/10.1007/978-3-319-21173-2
5. https://www.electrical4u.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST202	BUSINESS COMMUNICATION & VALUE SCIENCE - II	L	T	P	C	H
		2	0	0	2	30

Course Objectives

- To develop effective writing, reading, presentation and group discussion skills.
- To identify personality traits and evolve as a better team player.
- To Introduce them to key concepts of Morality and Behaviour and beliefs ,diversity and inclusion
- Understand the concept of speed reading
- Identify the individual personality types

Course Outcomes

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

CO1 - Understand tools of structured written communication **(K2)**
CO2 - Understand the basics of presentation **(K2)**
CO3 - Apply the basic concept of speed reading, skimming and scanning **(K3)**
CO4 - Identify individual personality types and role in a team **(K3)**
CO5 - Recognize the concepts of outward and internal behaviour **(K1)**

UNIT – I SOCIETAL NEEDS AND EXPERTISE WRITING (6 Hrs)

Participate in 'Join Hands Movement'- Individual identification of social issues - Theory to introduce the participant - Research on the social cause - Class discussion - Good and Bad Writing - Common errors, punctuation rules, and use of words.

Practical: Plan and design an E Magazine. Refer Catherine Morris and Joanie McMahon's writing techniques - Create the magazine

SATORI – Participants share the personal take away acquired from GD, writing and reading skills activities captured in their handbook. Share the most important learning points from the activities done so far and how that learning has brought a change. Launching an E Magazine, Quiz Time

UNIT – II INNOVATIVE DESIGNING SKILLS (6 Hrs)

Each group will form an NGO. Create Vision, Mission, Value statement, tagline and Design a logo. Introduction to basic presentation skills & ORAI app. Prepare and publish the Second episode of the E Magazine. Skimming and Scanning.

SATORI –Participants to connect their learning gathered from AIP Unit-2 with their existing curriculum, Quiz Time

UNIT – III INTERPERSONAL SKILLS (6 Hrs)

Ad campaign- Brain storming, Design a skit, Enact the play, Intro of Dr. Meredith Belbin and his research on team work, Belbin's 8 Team Roles and Lindgren's Big 5 personality traits. Team Falcon Practical to identify individual personality traits with Belbin's 8 team player styles, Prepare and publish the third episode of the E Magazine.

SATORI –Participants share the personal take away acquired from working in teams, GD, learning about presentations, presenting their NGOs, Quiz Time

UNIT – IV FILM MAKING AND REVIEWING (6 Hrs)

A short film on diversity - Discuss key take away of the film. Touch the target (Blind man) - Debriefing of the Practical.- Film: "The fish and I'' by Babak Habibifar" (1.37mins)

Groups to create a story – 10 minutes of a person's life affected by the social issue groups are working on, Feedback - Research on a book, incident or film based on the topic of your respective NGO - Write a review in a blog on the topics they are covering in their research.

UNIT – V DIVERSIFIED COMMUNICATION SKILLS (6 Hrs)

Diversity & Inclusion - Different forms of Diversity in society - Teams to video record interviews of people from diverse groups. Share the recordings in FB - Debate - Discussion on TCS values - Prepare and publish the final episode of the E Magazine.

SATORI –Participants share the personal take away acquired from working in teams, GD, learning about presentations and understanding diversity inclusion. Quiz Time

Project

1. Each team to look for an NGO/ social group in the city which is working on the issue their college group is supporting.
2. Spend **a day with the NGO/ social group** to understand exactly how they work and the challenges they face.
3. Render voluntary service to the group for one day
4. Invite the NGO/ social group to address their university students for couple of hours. Plan the entire event, decide a suitable venue in the university, gather audience, invite faculty members etc. (they need to get their plan ratified their professor). Outcome-- Host an interactive session with the NGO spokesperson
5. The groups to present their experience of **a day with the NGO** and inspire students to work for the cause.

Reference Books

1. Guiding Souls : Dialogues on the purpose of life; Dr. A.P.J Abdul Kalam ;Publishing Year-2005; Co-author--Arun Tiwari
2. The Family and the Nation; Dr. A.P.J Abdul Kalam; Publishing year: 2015; Co-author: Acharya Mahapragya
3. The Scientific India: A twenty First Century Guide to the World around Us; Dr. A.P.J Abdul Kalam; Publishing year: 2011; Co-author- Y.S.Rajan
4. Forge Your Future: Candid, Forthright, Inspiring ; Dr. A.P.J Abdul Kalam; Publishing year: 2014
5. Abundance: The Future is Better Than You Think; Peter H. Diamandis and Steven Kotler; Published: 21 Feb, 2012; Publisher: Free Press
6. Start With Why: How Great Leaders Inspire Everyone to Take Action; Simon Sinek; Published: 6 October 2011; Publisher: Penguin
7. Advertising & IMC: Principles and Practice; Sandra Moriarty, Nancy D. Mitchell, William D. Wells; Published: 15 June 2016; Publisher: Pearson Education India

Web References

1. Ethics Fundamentals And Approaches To Ethics
   Https://Www.Eolss.Net/Sample-Chapters/C14/E1-37-01-00.Pdf
2. A Framework for Making Ethical Decisions
3. https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions
4. Five Basic Approaches to Ethical Decision-
   http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf
5. https://youtu.be/CsaTslhSDI
6. https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
7. https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y
8. https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be
9. https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
2	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
3	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	1	-	1	-
5	1	-	-	-	-	-	-	1	-	3	-	1	-	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST203	FUNDAMENTALS OF ECONOMICS	L	T	P	C	H
		2	0	0	2	30

Course Objectives

- To develop an understanding of the framework that economists use to analyse choices made by individuals in response to incentives and consider how these choices can also serve the social interest.
- To Measure how changes in price and income affect the behaviour of buyers and sellers
- To analyze how buyers and sellers interact in a free and competitive market to determine prices and quantities of goods
- To evaluate macro-economic performance using indicators that include output measures and unemployment
- To understand the strengths and weakness of fiscal and monetary policy to determine an appropriate stabilization policy for a given macroeconomic situation

Course Outcomes

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

CO1 – Infer how competitive markets organise the allocation of scarce resources and the distribution of goods and services. **(K1)**

CO2 – Relate the basic economic theory and principles to current microeconomic issues and evaluate related public policy. **(K2)**

CO3 – Analyse the various types of markets and compare their efficiency. **(K2)**

CO4 – Determine the major economic indicators used to assess the state of the macro economy. **(K3)**

CO5 – Chooses an appropriate fiscal and monetary policy for a given state of the economy. **(K1)**

UNIT I DEMAND AND SUPPLY (6 Hrs)

Principles of Demand and Supply- Supply Curves of Firms - Elasticity of Supply; Demand Curves of Households- Elasticity of Demand; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve).

UNIT II WELFARE ANALYSIS AND CONSUMER BEHAVIOUR (6 Hrs)

Consumers' and Producers' Surplus - Price Ceilings and Price Floors; Consumer Behaviour- Axioms of Choice - Budget Constraints and Indifference Curves; Consumer's Equilibrium- Effects of a Price Change, Income and Substitution Effects -Derivation of a Demand Curve; Applications- Tax and Subsidies -Intertemporal Consumption - Suppliers' Income Effect.

UNIT III PRODUCTION CONCEPT AND COST CONCEPT (6 Hrs)

Theory of Production - Production Function and Iso-quants - Cost Minimization; Cost Curves- Total, Average and Marginal Costs - Long Run and Short Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition.

UNIT IV MACROECONOMIC MEASURES OF PERFORMANCE (6 Hrs)

National Income and its Components- GNP, NNP, GDP, NDP; Consumption Function; Investment; Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector- Taxes and Subsidies; External Sector- Exports and Imports.

UNIT V STABILIZATION POLICY (6 Hrs)

Money- Definitions; Demand for Money-Transactionary and Speculative Demand; Supply of Money- Bank's Credit Creation Multiplier; Integrating Money and Commodity Markets- IS, LM Model; Business Cycles and Stabilization- Monetary and Fiscal Policy - Central Bank and the Government; The Classical Paradigm- Price and Wage Rigidities - Voluntary and Involuntary Unemployment.

Text Books

1. Pindyck, Robert S., and Daniel L. Rubinfeld, “Microeconomics”, Pearson, Eigth Edition, 2012.
2. Dornbusch, Fischer and Startz, “Macroeconomics”, Tata McGraw Hill, Twelfth Edition, 2018.
3. Paul Anthony Samuelson, William D. Nordhaus, “Economics”, Tata McGraw Hill, Nineteenth Edition, 2010.

Reference Books

1. Hal R, Varian, “Intermediate Microeconomics: A Modern Approach”, W.W. Norton & Company, Eighth Edition, 2010.
2. N. Gregory Mankiw, Principles of Macroeconomics, Cengage, Eighth Edition, 2015.
3. Case, Karl E., and Ray C. Fair, “Principles of microeconomics”, Pearson Education, Thirteenth Edition, 2020.
4. Koutsoyiannis, Anna. Modern microeconomics. Springer, Second Edition, 1975.
5. McConnell, Campbell R., Stanley L. Brue, and Sean Masaki Flynn, “Economics: Principles, problems, and policies”, Boston McGraw-Hill/Irwin, 21st Edition, 2018.
6. Froyen, Richard T., and Stephen J. Perez, “Macroeconomics: Theories and policies”, Macmillan, 1990.
7. Goodwin, Neva, et al, “Macroeconomics in context”, ME Sharpe, Third Edition, 2013.

Web References

1. http://economics.mit.edu/
2. http://hbswk.hbs.edu/
3. http://www.cbsnews.com/moneywatch/
4. http://mruniversity.com/
5. http://www.economist.com/
6. http://www.bloomberg.com/
7. http://www.moneyweek.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-
2	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-
3	1	-	-	-	-	-	1	-	-	-	-	-	1	1	-
4	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-
5	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20BST216	LINEAR ALGEBRA	L	T	P	C	Hrs
		3	1	0	4	60

Course Objectives

- To familiarize the concept of Linear algebra.
- To know determinant of a matrix and the solution of simultaneous linear equations.
- To learn linear dependence and linear independence in vector space.
- Understand the characteristics of matrices.
- To acquaint with the concepts of differential and integral calculus.

.

Course Outcomes

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

CO1 - Analyse the concepts of Linear Algebra. **(K2)**

CO2 - Solve systems of linear equations **(K3)**

CO3 - Recognize and use basic properties of subspaces and vector spaces, Identify the dimension of a vector space. **(K2)**

CO4 - Find Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices. **(K3)**

CO5 - Evaluate double integral and triple integral. **(K2)**

UNIT I MATRICES **(12 Hrs)**

Introduction to Matrices and Determinants; Solution of Linear Equations; Cramer's rule; Inverse of a Matrix.

UNIT II VECTORS **(12 Hrs)**

Vectors and linear combinations; Rank of a matrix; Gaussian elimination; LU Decomposition; Solving Systems of Linear Equations using the tools of Matrices.

UNIT III VECTOR SPACE **(12 Hrs)**

Vector space, Subspace, Dimension, Geometric interpretations, Linearly independent. Basis, Orthogonality.

UNIT IV EIGEN VALUES AND EIGEN VECTORS **(12 Hrs)**

Eigenvalues and Eigenvectors; Positive definite matrices; Linear transformations; Hermitian and unitary matrices.

UNIT V CALCULUS **(12 Hrs)**

Basic concepts of Differential and integral calculus, application of double and triple integral.

Content beyond Syllabus

Singular value decomposition and Principal component analysis; Introduction to their applications in Image Processing and Machine Learning.

Text Books

1. B. S. Grewal, Khanna Publishers, “Higher Engineering Mathematics”, Khanna Publication, Delhi 4th Edition,2015
2. Gregory Hartman, “Fundamentals of Matrix Algebra”, Virginia Military Institute, APEX Calculus. Copyright Year: 2011
3. G. Balaji, “Linear Algebra and Partial Differential Equations: Balaji Publisher,3rd Edition 2017.

Reference Books

1. Peter V. O'Neil, “Advanced Engineering Mathematics”, (Seventh Edition), Cengage Learning,7th Edition 2011.
2. Michael. D. Greenberg, “Advanced Engineering Mathematics”, Pearson, 2nd Edition 2013.
3. Gilbert Strang, “Introduction to linear algebra”, (Fifth Edition), Wellesley-Cambridge Press,2016
4. P. N. Wartikar & J. N. Wartikar, “Applied Mathematics” (Vol. I & II), Pune Vidyarthi GrihaPrakashan, 2010.
5. M. D. Greenberg,” Advanced Engineering Mathematics”, Pearson Education, (Second Edition).

Web References

1. https://machinelearningmastery.com/introduction-matrices-machine-learning/
2. https://nptel.ac.in/courses/108/104/108104112/
3. https://nptel.ac.in/courses/111108098/
4. https://youtu.be/wo - Vag3yls

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	1
4	3	2	1	1	-	-	-	-	-	-	-	-	2	2	1
5	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20BST217	STATISTICAL METHODS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn basic concepts of a few statistical and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- It is framed to address the issues and the principles of estimation theory.
- To learn the concept of testing of hypothesis using statistical analysis.
- Identify the direction and strength of a linear correlation between two factors.
- Analyze the data on agriculture field experiments using various types of designs they learned.

Course Outcomes

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

CO1 - Understand the basic concepts of Statistics. **(K2)**

CO2 - Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem. **(K3)**

CO3 - Apply the concept of testing of hypothesis for small and large samples in real life problems. **(K2)**

CO4 - Concept of linear regression, correlation, and its applications. **(K3)**

CO5 - List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments. **(K3)**

UNIT I MEASURES OF DISPERSION (9 Hrs)

Standard Deviation – Mean Deviation – Quartile Deviation – Range –Measures of Skewness and Pearson's coefficient of skewness– Moments about the arbitrary origin and moments based on measures of skewness and kurtosis.

UNIT II ESTIMATIONTHEORY (9 Hrs)

Estimators: Unbiasedness, Consistency, Efficiency and sufficiency – Maximum likelihood estimation – Method of moments.

UNIT III TESTING OF HYPOTHESIS (9 Hrs)

Sampling distributions – Small and large samples –Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions –– Contingency table (test for independent) Goodness of fit.

UNIT IV CORRELATION AND REGRESSION (9 Hrs)

Correlation –Rank correlation– Regression –Multiple and partial correlation – Method of least squares – Plane of regression – Coefficient of multiple correlation – Coefficient of partial correlation.

UNIT V DESIGN OF EXPERIMENTS (9 Hrs)

Analysis of variance – One way and two-way classifications – Completely randomized design – Randomized block design – Latin square design - 2^2 Factorial design.

Text Books

1. Richard A. Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.
2. Murray R. Spegel, Larry J. Stephens, "Schaum's Outlines- Statistics" Mc. Graw Hill Education, 6th Edition ,2017.
3. Gupta. S. C., and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 11th Edition, 2002.
4. Mood, A.M., Graybill, A.M. and Boes, D.C. (1974): "Introduction to theory of Statistics", McGraw Hill.
5. Johnson, R.A. and Wichern, D. W. "Applied Multivariate Statistical Analysis", Pearson Education, Asia, 6th Edition, 2007.

Reference Books

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, New Delhi,10th Edition, 2019.
2. Grewal. B.S. and Grewal. J.S., “Numerical Methods in Engineering and Science “, 10th Edition, Khanna Publishers, New Delhi, 2015.
3. Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 8th Edition, 2015.
4. Dr. G. Balaji “Statistics and Numerical methods” Balaji publication, 11th Edition, 2017.

Web References

1. https://nptel.ac.in/courses/110/105/110105087/
2. https://nptel.ac.in/courses/111/105/111105077/
3. https://www.coursera.org/learn/basic-statistics
4. https://www.youtube.com/watch?v=k3lUo0XYG3E

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	2	1	1
5	3	2	1	1	-	-	-	-	-	-	-	-	2	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

		L	T	P	C	H
U20EST251	**PRINCIPLES OF ELECTRONICS**	**2**	**0**	**0**	**2**	**30**

Course Objectives

- To introduce the concepts of semiconductor physics
- To introduce the concepts of semiconductor diodes to understand in detail the operation, characteristics and various parameters of diodes.
- To gain insight into the operation, characteristics and functional aspects of BJT in different configurations.
- To understand in depth the construction, operation, characteristics and various parameters of JFET and MOSFET.
- To understand operation of feedback amplifiers, oscillator circuits and operational amplifiers

Course Outcomes

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

CO1 - Understand the basic Semiconductor Theory concepts **(K2)**
CO2 - Understand the characteristics and applications of diodes **(K2)**
CO3 - Understand the working principle and characteristics of BJTs **(K2)**
CO4 - Describe the working principle and characteristics of JFET and MOSFETs **(K2)**
CO5 - Characterize and analyse the applications of feedback amplifiers, Oscillators and operational amplifiers. **(K2)**

UNIT I SEMICONDUCTORS: CRYSTALLINE MATERIAL (6 Hrs)

Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers.

UNIT II DIODES AND DIODE CIRCUITS (6 Hrs)

Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

UNIT III BIPOLAR JUNCTION TRANSISTORS (6 Hrs)

Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor

UNIT IV FIELD EFFECT TRANSISTORS (6 Hrs)

Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles

UNIT V FEEDBACK AMPLIFIER, OSCILLATORS AND OPERATIONAL AMPLIFIERS (6 Hrs)

Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feedback: instability and oscillation, condition of oscillation, Barkhausen criteria. Introduction to integrated circuits, operational amplified and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator

Digital Electronics Fundamentals: Difference between analog and digital signals, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

Text Books

1. Adel S. Sedra and Kenneth Carless Smith, “Microelectronics Circuits”, Oxford University Press, Fourth Edition, 1998.
2. Jacob Millman, Christos Halkias, Chetan Parikh, “Millman’s Integrated Electronics”, McGraw Hill Education, Second Edition,2009.
3. M. Morris Mano, “Digital Logic & Computer Design”, Pearson, 2006.
4. Jacob Millman, Arvin Grabel, “Microelectronics”, Indian Edition, Second Edition, 2017.
5. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition PHI Learning Private Limited, 2016

Reference Books

1. Robert L. Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson, Eleventh Edition, 2013.
2. Ben Streetman, Sanjay Banerjee, “Solid State Electronic Devices”, Prentice Hall, 6th Edition, 2015.
3. Albert Paul Malvino, “Electronic Principle”, Tata Mc Graw Hill, Seventh Edition, 2013.
4. D Schilling C Belove T Apelewicz R Saccardi, “Electronics Circuits:Discrete & Integrated”, Indian Edition,Third Edition, 2002.
5. S. Salivahanan, N. Suresh Kumar, A. Vallavaraj, “Electronics Devices & Circuits”, Tata Mc Graw Hill, Third Edition, 2012.

Web References

1. https://www.electronics-tutorials.ws/
2. https://www.tutorialspoint.com/basic_electronics/index.htm
3. https://www.electronicshub.org/tutorials/
4. https://nptel.ac.in/courses/122/106/122106025/
5. https://www.worldscientific.com/worldscibooks/10.1142/10998

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-
2	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-
3	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-
4	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-
5	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT201	DATA STRUCTURES & ALGORITHMS	L	T	P	C	H
		3	0	0	3	45

Course Objectives

- To understand performance analysis of an algorithm
- To learn linear data structures
- To learn non-linear data structures
- To understand sorting, searching and hashing algorithms
- To learn file organization and accessing methods

Course Outcomes

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

CO1 - Understand the usage and analysis of algorithms in computing. **(K1)**
CO2 - Implement and apply linear data structures to solve various problems **(K3)**
CO3 - Represent and apply non-linear data structures to solve real time problems **(K2)**
CO4 - Develop and analyse algorithms for sorting and searching data organized in linear and non-Linear data structures **(K3)**
CO5 - Understand various file organization and accessing methods **(K2)**

UNIT I CONCEPTS OF ALGORITHM AND DATA ORGANISATION (9 Hrs)

Algorithm specification – Recursion - Performance analysis - Asymptotic Notation - The Big-O - Omega and Theta notation - Programming Style - Refinement of Coding - Time-Space Trade Off – Testing - Data Abstraction

UNIT II LINEAR DATA STRUCTURE (9 Hrs)

Array - Stack - Queue - Linked-list and its types - Various Representations - Operations & Applications of Linear Data Structures

UNIT III NON-LINEAR DATA STRUCTURE (9 Hrs)

Trees - Binary Tree - Threaded Binary Tree - Binary Search Tree – B-Tree - B+ Tree - AVL Tree - Splay Tree. Graphs: Basic Terminologies - Directed – Undirected - Various Representations - Operations - Graph search and traversal algorithms - complexity analysis - Applications of Non-Linear Data Structures.

UNIT IV SEARCHING AND SORTING ON VARIOUS DATA STRUCTURES (9 Hrs)

Sequential Search - Binary Search - Comparison Trees - Breadth First Search - Depth First Search Insertion Sort - Selection Sort - Shell Sort - Divide and Conquer Sort - Merge Sort - Quick Sort- Heapsort - Introduction to Hashing

UNIT V FILE CONCEPTS (9 Hrs)

File Organisation – Sequential – Direct - Indexed Sequential - Hashed and various types of accessing schemes.

Text Books

1. E. Horowitz, S. Sahni, S. A-Freed, “Fundamentals of Data Structures”, Universities Press, Second Edition, 2008.
2. A. V. Aho, J. E. Hopperoft, J. D. UIlman, “Data Structures and Algorithms”, Pearson, First Edition, 2003.
3. Gregory L. Heilman, Data Structures, Algorithms and Object Oriented Programming, Tata Mcgraw-Hill, New Delhi, 2002.

4. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, New Delhi, 1991.
5. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures & Algorithms, Pearson Education, New Delhi, 2006

Reference Books

1. Donald E. Knuth, “The Art of Computer Programming: Volume 1: Fundamental Algorithms”, Third Edition, Dorling Kindersley Pvt Ltd, Third Edition, 1997.
2. Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, The MIT Press,Third Edition,2009 .
3. Pat Morin, “Open Data Structures: An Introduction (Open Paths to Enriched Learning)”, UBC Press, Thirty First Edition, 2013.

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://nptel.ac.in/courses/106/102/106102064/
3. https://www.geeksforgeeks.org/data-structures/
4. https://www.javatpoint.com/data-structure-tutorial

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	3	2	1	-	-	-	-	-	-	-	-	-	2	1	-
3	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
4	3	2	1	-	-	-	-	-	-	-	-	-	3	2	-
5	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20BSP218	STATISTICAL METHODS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To familiarize the concept of Mean, median, mode and Standard deviation.
- To know Correlation and Regression analysis
- Learn the concept of single mean, difference of mean.
- To understand sampling distribution.
- To introduce the concepts of ANOVA classification.

Course Outcomes

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

CO1 - Gain knowledge in the concepts of statistical methods and models. **(K2)**

CO2 - Trained for data collection on various fields of survey enabling them to classify them statistically. **(K3)**

CO3 - Familiarized in various statistical software. **(K3)**

CO4 - Find the correlation between two variables. **(K2)**

CO5 - Compute regression lines. **(K3)**

List of Experiments:

1. Descriptive Statistics
2. Test for Single mean
3. Test for difference of mean
4. Standard Deviation
5. Sampling distributions
6. ANOVA One-way Classification
7. Two-way ANOVA
8. Chi-Square Test
9. Correlation and Regression (Simple and Multiple)
10. Maximum likelihood estimation

Web References

1. https://www.mathworks.com/help/matlab/ref/std.html
2. https://www.mathworks.com/help/stats/mle.html
3. https://www.mathworks.com/help/stats/two-way-anova.html
4. https://youtu.be/ullVTCmQdpI
5. www.youtube.com/watch?v=ullVTCmQdpI

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
5	2	2	1	1	-	-	-	-	-	-	-	-	1	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20ESP252	PRINCIPLES OF ELECTRONICS LABORATORY	L	T	P	C	H
		0	0	2	1	30

Course Objectives

- To give a thorough knowledge of Various Diodes
- To make the student to understand BJT Modes of Operations and Characteristics
- To enable the student to understand JFET and MOSFET Characteristics
- To design and measure frequency response, signal handling capacity, input and output impedances of various types of amplifiers
- To design and construct low ad frequency oscillator circuits
- To construct and study the application of operational amplifier

Course Outcomes

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

CO1 - Understand the basic operations of various diodes with VI Characteristics **(K1)**
CO2 - Analyse the various characteristics of JFET and MOSFET **(K1)**
CO3 - Use the diodes such as Rectifiers, Voltage regulators, Clippers and Logic gates **(K1)**
CO4 - Design low and high frequency generation of oscillators. **(K2)**
CO5 - Construct the applications of operational amplifier. **(K3)**

LIST OF EXPERIMENTS

1. V-I characteristics of semiconductor diodes
   a) PN Junction diode
   b) Point contact diode
   c) Zener diode
2. Characteristics of BJT in CB configuration
   a) Determination of input and output characteristics
   b) Determination of voltage gain, current gain, input and output resistances from the characteristics
3. Characteristics of BJT in CE configuration
   a) Determination of input and output characteristics
   b) Determination of voltage gain, current gain, input and output resistances from the characteristics
4. Characteristics of JFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, rd, gm and μ from the characteristics
5. Characteristics of MOSFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, rd, gm and μ from the characteristics
6. Rectifier and Voltage Regulators
   a) Determination of ripple factor for different types of rectifiers with and without filters.
   b) Voltage regulation characteristics of shunt, series and IC regulators
7. Design and measurement of frequency response, signal handling capacity, input and output impedances of CE amplifier.
8. Design and measurement of frequency response, signal handling capacity, input and output impedances of common source and common drain FET amplifier.
9. To design, construct and study the low frequency and high frequency oscillators.
10. Applications of Op-amp : To study the application of Opamp IC741 as
    a) Inverting amplifier
    b) Non-inverting amplifier
    c) Voltage follower
    d) Summer
    e) Subtractor

Reference Books

1. Robert L. Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson, Eleventh Edition, 2013.
2. Robert L. Boylestad, “Electronic Devices and Circuit Theory”, Pearson, 11th edition 2015
3. L. K. Maheshwari, M. M. S. Anand, “Laboratory Manual for Introductory Electronics Experiments”, New Age International (P) Ltd, 2012
4. Ramakant A.Gayakwad, OP-AMP and Linear IC's , Prentice Hall of India, 2012.
5. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2016

Web References

1. https://www.industrial-electronics.com/experiments_0.html
2. https://www.electronics-tutorials.ws/
3. http://www2.ece.ohio-state.edu/ee327/
4. http://www.vlab.co.in/broad-area-electronics-and-communications
5. https://www.worldscientific.com/worldscibooks/10.1142/10998

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
2	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
3	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
5	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP201	DATA STRUCTURES & ALGORITHMS LABORATORY	L	T	P	C	H
		0	0	2	1	30

Course objectives

- To apply linear data structures
- To apply non-linear data structures
- To understand the different operations on trees
- To implement graph traversal algorithms
- To access non-linear data structure from a file

Course Outcomes

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

CO1 - Solve the given problem by identifying the appropriate Data Structure. **(K3)**
CO2 - Implement and apply trees to improve accessing of data **(K3)**
CO3 - Apply graph to solve various real time problems **(K3)**
CO4 - Analyze the algorithm's / program's efficiency in terms of time and space complexity. **(K3)**
CO5 - Use linear data structures while solving simple and complex problems **(K3)**

LIST OF EXPERIMENTS

1. Towers of Hanoi using user defined stacks.
2. Reading, writing, and addition of polynomials.
3. Line editors with line count, word count showing on the screen.
4. Trees with all operations.
5. All graph algorithms.
6. Saving / retrieving non-linear data structure in/from a file

Text Books

1. E. Horowitz, S. Sahni, S. A-Freed ,"Fundamentals of Data Structures", Universities Press.
2. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, New Delhi, 1991.
3. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures & Algorithms, Pearson Education, New Delhi, 2006

Reference Books

1. Donald E. Knuth,"The Art of Computer Programming: Volume 1: Fundamental Algorithms", Pearson,Third Edition, 2005.
2. Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", The MIT Press,Third Edition,2009 .
3. Pat Morin, "Open Data Structures: An Introduction (Open Paths to Enriched Learning)", UBC Press, Thirty First Edition, 2013.

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms/dsa_quick_guide.htm
2. https://www.programiz.com/dsa
3. http://cse01-iiith.vlabs.ac.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20BST328	COMPUTATIONAL STATISTICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know the multivariate normal distribution and its relation.
- To solve the multiple linear regression model and autocorrelation.
- To gain knowledge in multivariate regression.
- To learn the discriminant and principal components.
- To learn the factor and cluster analysis.

Course Outcomes

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

CO1 - Classify the Solution of multivariate normal distribution. **(K2)**
CO2 - Know the multiple linear regression model and autocorrelation. **(K2)**
CO3 - Know the multivariate regression. **(K3)**
CO4 - Analysis the discriminant and principal components. **(K3)**
CO5 - Analysis the factor and cluster analysis. **(K2)**

UNIT I MULTIVARIATE NORMAL DISTRIBUTION (9 Hrs)

Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters.

UNIT II MULTIPLE LINEAR REGRESSION MODEL (9 Hrs)

Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions.

UNIT III MULTIVARIATE REGRESSION (9 Hrs)

Assumptions of Multivariate Regression Models, Parameter estimation, Multivariate Analysis of variance and covariance

UNIT IV DISCRIMINANT & PRINCIPAL COMPONENT ANALYSIS (9 Hrs)

Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties. Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot.

UNIT V Factor & Cluster Analysis (9 Hrs)

Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores. Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters.

Text Books

1. T.W. Anderson, “An Introduction to Multivariate Statistical Analysis”, 2 nd edition, 2003
2. J.D. Jobson ,” Applied Multivariate Data Analysis”, Vol I & II, 2 nd edition ,1991.
3. Magnus Lie Hetland ,”Beginning Python: From Novice to Professional”, 9th. Edition, 2005.

Reference Books

1. D.A. Belsey, E. Kuh and R.E. Welsch, “Regression Diagnostics, Identifying Influential Data and Sources of Collinearety”, New York, 1980.
2. D.C. Montgomery and E.A. Peck, “Introduction to Linear Regression Analysis”,5 th edition , 2012.
3. D.F. Morrison, “Multivariate Statistical Analysis”, 2013.

Web References

1. http://www.ams.sunysb.edu/~zhu/ams571/normals_quadratics_regressions.pdf
2. https://www.slideshare.net/jtneill/multiple-linear-regression
3. http://home.iitk.ac.in/~shalab/regression/Chapter3-Regression-MultipleLinearRegressionModel.pdf
4. https://www.slideshare.net/jewelmrefran/cluster-analysis-15529464

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	1	-	-	-	-	-	-	-	2	1	2
2	2	2	2	2	1	-	-	-	-	-	-	-	2	1	2
3	3	2	3	2	1	-	-	-	-	-	-	-	2	1	2
4	3	2	3	3	2	-	-	-	-	-	-	-	2	2	3
5	2	2	3	3	2	-	-	-	-	-	-	-	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT302	FORMAL LANGUAGE AND AUTOMATA THEORY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know about the fundamental concepts of finite automata and its minimization
- To construct the regular expressions and context free grammars for various languages
- To construct the Push down stack machine and context sensitive language
- To construct basic Turing machine for its recursive languages and functions
- To solve various undecidability, P, NP and NP completeness problems

Course Outcomes

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

CO1 – Illustrate the concepts of finite automata and reduce the states in finite automata. **(K2)**
CO2 - Design regular expressions and context free grammars for various languages. **(K2)**
CO3 – Familiarize the concepts of Push down stack machine and context sensitive language **(K3)**
CO4 - Construct Turing machine for its recursive languages and functions **(K3)**
CO5 – Determine and classify the various undecidability, P, NP and NP completeness problems **(K3)**

UNIT I FINITE AUTOMATA **(9 Hrs)**

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Regular languages and finite automata:, deterministic finite automata (DFA), nondeterministic finite automata (NFA), equivalence with DFA and NFA, Myhill-Nerode theorem and its uses, minimization of finite automata

UNIT II REGULAR AND CONTEXT-FREE LANGUAGES **(9 Hrs)**

Regular expressions and languages, regular grammars and equivalence with finite automata, properties of regular languages, Kleene's theorem, pumping lemma for regular languages,

Context-free languages: Context-free grammars (CFG) and languages (CFL), parse trees, ambiguity in CFG, Chomsky and Greibach normal forms, pumping lemma for context-free languages, closure properties of CFLs

UNIT III PUSHDOWN AUTOMATA AND CONTEXT-SENSITIVE LANGUAGES **(9 Hrs)**

Pushdown Automata: Pushdown automata (PDA), Deterministic pushdown automata, Nondeterministic pushdown automata and equivalence with CFG, **Context-sensitive languages:** Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

UNIT IV TURING MACHINES **(9 Hrs)**

Turing machines: The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators

UNIT V UNDECIDABILITY AND COMPLEXITY **(9 Hrs)**

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.

Basic Introduction to Complexity: Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, P and NP, NP- completeness, Cook's Theorem, other NP -Complete problems

Text Books

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, "Introduction to Automata Theory, Languages, and Computation ",Third Edition, Pearson Education, 2013.
2. Peter Linz, "An introduction to Formal Languages and Automata", Sixth Edition, Jones & Bartlett, 2016
3. K.V.N Sunitha and N.Kalyani , "Formal Languages and Automata Theory", Pearson Education India, 2015

Reference Books

1. Harry R. Lewis and Christos H. Papadimitriou,"Elements of the Theory of Computation", Second Edition, Prentice Hall of India,2003.
2. Dexter C. Kozen, "Automata and Computability", Springer-Verlag, Berlin, 1997.
3. Michael Sipser, "Introduction to the Theory of Computation , "Third Edition, Cengage Learning, 2013.
4. John C. Martin, "Introduction to Languages and the Theory of Computation ", Fourth Edition, McGraw-Hill, 2011.
5. M. R. Garey and D. S. Johnson, "Computers and Intractability: A Guide to the Theory of NP Completeness ", A Series of Books in the Mathematical Sciences, W. H. Freeman and Company, 1979.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	-	-	-	-	-	-	-	2	2	2	1
2	3	3	2	3	-	-	-	-	2	-	-	2	2	2	1
3	3	3	2	3	-	-	-	-	2	-	-	2	3	2	1
4	3	3	2	3	2	-	-	-	2	-	-	2	3	2	1
5	3	3	2	3	2	-	-	-	2	-	-	2	3	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT303	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic structure and operation of a digital computer
- To learn the fundamentals of organizational and architectural aspects of control unit
- To obtain knowledge on pipelining concepts and parallel processing
- To acquire knowledge about processor and memory design of a digital computer
- To have a broad understanding of various system interfaces and Input output devices

Course Outcomes

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

CO1 - Identify and explain the basic structure of a computer and instruction sets with addressing modes and discuss the design of ALU. **(K2)**

CO2 - Apply fixed and floating-point arithmetic operations **(K2)**

CO3 - Illustrate the concepts of CPU design pipelining and parallel processors **(K2)**

CO4 - Choose the appropriate memory mapping procedure to enhance the performance of the system **(K2)**

CO5 - Describe and identify the standard I/O interfaces and peripheral devices. **(K2)**

UNIT I COMPUTER ORGANIZATION AND DESIGN (9 Hrs)

Functional blocks of a computer, Instruction set architecture of a CPU: Registers -instruction execution cycle- RTL interpretation of instruction- addressing modes- instruction set. Outlining instruction sets of some common CPUs

UNIT II DATA REPRESENTATION AND COMPUTER ARITHMETIC (9 Hrs)

Data representation: Signed number -fixed and floating point number -character representation

Computer arithmetic: Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add- Booth multiplier- carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format,

UNIT III PROCESSOR AND CONTROL UNIT (9 Hrs)

Introduction to x86 architecture, CPU control unit design: Hardwired and micro-programmed design approaches - consideration design of a simple hypothetical CPU

Basic concepts of pipelining- throughput and speedup -pipeline hazards

Parallel Processors: Introduction to parallel processors- Concurrent access to memory - cache coherency, introduction to multicore processor, multiprocessor and cluster multiprocessor

UNIT IV MEMORY ORGANIZATION (9 Hrs)

Semiconductor memory technologies- Memory interleaving, concept of hierarchical memory organization: auxiliary memory –Associate memory – Virtual memory -cache memory -cache size vs. block size- mapping functions- replacement algorithms- write policies

UNIT V PERIPHERAL DEVICES AND THEIR CHARACTERISTICS (9 Hrs)

Input-output subsystems- I/O device interface- I/O transfers – program controlled- interrupt driven and DMA - privileged and non-privileged instructions -software interrupts and exceptions - Programs and processes – role of interrupts in process state transitions- I/O device interfaces – SCII, USB

Content Beyond Syllabus

Recent Intel processor architectures

Text Books

1. Morris Mano, "Computer System Architecture ", Prentice Hall of India, Third Edition, 2008
2. David A. Patterson and John L. Henessey, “Computer Organisation and Design”, Fifth edition, Morgan Kauffman / Elseveir, 2014
3. Carl Hamacher, Zvonko G. Vranesic, Safwat G. Zaky, Computer Organization, 5th edition, McGraw-Hill, 2014

Reference Books

1. John P.Hayes, Computer Architecture and Organisation, McGraw Hill, 2012.
2. William Stallings, Computer Organization and Architecture, 7th edition, Prentice-Hall of India Pvt. Ltd., 2016.
3. Vincent P. Heuring, Harry F. Jordan, “Computer System Architecture”, 2nd Edition, Pearson Education, 2005.

Web References

1. http://www.inetdaemon.com/tutorials/computers/hardware/cpu/
2. https://inst.eecs.berkeley.edu/~cs152/sp18/
3. http://users.ece.cmu.edu/~jhoe/doku/doku.php?id=18-447_introduction_to_computer_architecture

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	1	-	-	-	-	-	-	-	3	2	-
2	3	3	2	1	2	-	-	-	-	-	-	-	3	2	1
3	3	2	2	2	2	-	-	-	-	-	-	-	3	2	2
4	3	2	2	2	-	-	-	-	-	-	-	-	3	1	-
5	3	2	2	2	-	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT304	OBJECT ORIENTED PROGRAMMING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the concepts of Basic Object Oriented concepts and Programming Basics.
- To understand in depth about the Classes and Objects.
- To study the Operator overloading and Inheritance concepts.
- To understand the Generic Programming and File I/O.
- To apply object-oriented concepts to solve real time computing problems.

Course Outcomes

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

CO1 - Describe the programming elements of C++. **(K1)**
CO2 - Explain the concepts Object oriented approach for finding Solutions **(K2)**
CO3 - Solve various real-world problems using inheritance and polymorphism concept **(K3)**
CO4 - Manipulate programs using concepts of Templates, files and streams in C++. **(K3)**
CO5 - Exemplify simple applications using Object Oriented Design and Modeling. **(K3)**

UNIT I INTRODUCTION TO C++ (9 Hrs)

Procedural programming, An Overview of C, **Difference between C and C++:** Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments

UNIT II FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING (9 Hrs)

Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object.

More extensions to C in C++ to provide OOP Facilities: Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, friend class, error handling (exception)

UNIT III ESSENTIALS OF OBJECT ORIENTED PROGRAMMING (9 Hrs)

Operator overloading, Inheritance – Single and Multiple, Class Hierarchy, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, Overloading, overriding and hiding, Error Handling

UNIT IV GENERIC PROGRAMMING AND I/O (9 Hrs)

Generic Programming: Template concept, class template, function template, template specialization
Input and Output: Streams, Files, Library functions, formatted output

UNIT V OBJECT ORIENTED DESIGN AND MODELLING (9 Hrs)

UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design

Text Books

1. BjarneStroustrup, “The C++ Programming Language “, Fourth Edition, Addison Wesley, 2013.
2. Debasish Jana,” C++ and Object-Oriented Programming Paradigm”, Third Edition, PHI Learning Pvt. Ltd, 2014.
3. E Balagurusamy,Object-Oriented Programming with C++, 7th Edition,2017

Reference Books

1. Bjarne Stroustrup, “A Tour of C++ “, Addison-Wesley Professional; 2nd Edition, 2018.
2. Scott Meyers “Effective Modern C++”, Shroff/O'Reilly; First Edition, 2014.
3. Stanley Lippman, Josée Lajoie , Barbara Moo , “C++ Primer”, 5th Edition, 2012.
4. Bjarne Stroustrup, "The Design and Evolution of C++", Addison-Wesley , 2005.
5. Alexanderscu “Modern C++ Design” Pearson; 1st Edition, 2004.

Web References

1. https://www.tutorialspoint.com/cplusplus/index.htm
2. http://www.cplusplus.com/doc/tutorial/
3. https://www.w3schools.com/cpp/
4. https://www.javatpoint.com/cpp-tutorial
5. https://www.geeksforgeeks.org/cpp-tutorial/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	3	-	-	-	-	-	-	-	3	2	1
2	2	1	-	-	3	-	-	-	-	-	-	-	3	2	1
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
4	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
5	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT305 DATABASE MANAGEMENT SYSTEMS

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the various data models, conceptualize E-R diagram and depict using relational model
- To gain knowledge about database languages and frame query using Relational Algebra and SQL
- To understand and design an efficient database schema using the various normal forms
- To impart knowledge on data storage and transaction processing, concurrency control techniques and recovery procedures
- To explore knowledge on database security

Course Outcomes

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

CO1 - Explain the concepts of Database Management System **(K2)**

CO2 - Manipulate and build database queries using Structured and Relational Query Language **(K3)**

CO3 - Use data normalization principles to develop a normalized database for a given application. **(K3)**

CO4 - Illustrate various transactions and recovery techniques **(K2)**

CO5 - Describe the concepts of Database Security **(K2)**

UNIT I INTRODUCTION **(9 Hrs)**

Introduction: Introduction to Database. Hierarchical, Network and Relational Models.

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).

UNIT II DATA MODELS AND DATABASE LANGUAGES **(9 Hrs)**

Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

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

UNIT III RELATIONAL-DATABASE DESIGN **(9 Hrs)**

Relational database design: Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design.

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

UNIT IV DATA STORAGE AND TRANSACTIONS **(9 Hrs)**

Storage strategies: Indices, B-trees, Hashing.

Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

UNIT V DATABASE SECURITY **(9 Hrs)**

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

Content beyond Syllabus

Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Text Books

1. Silberschatz, Korth, Sudarshan, Database System Concepts, 7thEdition – McGraw-Hill Higher Education, International Edition, 2019.
2. Ramez Elmasri, and Shamkant B. Navathe, Fundamentals of Database Systems (7th edition), ,Publisher: Pearson,2016.
3. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.

Reference Books

1. J. D. Ullman ,Principles of Database and Knowledge – Base Systems, Vol 1,2016
2. R. Elmasri and S. Navathe ,Fundamentals of Database Systems,2015
3. Serge Abiteboul, Richard Hull and Victor Vianu, Foundations of Databases: The Logical Level,1994

Web References

1. http://www.database.com/
2. http://cassandra.apache.org/
3. https://www.mongodb.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	3	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	2	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
4	2	1	-	-	3	-	-	-	-	-	-	-	3	1	1
5	2	1	-	-	3	-	-	-	-	-	-	-	3	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

		L	T	P	C	Hrs
U20BSP329	COMPUTATIONAL STATISTICS LABORATORY	0	0	2	1	30

Course Objectives

- To study the concepts of linear regression models
- To develop a sound understanding of correlation
- To analyze the concept of autocorrelation
- To apply principles of multivariate data
- To understand the concept of clustering.

Course Outcomes

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

CO1 - Remember the basic concepts of linear regression. **(K3)**
CO2 - Interpret the results of correlation coefficient. **(K3)**
CO3 - Develop a sound understanding of auto correlation. **(K3)**
CO4 – Analyze the concept of multivariate data. **(K3)**
CO5 – Know the application of clustering. **(K3)**

List of experiments:

1. Program on Regression lines
2. Program on correlation coefficient
3. Program on Autocorrelation
4. Program on Multivariate analysis
5. Program on Factor scores
6. Program on multivariate data
7. Implement k-means, logistic and time series algorithm using Scikit-learn
8. Draw statistical graphics using seaborn
9. Working with hierarchical clustering
10. Working with overlapping clustering

Text Books

1. T.W. Anderson, “An Introduction to Multivariate Statistical Analysis”, 2 nd edition, 2003
2. J.D. Jobson ,” Applied Multivariate Data Analysis”, Vol I & II, 2 nd edition ,1991.
3. Magnus Lie Hetland ,”Beginning Python: From Novice to Professional”, 9th. Edition, 2005.

Reference Books

1. D.A. Belsey, E. Kuh and R.E. Welsch, “Regression Diagnostics, Identifying Influential Data and Sources of Collinearety”, New York, 1980.
2. D.C. Montgomery and E.A. Peck, “Introduction to Linear Regression Analysis”,5 th edition , 2012.
3. D.F. Morrison, “Multivariate Statistical Analysis”, 2013.

Web References

1. https://www.edx.org/course/statistical-modeling-and-regression-analysis
2. https://www.cin.ufpe.br/~embat/Python%20for%20Data%20Analysis.pdf
3. https://www.kdnuggets.com/2016/07/statistical-data-analysis-python.html
4. https://people.duke.edu/~ccc14/sta-663/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	2	1	
2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	-	2	1	1
4	3	2	1	1	-	-	-	-	-	-	-	-	2	1	1
5	3	2	1	1	-	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP302	OBJECT ORIENTED PROGRAMMING LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce the concepts of Basic Object Oriented concepts and Programming Basics.
- To gain insight into the Functions and Array usages using C++.
- To understand in depth about the Classes and Objects.
- To study the Operator overloading and Inheritance concepts.
- To acquaint the Files and Exception Handling concepts.

Course Outcomes

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

CO1 - Implement the Object Oriented concepts in simple applications. **(K3)**

CO2 - Employ the Functions and Arrays in simple programs. **(K3)**

CO3 - Demonstrate simple programs with Classes and Objects. **(K3)**

CO4 - Illustrate Operator overloading and Inheritance concepts. **(K3)**

CO5 - Experiment Files and Exception Handling concepts. **(K3)**

List of Exercises

1. Programs on concept of classes and objects
2. Programs using friend functions
3. Programs using static polymorphism
4. Programs using constructors
5. Programs using inheritance
6. Programs on dynamic polymorphism
7. Programs on exception handling
8. Programs on generic programming using template function & template class
9. Programs on file handling

Reference Books

1. Yashavant Kanetkar, “Let Us C++ “, BPB Publications, 2020.
2. Bjarne Stroustrup, “The C++ Programming Language”, Pearson Education, 3rd Edition, 2009
3. Debasish Jana, “C++ and Object-Oriented Programming Paradigm”, PHI Learning, 2nd Edition,2005
4. Bjarne Stroustrup, “Programming: Principles and Practice Using C++”, Addison Wesley, 2009
5. Bjarne Stroustrup, “The Design and Evolution of C++”, Pearson Education, 2009

Web References

1. https://www.studytonight.com/cpp/cpp-and-oops-concepts.php
2. https://www.tutorialspoint.com/What-are-basic-Object-oriented-programming-concepts
3. https://www.cplusplus.com/doc/tutorial/
4. https://www.w3schools.com/cpp/
5. https://www.javatpoint.com/cpp-tutorial
6. https://www.geeksforgeeks.org/cpp-tutorial/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
5	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP303	DATABASE MANAGEMENT SYSTEMS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand data definitions and data manipulation commands
- To understand data selection and data projection commands
- To learn the use of nested and join queries
- To understand functions, procedures and procedural extensions of databases
- To understand design and implementation of typical database applications.

Course Outcomes

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

CO1 - Implement relational database systems using SQL statements. **(K3)**

CO2 - Use typical data definitions and manipulation commands in various applications. **(K3)**

CO3 - Demonstrate applications using Nested and Join Queries. **(K3)**

CO4 - Execute various PL/SQL Queries. **(K3)**

CO5 - Build commercial relational database applications. **(K3)**

List of Experiments

Structured Query Language:

1. Conceptual Database design using E-R DIAGRAM
2. Implementation of SQL commands DDL, DML, DCL and TCL
3. Queries to demonstrate implementation of Integrity Constraints
4. Practice of Inbuilt functions
5. Implementation of Join and Nested Queries AND Set operators
6. Implementation of virtual tables using Views

PL/SQL

7. Practice of Procedural extensions (Procedure, Function, Cursors, Triggers)

Application Development

8. Mini Project (Application Development using DB)
9. Mini Project (Application Development using NoSQL)

Reference Books

1. Oracle developer handbook
2. SQL/PL/SQL for Oracle by P.S. Deshpande IIT Madras, Dream Tech Press
3. Alan Beaulieu, Mastering SQL Fundamentals, Second Edition, OReilly,2009
4. Silberschatz, Korth, Sudarshan, Database System Concepts, 7thEdition – McGraw-Hill Higher Education, International Edition, 2019

Web References

1. www.oracle-developer.net
2. www.oracle.com/DBA

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
2	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
4	3	2	1	1	3	-	-	-	-	-	-	-	3	3	1
5	3	2	1	1	3	-	-	-	-	-	-	-	3	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST404	BUSINESS COMMUNICATION & VALUE SCIENCE – III	L	T	P	C	Hrs
		1	0	2	2	30

Course Objectives

- To develop technical writing skills
- To Introduce students to Self-analysis techniques like SWOT & TOWS
- To enrich students to the key concepts of Pluralism and cultural spaces
- To imbibe self-motivation and foresee future prospects.
- To inculcate the importance of science in nation building

Course Outcome(s)

By the end of the course, students will be able to,

CO1: Understand, apply & analyze the tools of technical writing **(K2)**

CO2: Apply basic principles of SWOT & life positions **(K3)**

CO3: Identify & respect pluralism in cultural spaces **(K1)**

CO4: Inherent the skill of self- introspection and envision the future **(K2)**

CO5: Learn to apply the role of science in nation building **(K3)**

UNITI TECHNICAL WRITING SKILLS(6Hrs)

Technical writing – Introduction and application of Technical writing Identify the best practices on technical writing. - Technical writing in profession -Theory with YouTube and DrBimal Ray's videos on cryptology. - Technical writing in real-life scenarios-Scenario-based Assessment on technical writing - Sell Analytics and Insight to the local tea seller -Explain the concept of Cloud to your 87 year old grandmother-Introduce the concept of friendly robots to a class 3 kid.

UNIT II ANALYSIS OF LIFE POSITION(6Hrs)

Personal analysis: SWOT analysis - SWOT and Life Positions –Analysis of others' lives – Analysis of one's own life. - TOWS Analysis: How to turn threat into opportunity – VUCA - Volatility, uncertainty, complexity and ambiguity - Application of analysis in real life scenarios – Activity: SWOT analysis of a well-known individual's life – TED talk on bio mimicry – Group activity - Presentation on strengths identified to survive in the VUCA World – Watching videos of motivation & discussion.

UNIT IIIPLURALISM IN CULTURAL SPACES(6Hrs)

Identifying Pluralism in cultural spaces - uniqueness and differences - Global, Glocal and Translocational cultures – benefits, differences and implications of multi-culture – Gender awareness - Roles and relations of different genders- Group activity – Exploring cultures and traditions of different states – Performing Indian dance forms – Debate on Global, Glocal and Translocational impacts – cultural misunderstanding – Group discussion on implications of cross cultural communication –Gender awareness campaign: College, Workplace, Family, Friend.

UNIT – IV SELF DRIVEN HUMAN VALUES AND FUTURISM (6Hrs)

Motivation in real life: Stories - YouTube videos on Maslow's Theory - Explain the idea of motivation with the help of examples - Gender awareness: Differentiate between the roles and relations of different gender - Gender awareness with four different themes: College-Workplace-Family-Friends. Design your college in the year 2090: Groups need to create the college of future with the future teachers, teaching methods, types of students, etc. How will offices/workplaces change in future? -Motivational TED talk videos.

UNIT V ROLE OF SCIENCE IN NATION BUILDING(6Hrs)

Role of science in nation building – Pre & Post Independent scientific inventions and inventors – development of Information Technology –Discussion on the role of scientists and mathematicians – Presentation on eminent scientists and mathematicians – Quiz on Scientists and inventions – Explaining DNA ,Rings of Saturn ,structure of heart to visually impaired person.

Reference Books

1. Self-Analysis by Ron Hubbard, Bridge Pubns; 2007th edition
2. Managing a Diverse Workforce: Learning Activities, Gary N. Powell, 3rd Edition, Sage Publication,2010
3. Unity in Diversity: The Indian Experience in Nation-building, M.S. Gore, Rawat Publication,2015
4. Carrie Hutchinson, “Cross Cultural Communication A Guide for International Students” Createspace Independent Pub 1 December 2013.

Web References

1. https://freelance-writing.lovetoknow.com/kinds-technical-writing
2. https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technical-writer/
3. https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/
4. https://www.investopedia.com/terms/c/cross-culture.asp
5. https://link.springer.com/article/10.1007/s11569-018-0327-8

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	2	-	3	-	1	1	-	-
2	1	-	-	-	-	-	-	2	-	3	-	1	1	-	-
3	1	-	-	-	-	-	-	2	-	3	-	1	1	1	1
4	1	-	-	-	-	-	-	2	-	3	-	1	1	1	1
5	1	-	-	-	-	-	-	2	-	3	-	1	1	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST405	INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To acquaint the students with the knowledge base of Entrepreneurship
- To learn about Innovation and Creativity
- To learn to manage various types of Intellectual Property Rights IPR to protect competitive advantage
- To know about the Building an Innovative Organization
- To enable students to investigate, understand and internalize the process of founding a start-up.

Course Outcomes

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

CO1 - Examine different types' entry strategies of entrepreneurship **(K3)**

CO2 - Demonstrate about Innovation and Creativity **(K2)**

CO3 - Elaborate on various types of Intellectual Property Rights **(K3)**

CO4 -Analyze various entrepreneurial opportunities. **(K3)**

CO5- Evaluate the process of founding a start-up **(K3)**

UNITI INNOVATION(9Hrs)

Innovation: Definition and meaning; Innovation as a core business process, Sources of innovation, Types of Innovation,Challenges in Innovation, Knowledge push vs. need pull innovations. Innovation Vs. Creativity.

UNIT II BUILDING AN INNOVATIVE ORGANIZATION (9Hrs)

Creating new products and services, Exploiting open innovation and collaboration, Use of innovation for starting a new venture

UNIT III INTELLECTUAL PROPERTY RIGHTS (IPR) (9 Hrs)

Introduction and the economics behind development of IPR: Business Perspective; IPR in India – Genesis and Development; International Context; Concept of IP Management, Use in marketing; Types of Intellectual Property: Patent- Procedure, Licensing and Assignment, Infringement and Penalty, Trademark- Use in marketing, example of trademarks- Domain name, Geographical Indications, Copyright, Industrial Designs.

UNIT IVENTREPRENEURSHIP (9Hrs)

Opportunity recognition and entry strategies, Entrepreneurship as a Style of Management, Types of Entrepreneurship, Maintaining Competitive Advantage- Use of IPR to protect Innovation.

UNIT V ENTREPRENEURSHIP- FINANCIAL PLANNING(9Hrs)

Financial Projections and Valuation, Stages of financing, Debt, Venture Capital and other forms of Financing.

Text Books

1. Joe Tidd, John Bessant. Managing Innovation: Integrating Technological, Market and Organizational Change,Sixth Edition, John Wiley & Sons Limited, 2018
2. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd: Entrepreneurship, Tata McGraw Hill,2007
3. Lee Swanson, Entrepreneurship and Innovation Toolkit, Open press,2017

Reference Books

1. Arya Kumar: Creating and Leading an Entrepreneurial Organization, Pearson, 2012
2. Vasant Desai: The Dynamics of Entrepreneurial Development and Management,Himalaya Publishing House,2011
3. Gabe Burton: Entrepreneurship and Small Business Management, Library Press, 2017

Web References

1. www.ediindia.org
2. www.enterweb.org/entrship.htm
3. https://www.theweekendleader.com/more-articles.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	1	3	2
2	2	1	-	-	3	-	-	-	-	-	-	-	1	2	1
3	3	2	1	1	3	-	-	-	-	-	-	-	1	3	2
4	3	2	1	1	3	-	-	-	-	-	-	-	1	3	2
5	3	2	1	1	3	-	-	-	-	-	-	-	1	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20BST440	OPERATIONS RESEARCH	L	T	P	C	Hrs
		2	0	0	2	30

Course Objectives

- To learn about the Linear programming problem
- To know the types of solution of LPP
- To understand Transportation and Assignment Problem.
- To learn the Project scheduling techniques.
- To study the behavior of the functions of inventory and its disadvantages

Course Outcomes

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

CO1 - Frame the Linear programming problem **(K2)**

CO2 - Solve the Linear Programming problem **(K3)**

CO3 - Know the solution of Transportation and Assignment problem. **(K2)**

CO4 - Understand the Applications of PERT- CPM **(K2)**

CO5 - Understand the types of Inventory control **(K2)**

UNITI INTRODUCTION TO OR **(6Hrs)**

Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.

Linear programming – Examples from industrial cases, formulation & definitions, Matrix form.Implicit assumptions of LPP. Convex set, Convex polyhedron, Extreme points, Basic feasible solutions.

Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence / Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane,

UNIT II LINEAR PROGRAMMING **(6Hrs)**

Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy & degeneracy, Sensitivity analysis.

Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations.

Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms

UNIT IIITRANSPORTATION AND ASSIGNMENT PROBLEMS **(6Hrs)**

TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.

AP - Examples, Definitions – decision variables, constraints, formulation, Balanced & unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.

UNIT IV PROJECT SCHEDULING **(6Hrs)**

Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.

UNIT V INVENTORY CONTROL **(6Hrs)**

Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known / unknown stock out situations, models under prescribed policy, Probabilistic situations

Text Books

1. H.A. Taha., Operations Research: An Introduction. Pearson,10th edition,2017
2. F.S. Hiller and G.J. Lieberman, Introduction to Operations Research. Third edition 2015.
3. K.G. Murthy, Linear Programming. Wiley, Third edition 2019.

Reference Books

1. G. Hadley, .Linear Programming,2002
2. H.M. Wagner, Principles of OR with Application to Managerial Decisions,1980
3. Thomas L Saaty, Elements of Queuing Theory with Applications, 2000
4. A.RaviRavindran, Operations Research and Management Science, Hand Book: Management Guide to PERT/CPM. CRC Press; 1st edition, 2016
5. J.W. Prichard and R.H Modern Inventory Management,1965

Web References

1. https://www.ifors.org/what-is-
2. https://www.springer.com/journal/12351
3. https://www.britannica.com/topic/operations-research

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	1	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	1	-	1
3	2	1	-	-	3	-	-	-	-	-	-	-	1	-	1
4	2	1	-	-	3	-	-	-	-	-	-	-	1	-	2
5	2	1	-	-	3	-	-	-	-	-	-	-	1	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT406	OPERATING SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To grasp a fundamental understanding of operating systems and processes
- To learn the concepts of CPU scheduling and Inter Process Communication
- To learn the concepts of Dead lock and Concurrent Programming
- To understand memory management concepts in OS
- Understand the concepts of I/O, file and disk management
- To learn the features of UNIX operating systems

Course Outcomes

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

CO1 - Define the concepts of operating systems operations, processes and threads. **(K2)**

CO2 - Apply the concepts of CPU scheduling and Inter Process Communication **(K3)**

CO3 - Describe the concepts of Dead lock and Concurrent Programming. **(K2)**

CO4 - Simulate the principles of memory management **(K3)**

CO5 - Identify appropriate I/O, file system and disk organizations for a variety of computing scenario **(K2)**

UNITI INTRODUCTION AND PROCESS MANAGEMENT (9Hrs)

Introduction: Concept of Operating Systems - Generations of OS- Types of OS-OS Services- Interrupt handling and System Calls-Basic architectural concepts of an OS - Concept of Virtual Machine- Resource Manager view- process view and hierarchical view of an OS.

Processes: Definition-Process Relationship- Different states of Process- Process State transitions- Process Control Block (PCB) - Context switching. Thread: Definition- Various states- Benefits of threads- Types of threads- Concept of multithreads.

UNIT II CPU SCHEDULINGAND INTER PROCESS COMMUNICATION (9Hrs)

Process Scheduling: Foundation and Scheduling objectives - Types of Schedulers- Scheduling criteria. Scheduling algorithms: Pre-emptive and non-pre-emptive- FCFS- SJF- RR- Multiprocessor scheduling- Real Time scheduling.

Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem.

UNIT IIIDEAD LOCK AND I/O (9Hrs)

Deadlocks: Definition - Necessary and sufficient conditions for Deadlock - Deadlock Prevention, Deadlock Avoidance: Banker's algorithm - Deadlock detection and Recovery.

Concurrent Programming: Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP)

UNIT IV MEMORY MANAGEMENT (9Hrs)

Memory Management: Basic concept - Logical and Physical address maps - Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference- Page allocation- Partitioning, Paging- Page fault-Working Set-Segmentation- Demand paging- Page Replacement algorithms: Optimal, FIFO – SC –NRU-LRU.

UNIT V I/O ANDFILE MANAGEMENT (9 Hrs)

I/O Hardware: I/O devices- Device controllers-Direct Memory Access- Principles of I/O

File Management: Concept of File- Access methods- File types- File operation- Directory structure-File System structure-Allocation methods -Free-space management - directory implementation- efficiency and performance.

Disk Management: Disk structure- Disk scheduling – FCFS- SSTF- SCAN- C-SCAN- Disk reliability, Disk formatting, Boot-block, Bad blocks.

Case study: UNIX OS file system

Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, John Wiley & Sons (Asia) Pvt. Ltd, Ninth Edition,2017.
2. Gary Nutt, “Operating Systems- A Modern Perspective”, Pearson Education Pvt. Ltd, Second Edition, 2013.
3. Andrew S. Tanenbaum, “Modern Operating Systems”, 3rd edition Prentice Hall of India Pvt. Ltd,2015.

Reference Books

1. William Stallings, “Operating System”, Prentice Hall of India, 6th Edition, 2009
2. Charles Patrick Crowley, “Operating System: A Design-oriented Approach”Tata McGraw - Hill Edition 1998 21st reprint,2009 .
3. Maurice J. Bach , “Design of the Unix Operating Systems”Prentice-Hall2 nd edition ,1986
4. Daniel Pierre Bovet, Marco Cesati , “Understanding the Linux Kernel”O'Reilly Media, Incorporated publications,2 nd edition ,2005

Web References

1. https://nptel.ac.in/courses/106108101/
2. http://www.tcyonline.com/tests/operating-system-concepts
3. http://www.galvin.info/history-of-operating-system-concepts-textbook
4. http://www.ittestpapers.com/operating-system-concepts

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	3	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	2	2	-
3	2	1	-	-	3	-	-	-	-	-	-	-	2	2	1
4	3	2	1	1	3	-	-	-	-	-	-	-	2	2	1
5	2	1	-	-	3	-	-	-	-	-	-	-	2	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT407	SOFTWARE ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know the various software engineering approaches
- To learn about the software project management.
- To understand the software quality and reliability.
- To explore software requirements analysis, design and construction.
- To acquire the knowledge of software testing concepts.

Course Outcomes

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

CO1 - Know the various software engineering approaches. **(K2)**
CO2 - Learn about the software project management **(K2)**
CO3 - Analyze and understand the software quality and reliability **(K3)**
CO4 - Explore software requirements analysis, design and construction. **(K3)**
CO5 - Acquire the knowledge of software testing concepts. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; engineering approach to software development; role of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline.

UNIT II SOFTWARE PROJECT MANAGEMENT (9 Hrs)

Basic concepts of life cycle models – different models and milestones; software project planning – identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management

UNIT III SOFTWARE QUALITY AND RELIABILITY (9 Hrs)

Internal and external qualities; process and product quality; principles to achieve software quality; introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO – 9126; Introduction to Capability Maturity Models (CMM and CMMI); introduction to software reliability, reliability models and estimation.

UNIT IV SOFTWARE REQUIREMENTS ANALYSIS, DESIGN AND CONSTRUCTION (9 Hrs)

Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modeling – decision tables, event tables, state transition tables, Petri nets; requirements documentation through use cases; introduction to UML, introduction to software metrics and metrics based control methods; measures of code and design quality.

UNIT V SOFTWARE TESTING (9 Hrs)

Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transactionbased testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection.

Text Books

1. Ian Sommerville, “Software Engineering “, Ninth edition, Pearson Education, 2010.
2. Roger S. Pressman,” Software Engineering – A Practitioner’s Approach”, Seventh edition, 2010
3. Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino,” Fundamentals of Software Engineering”, second edition,2002

Reference Books

1. Michael Jackson,” Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices”,first edition, ACM Press, 1995
2. Ivar Jacobson, Grady Booch, James Rumbaugh,“The Unified Development Process”, Addison-Wesley, 1999
3. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns: Elements of Object-Oriented Reusable Software”, First edition, 1994
4. Norman E Fenton, Shari Lawrence Pfleeger,” Software Metrics: A Rigorous and Practical Approach”, Second edition, International Thomson Computer Press, 1997
5. Shari Lawrence Pfleeger and Joanne M. Atlee, “Software Engineering: Theory and Practice“, fourth edition, Pearson, 2009
6. Bertrand Meyer, second edition,” Object-Oriented Software Construction”, Prentice-hall International Series, 1997
7. Ivar Jacobson, “Object Oriented Software Engineering: A Use Case Driven Approach“, First edition, ACM Press, 1992
8. Bertrand Meyer, “Touch of Class: Learning to Program Well with Objects and Contracts “, First edition, Springer-Verlag Berlin Heidelberg,2013
9. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language “, Third edition,Addison Wesley, 2003

Web References

1. http://www.nptelvideos.in/2012/11/software-engineering.html
2. https://www.projectengineer.net/the-earned-value-formulas/
3. https://www.smartdraw.com/downloads/
4. https://www.visual-paradigm.com/support/documents/vpuserguide.jsp

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	1	1	1	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	2	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	2	2
5	2	1	2	2	2	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT408	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Learn and understand the algorithm analysis techniques and complexity notations
- Become familiar with the different algorithm design techniques for effective problem solving in computing.
- Learn to apply the design techniques in solving various kinds of problems in an efficient way.
- Become familiar with various Computability classes of problem.
- Understand the Randomized algorithmsand Approximation algorithms to deal optimization problems in polynomial time

.

Course Outcomes

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

CO1 - Analyze the best, worst and average behavior of an algorithm based on time and space **(K2)**

CO2 - Understand various algorithm design strategies to synthesize algorithms for solving various problems. **(K2)**

CO3 - Choose and apply appropriate algorithm design strategies to design algorithms based on the nature of problems **(K3)**

CO4 - Apply Backtracking and Branch and Bound techniques to develop algorithms to solve various problems **(K3)**

CO5 – Understand various computability classes of problem **(K2)**

UNITI ALGORITHM ANALYSIS (9 Hrs)

Introduction: Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behavior; Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

UNIT II FUNDAMENTAL ALGORITHMIC STRATEGIES (9 Hrs)

Brute-Force, Heuristics, Greedy, Divide and Conquer, Dynamic Programming

UNIT III GRAPH AND TREE ALGORITHMS (9 Hrs)

Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

UNIT IV ALGORITHMIC STRATEGIES (9 Hrs)

Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem-Solving , n-Queens Problem , Graph Coloring , Knapsack, Travelling Salesman Problem.

UNIT V TRACTABLE AND INTRACTABLE PROBLEMS (9 Hrs)

Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard.Cook's theorem, Standard NP-complete problems and Reduction techniques.

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithm.

Text Books

1. E. Horowitz and S. Sahni., “Fundamental of Computer Algorithms”, Second Edition, Computer Science Press, 2008.
2. A. Aho, J. Hopcroft and J. Ullman, “The Design and Analysis of Computer Algorithms”, Fourth edition, Pearson India, 2009.
3. T. H. Cormen, C. E. Leiserson and R. L. Rivest, “Introduction to Algorithms”, Third Edition, MIT Press, 2009.

Reference Books

1. S. Baase, “Computer Algorithms: Introduction to Design and Analysis”, Third Edition, Pearson, 2000.
2. D. E. Knuth ,”The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3”, Third Edition, Mathematical Science Publishers,1997.
3. Michael A. Nielsen and Isaac L. Chuang ,Quantum Computation and Quantum Information: 10th Anniversary Edition.Cambridge University Press, 2010

Web References

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
2. https://www.javatpoint.com/daa-tutorial
3. https://www.guru99.com/design-analysis-algorithms-tutorial.html
4. https://nptel.ac.in/courses/106/106/106106131/
5. https://online.stanford.edu/courses/soe-ycsalgorithms1-algorithms-design-and-analysis-part-1

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20BSP441 OPERATIONS RESEARCH LABORATORY

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn about the Queuing models
- To know the Random number generator
- To understand Poisson's Process.
- To learn little's law.
- To study the Application in Scheduling

Course Outcomes

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

CO1 - Find waiting cost. **(K3)**

CO2 - Solve M/M/1 model. **(K3)**

CO3 - Solve M/M/m model. **(K3)**

CO4 - Understand the Applications in Scheduling. **(K3)**

CO5 - Understand the types of Inventory control. **(K3)**

List of Experiments

1. Formulation of linear programming problems.
2. Solution of linear programming problem using graphical method with:
    i. Multiple constraints
    ii. Unbounded solution
    iii. Infeasible solution
    iv. Alternative or multiple solution
3. Solution of linear programming problem with simplex method.
4. Problem solving using Big M method.
5. Problem solving using two phase method.
6. Solution on primal problem as well as dual problem.
7. Solution based on dual simplex method.
8. Solution of transportation problem.
9. Solution of assignment problem.
10. Simulation: Random number generation.
11. Performance measures for M/M/1 queuing model.
12. ABC analysis.

Reference Books

1. H.A. Taha., Operations Research: An Introduction. Pearson,10th edition,2017
2. F.S. Hiller and G.J. Lieberman, Introduction to Operations Research. Third edition 2015.
3. K.G. Murthy, Linear Programming. Wiley, Third edition 2019.Reference Books
4. G. Hadley, .Linear Programming, 2002
5. H.M. Wagner, Principles of OR with Application to Managerial Decisions,1980
6. Thomas L Saaty, Elements of Queuing Theory with Applications, 2000
7. A.RaviRavindran, Operations Research and Management Science, Hand Book: Management Guide to PERT/CPM. CRC Press; 1st edition, 2016

Web References

1. https://www.ifors.org/what-is-
2. https://www.springer.com/journal/12351
3. https://www.britannica.com/topic/operations-research

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	1	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	1	-	1
3	3	2	1	1	3	-	-	-	-	-	-	-	1	-	1
4	3	2	1	1	3	-	-	-	-	-	-	-	1	-	2
5	3	2	1	1	3	-	-	-	-	-	-	-	1	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP404	OPERATING SYSTEMS(UNIX) LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn about the UNIX commands &shell programs and UNIX system calls
- To simulate scheduling algorithms concepts
- To simulate process synchronization and deadlock,
- To learn about the various memory allocation and page replacement algorithms.
- To learn about the file allocation and organization techniques.

Course Outcomes

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

CO1 - Demonstrate the fundamental of UNIX commands &shell programs and UNIX system calls. **(K3)**

CO2 - Apply the scheduling algorithms for the given problem. **(K3)**

CO3 - Apply the process synchronous concept using semaphore and apply an algorithm to avoid dead lock. **(K3)**

CO4 - Apply the various methods in memory allocation and page replacement algorithm. **(K3)**

CO5 - Demonstrate the various operations of file system. **(K3)**

List of Experiments

1. UNIX Commands
2. Programs using Shell Programming
3. Implementation of UNIX System Calls
4. Simulation and Analysis of Non pre-emptive and Pre-emptive CPU Scheduling Algorithms
5. Simulation of Producer – Consumer Problem using Semaphores
6. Implementation of DiningPhilosopher's Problem to demonstrate Process Synchronization
7. Simulation of Banker's Algorithm for Deadlock Avoidance
8. Analysis and Simulation of Memory Allocation and Management Techniques
9. Implementation of Page Replacement Techniques
10. Simulation of Disk Scheduling Algorithms
11. Implementation of File organization Techniques

Reference Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons (Asia) Pvt. Ltd, Ninth Edition,2017.
2. Gary Nutt, "Operating Systems- A Modern Perspective", Pearson Education Pvt. Ltd, Second Edition, 2013.
3. Andrew S. Tanenbaum, "Modern Operating Systems", 3rd edition Prentice Hall of India Pvt. Ltd,2015.
4. Charles Patrick Crowley, "Operating System: A Design-oriented Approach"Tata McGraw - Hill Edition 1998 21st reprint, 2009 .

Web References

1. https://www.geeksforgeeks.org/operating-systems/
2. http://www.inf.ed.ac.uk/teaching/courses/os/prac/
3. http://www.scribd.com/doc/7137624/OS-Practical-File/
4. http://www.cl.cam.ac.uk/freshers/raspberrypi/tutorials/os/introduction.html/

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	2	2	-
3	3	2	1	1	3	-	-	-	-	-	-	-	2	2	1
4	3	2	1	1	3	-	-	-	-	-	-	-	2	2	1
5	3	2	1	1	3	-	-	-	-	-	-	-	2	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP405	SOFTWARE ENGINEERING LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn the development of requirements specification.
- To learn the function oriented design using SA/SD.
- To introduce the object-oriented design using UML, test case design
- To study about the implementation using C++ and testing.
- To understand the use of appropriate CASE tools and other tools such as configuration management tools, program analysis tools in the software life cycle.

Course Outcomes

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

CO1 - learn the development of requirements specification **(K3)**

CO2 - learn the function oriented design using SA/SD **(K3)**

CO3 - Know the object-oriented design using UML, test case design. **(K3)**

CO4 - Implement using C++ and testing. **(K3)**

CO5 - use appropriate CASE tools and other tools such as configuration management tools, program analysis tools in the software life cycle **(K3)**

List of Experiments

- Development of requirements specification,
- Function oriented design using SA/SD,
- Object-oriented design using UML,
- Test case design,
- Implementation of the designed software using C++ language.
- Perform Testing using any tool or different strategies
- Use of appropriate CASE tools and other tools such as configuration management tools
- program analysis tools in the software life cycle

Reference Books

1. Roger S. Pressman," Software Engineering – A Practitioner's Approach", Seventh edition, 2010
2. Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino," Fundamentals of Software Engineering", second edition,2002
3. Michael Jackson," Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices",first edition, ACM Press, 1995
4. Ivar Jacobson, Grady Booch, James Rumbaugh,"The Unified Development Process", Addison-Wesley, 1999
5. Ivar Jacobson, "Object Oriented Software Engineering: A Use Case Driven Approach", First edition, ACM Press, 1992
6. Bertrand Meyer, "Touch of Class: Learning to Program Well with Objects and Contracts ", First edition, Springer-Verlag Berlin Heidelberg,2013
7. Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language ", Third edition,Addison Wesley, 2003

Web References

1. http://vlabs.iitkgp.ernet.in/se/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	2	2	1
4	3	2	1	1	3	-	-	-	-	-	-	-	2	2	1
5	3	2	1	1	3	-	-	-	-	-	-	-	2	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP406	DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY	L	T	P	C	H
		0	0	2	1	30

Course objectives

- To apply linear data structures
- To apply non-linear data structures
- To understand the different operations on trees
- To implement graph traversal algorithms
- To access non-linear data structure from a file

Course Outcomes

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

CO1 - Use linear data structures while solving simple and complex problems **(K3)**
CO2 - Implement and apply trees to improve accessing of data **(K3)**
CO3 - Apply graph to solve various real time problems **(K3)**

LIST OF EXPERIMENTS

1. Design and implement algorithms using Brute Force Technique.
2. Design and implement algorithms using Divide and Conquer Technique.
3. Design and implement algorithms using Greedy Technique.
4. Design and implement algorithms using Dynamic Programming.
5. Design and implement algorithms using Backtracking.
6. Design and implement algorithms using Branch and Bound.

Text Books

1. E. Horowitz and S. Sahni., “Fundamental of Computer Algorithms”, Second Edition, Computer Science Press, 2008.
2. A. Aho, J. Hopcroft and J. Ullman, “The Design and Analysis of Computer Algorithms”, Fourth edition, Pearson India, 2009.
3. T. H. Cormen, C. E. Leiserson and R. L. Rivest, “Introduction to Algorithms”, Third Edition, MIT Press, 2009.

Reference Books

1. S. Baase, “Computer Algorithms: Introduction to Design and Analysis”, Third Edition, Pearson, 2000.
2. D. E. Knuth ,”The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3”, Third Edition, Mathematical Science Publishers,1997.
3. Michael A. Nielsen and Isaac L. Chuang ,Quantum Computation and Quantum Information: 10th Anniversary Edition.Cambridge University Press, 2010

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms/dsa_quick_guide.htm
2. https://www.programiz.com/dsa
3. http://cse01-iiith.vlabs.ac.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST507	FUNDAMENTALS OF MANAGEMENT	L	T	P	C	Hrs
		2	0	0	2	30

Course Objectives

- To provide an overview on the evolution of management
- To explain the primary functions of management
- To make the students familiar with the concepts of organizational behaviour and its pertinence
- To describe the major organizational functions
- To understand the importance managerial ethics and leadership skills

Course Outcomes

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

CO1 – Understanding the evolution of management and management theories (**K1)**
CO2 – Illustrating the roles, skills and functions of management (**K2)**
CO3 – Assessing the role of organizational behaviour (**K2)**
CO4 – Develop an interpretation about how organizations function (**K2)**
CO5 – Understanding management ethics and leadership skills (**K2)**

UNIT I THEORIES OF MANAGEMENT (6 Hrs)

Concept and foundations of management - Evolution of management thoughts – Pre -scientific management era before (1880) – Classical management era (1880 – 1930) – Neo – classical management era (1930 – 1950) – Modern management era – (1950 onwards) – Contribution of management thinkers – Taylor, Fayol, Elton Mayo

UNIT II FUNCTIONS OF MANAGEMENT (6 Hrs)

Planning – Organizing – Staffing – Directing – Controlling – Coordinating – Communication – Types, Process and Barriers – Decision Making – Concepts, Process, Techniques and Tools

UNIT III ORGANIZATIONAL BEHAVIOUR (6 Hrs)

Introduction – Personality – Perception - Learning and Reinforcement - Motivation - Group Dynamics - Power & Influence - Work Stress and Stress Management - Decision Making - Problems in Decision Making - Decision Making - Organizational Culture - Managing Cultural Diversity

UNIT IV ORGANIZATIONAL DESIGN (6 Hrs)

Classical, Neoclassical and Contingency approaches to organizational design - Organizational theory and design - Organizational structure - (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure)

UNIT V MANAGERIAL ETHICS AND LEADERSHIP (6 Hrs)

Ethics and Business - Ethics of Marketing & advertising - Ethics of Finance & Accounting - Decision making frameworks - Business and Social Responsibility - International Standards - Corporate Governance -Corporate Citizenship - Corporate Social Responsibility - Concept, Nature, Importance, Attributes of a leader - developing leaders across the organization Leadership Grid

Text Books

1. Richard L. Daft, Understanding the Theory and Design of Organizations
2. Fundamentals of Management by A.R. Aryasri, Mcgraw Hill India, 2018.
3. Fundamentals Of Management: Essential Concepts and Applications, 9Th Edition by Stephen P Robbins and Mary Coulter, Pearson.

Reference Books

1. Fundamentals of Human resource management, 4th edition, by Gary dessler, Pearson 2017
2. Principles of Management Essentials You Always Wanted to Know, 2nd Edition, by Callie daum, Vibrant publications 2020.
3. Organizational Behaviour, 18th edition, by Stephen Robbins, Pearson 2018

Web Resources

1. www.shrm.org
2. www.shrmindia.org
3. http://nptel.ac.in/courses/122/108/122108038/
4. Journal of Human resources
5. www.obnetwork.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	2	1	-	-	3	2	1	1
2	2	1	-	-	-	-	-	2	1	-	-	3	2	1	1
3	2	1	-	-	-	-	-	2	1	3	-	3	2	1	-
4	2	1	-	-	-	-	-	2	1	3	-	3	2	-	1
5	2	1	-	-	-	-	-	2	1	3	-	3	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST508	BUSINESS STRATEGY	L	T	P	C	Hrs
		2	0	0	2	30

Course Objectives

- To learn the fundamental concepts of strategic management to analyze business situations and apply these concepts to solve business problems
- To understand the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, HR and information technology
- To understand the inter-relationships of business to individuals, other organizations, government and society
- To analyze complex, unstructured qualitative and quantitative problems, using appropriate tools
- To analyse alternatives to choose appropriate strategies

Course Outcomes

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

CO1 - Summarize the Key dimensions of strategic management – Analysis, Evaluation, Choice and Implementation. **(K1)**

CO2 - Analyse and apply information from a variety of Environmental sources. **(K2)**

CO3 - Improve structure, design, culture and working environment to effective strategic Management. **(K2)**

CO4 - Compare alternative strategies for business development in differing operating contexts. **(K3)**

CO5 - Evaluate to implement chosen strategies and identify the areas requiring change. **(K3)**

UNIT I INTRODUCTION TO STRATEGIC MANAGEMENT (6 Hrs)

Importance of Strategic Management- need, dimensions -Vision and Objectives- Schools of thought in Strategic Management- Strategy Content, Process, and Practice- Fit Concept and Configuration Perspective in Strategic Management

UNIT II ENVIRONMENT ANALYSIS (6 Hrs)

Environmental Scanning and approaches- Core Competence as the Root of Competitive Advantage-Sources of Sustained Competitive Advantage-Business Processes and Capabilities-based Approach to Strategy

UNIT III PORTFOLIO EXTERNAL ENVIRONMENTS OF FIRM- COMPETITIVE STRATEGY (6 Hrs)

SWOT Analysis -Five Forces of Industry Attractiveness that Shape Strategy-The concept of Strategic Groups, and Industry Life Cycle-Generic Strategies-Generic Strategies and the Value Chain

UNIT IV CORPORATE STRATEGY, AND GROWTH STRATEGIES (6 Hrs)

The Motive for Diversification-Related and Unrelated Diversification-Business Portfolio Analysis-Expansion, Integration and Diversification-Strategic Alliances, Joint Ventures, and Mergers & Acquisitions-– Strategic Alliances

UNIT V STRATEGY IMPLEMENTATION: STRUCTURE AND SYSTEMS (6 Hrs)

The 7S Framework-Strategic Control - Challenges of Change and Corporate Governance- Recent Trends in Strategic Management- Recent Trends in business strategy

Textbooks

1. Robert M. Grant (2012). *Contemporary Strategic Management*, Blackwell, 7th Edition.
2. Thomas L. Wheelan,J. David Hunger, Alan N. Hoffman & Charles E. Bamford . Concepts in Strategic Management and Business Policy: Globalization, Innovation and Sustainability.5th Edition. Pearson; 2017
3. Charles W. L. Hill & Gareth R. Jones. Strategic Management. 9th edition. Cengage India, 2012.

Reference Books

1. M.E. Porter, Competitive Strategy, 1980.M.E. Porter,
2. Competitive Advantage, 1985 Richard Rumelt (2011). Good Strategy Bad Strategy: The Difference and Why It Matters.
3. Fred R. David & David. Strategic Management. Student edition. Pearson College Div, 2014.
4. J.-C. Spender. Business Strategy: Managing Uncertainty, Opportunity, and Enterprise. Reprint edition. Oxford University Press, 2015.
5. Niraj Dawar. Shifting Your Strategy from Products to Customers. 1st Edition. Harvard Business Review Press, 2013.
6. Azhar Kazmi. Strategic Management and Business Policy. 3rd edition. McGraw Hill Education, 2010.

.

Web References

1. www.brandweek.com
2. www.thenewstribune.com
3. Journal of Management and Strategy
4. www.foxnews.com
5. Strategic Management Journal
6. https://nptel.ac.in/courses/110/108/110108047/www.obweb.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	2	1	-	-	3	2	1	1
2	3	2	1	1	-	-	-	2	1	-	-	3	2	1	1
3	2	1	-	-	-	-	-	2	1	3	-	3	2	1	-
4	3	2	1	1	-	-	-	2	1	3	-	3	2	-	1
5	3	2	1	1	-	-	-	2	1	3	-	3	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST509 **DESIGN THINKING**

L	T	P	C	Hrs
2	0	2	3	45

Course Objectives

- To make the students familiar with the concepts of Design Thinking and its importance
- To understand phases of Design Thinking process
- To know about the steps in Design Thinking process.
- To understand and appreciate doodling & story telling
- To know how to value proposition statements during presenting ideas.

Course Outcomes:

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

CO1 - Understand the phases of Design Thinking process. **(K1)**
CO2 - List the steps required to complete each phase in Design Thinking process. **(K1)**
CO3 - Apply each phase in the Design Thinking process. **(K3)**
CO4 - Apply doodling and storytelling in presenting ideas and prototypes. **(K3)**
CO5 - Create value proposition statements in presenting the ideas. **(K3)**

UNIT-I INTRODUCTION TO DESIGN THINKING (9 Hrs)

Introduction to design thinking - Meaning and Importance of design thinking for business - Design thinking process – Five Step Stanford Model – Classroom activity – Case study.

UNIT-II EMPATHIZE PHASE (9 Hrs)

Steps involved - Touch the target Activity - Moccasin Walk Activity - Immersion activity - Case study.

UNIT-III DEFINE PHASE (9 Hrs)

Creation of personas - Problem statement defining, creation - Problem statement definition – Activities - Case Study.

UNIT-IV IDEATION PHASE (9 Hrs)

Ideation process - Ideation games - Ideate to find solutions - Doodling - Storytelling in design thinking - Case Study.

UNIT-V PROTOTYPE AND TESTING (9 Hrs)

Importance of prototype - Stages - Importance - Guidelines - Prototyping the idea - Group Activity - Value proposition statement - Testing in design thinking - Testing the Prototype - Documentation - Design thinking in functional work – Delivering customer satisfaction through Agile and Design Thinking - Case Study.

Text Books

1. Eyal, N. (2014). Hooked: How to build habit-forming products. Penguin.
2. Judkins, R. (2015). The art of creative thinking. Hachette UK.
3. Senor, D., & Singer, S. (2011). Start-up nation: The story of Israel's economic miracle. Random House Digital, Inc.

Reference Books

1. Sinek, S. (2009). Start with why: How great leaders inspire everyone to take action. Penguin.
2. Brown, T., & Katz, B. (2019). Change by design: How design thinking transforms organizations and inspires innovation (Vol. 20091). New York, NY: HarperBusiness.
3. Lee, D. (2018). Design thinking in the classroom: Easy-to-use teaching tools to foster creativity, encourage innovation, and unleash potential in every student. Simon and Schuster.
4. Shrutin N Shetty (2018). Design the Future: Simplifying Design Thinking to Help You. Notion Press.com

Web References

1. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process (Interaction Design Foundation)
2. https://voltagecontrol.com/blog/8-great-design-thinking-examples/ (Good examples of design thinking)
3. https://careerfoundry.com/en/blog/ux-design/design-thinking-examples/ (Good examples of design thinking)
4. https://justcreative.com/design-thinking-101/ (Design thinking 101: Principles, Tools & Examples to transform your creative process)
5. https://youtu.be/7oPZg_FR-ys (Understanding Design thinking WF NEN)
6. https://youtu.be/ir3E-TEUk48 (Design Thinking and Innovation at Apple Wei Li)
7. https://youtu.be/vSuK2C89yjA (Stanford Webinar- Design Thinking = Method, Not Magic)
8. https://youtu.be/pmjyZPibH14 (Stanford Design Thinking Virtual Crash Course)
9. https://youtu.be/5MFZTOK3e7s (So Many Uses- activity to spark creativity and design)

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	2	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	2	-	-
5	3	2	1	1	-	-	-	-	-	-	-	-	2	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT509	SOFTWARE DESIGN WITH UML	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Understand the object-oriented software development process
- To Design suitable pattern to develop software models
- To Analyze requirements to create requirements design model
- To Apply business modeling and modeling languages to design software
- To Develop correct and robust software deployment models

Course Outcomes

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

CO1 - Decide a suitable software model for a project **(K2)**

CO2 - Describe how to model object-oriented languages **(K2)**

CO3 - Design a project business model **(K3)**

CO4 - Elicit requirements and design a user interface model **(K2)**

CO5 - Create a deployment model **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Software development process: The Waterfall Model vs. The Spiral Model - The Software Crisis, description of the real world using the Objects Model. - Classes, inheritance and multiple configurations. - Quality software characteristics - Description of the Object-Oriented Analysis process vs. the Structure Analysis Model.

UNIT II UML LANGUAGE AND DESIGN PATTERNS **(9 Hrs)**

Standards - Elements of the language. - General description of various models -The process of Object-Oriented Software development. - Description of Design Patterns - Technological Description of Distributed Systems.

UNIT III BUSINESS MODEL DIAGRAMS **(9 Hrs)**

Requirements Analysis Using Case Modeling - Analysis of system requirements - Actor definitions. - Writing a case goal - Use Case Diagrams. - Use Case Relationships.

Dynamic Model: State Diagram / Activity Diagram- Description of the State Diagram - Events Handling - Description of the Activity Diagram - Exercise in State Machine - Case studies to implement in design lab.

UNIT IV LOGICAL VIEW DESIGN DIAGRAMS **(9 Hrs)**

Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams - Description of goal -Defining UML Method, Operation, Object Interface, Class - Sequence Diagram - Finding objects from Flow of Events - Describing the process of finding objects using a Sequence Diagram - Describing the process of finding objects using a Collaboration Diagram – Mapping use case to sequence diagram

The Static Structure Diagrams. -The Class Diagram Model - Attributes descriptions - Operations descriptions - Connections descriptions in the Static Model - Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity- Case studies to implement in design lab.

UNIT V TECHNICAL STACK DIAGRAMS **(9 Hrs)**

Package Diagram Model - Description of the model. - White box, black box - connections between packagers - Interfaces - Create Package Diagram - Drill Down - Component Diagram Model - Physical Aspect – Logical Aspect - Connections and Dependencies - User face - Initial DB design in a UML environment.

Deployment Model - Processors - Connections - Components - Tasks - Threads- Signals and Events. – Mapping class diagram to create skeleton code to implement - Case studies to implement in design lab.

Text Books

1. Bernd Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering: using UML, Patterns, and Java,Third Edition, Pearson, 2010.
2. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Addison Wesley, 1994.
3. Grady Booch, Robert Maksimchuk, Michael Engle, Bobbi Young Ph.D. (Author), Jim Conallen Kelli Houston,Object-Oriented Analysis and Design with Applications,Addison-Wesley,2007

Reference Books

1. Craig Larman, “Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development”, 3rd Edition, Pearson Education, 2005.
2. Simon Bennett, Steve Mc Robb and Ray Farmer, “Object Oriented Systems Analysis and Design Using UML”, Fourth Edition, Mc-Graw Hill Education, 2010
3. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, Third edition, Addison Wesley, 2003

Web References

1. https://www.javatpoint.com/software-engineering-software-design
2. https://www.tutorialspoint.com/software_engineering/software_design_basics.htm
3. https://www.javatpoint.com/software-engineering-software-design
4. https://onlinecourses.nptel.ac.in/noc20_cs84/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	2	1	-
2	2	1	-	-	3	-	-	-	-	-	-	-	2	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
4	2	1	-	-	3	-	-	-	-	-	-	-	3	2	1
5	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT510	COMPILER DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand various phases of compiler design
- Learn to understand the relation between regular expression and finite automata
- Learn to apply various paring techniques to construct syntactical analyzer
- To demonstrate intermediate code using technique of syntax directed translation
- To Illustrate the various optimization techniques for designing various optimizing compilers
- Understand compilation process of Object Oriented features and non-imperative programming languages

.

Course Outcomes

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

CO1 – Understand and explain different phases of compilation process **(K2)**
CO2 – Implement a lexical analyzer from a specification of a language's lexical rules **(K3)**
CO3 –Understand context-free grammar and top down and bottom up parsing techniques **(K2)**
CO4 – Implement syntactical analyzer using various parsing techniques **(K3)**
CO5 - Design syntax directed translation schemes for a given context free grammar **(K3)**
CO6 - Apply optimization techniques to intermediate code and generate machine code for high level language program **(K3)**
CO7 -Understand the structures and support required for compiling advanced language features **(K2)**

UNITI INTRODUCTION (9 Hrs)

Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).

UNIT II SYNTAX ANALYSIS (9 Hrs)

Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

UNIT III SEMANTIC ANALYSIS AND SYMBOL TABLE (9 Hrs)

Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree
Basic structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, scope.

UNIT IV INTERMEDIATE CODE GENERATION AND CODE IMPROVEMENT (9 Hrs)

Translation of different language features, different types of intermediate forms.
Control-flow, data-flow dependence etc.; local optimization, global optimization, loop optimization, peep-hole optimization etc.

UNIT V ARCHITECTURE DEPENDENT CODE IMPROVEMENT (9 Hrs)

Instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

Text Books

1. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, “Compilers – Principles, Techniques and Tools”, Second Edition, Pearson Education, 2007.
2. Kenneth C. Louden (1997), Compiler Construction– Principles and Practice, 1st edition, PWS Publishing.
3. K. L. P Mishra, N. Chandrashekaran (2003), Theory of computer science- Automata Languagesand computation, 2nd edition, Prentice Hall of India, New Delhi, India.

Reference Books

1. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence-based Approach”, First Edition, Morgan Kaufmann Publishers, 2002..
2. Steven S. Muchnick, “Advanced Compiler Design and Implementation”, First Edition, Morgan Kaufmann publishers, 2003.
3. D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, “Modern Compiler Design”, Wiley, 2008
4. Allen I. Holub, “Compiler Design in C”, Prentice Hall of India, 2003.

Web References

1. https://www.tutorialspoint.com/compiler_design/
2. https://www.javatpoint.com/compiler-tutorial
3. https://www.geeksforgeeks.org/introduction-of-compiler-design/ 4. https://nptel.ac.in/courses/106/105/106105190/
5. https://www.guru99.com/compiler-design-tutorial.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP507	SOFTWARE DESIGN WITH UML LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To analyze and identify the various requirements of software
- To plan the project development using project management tools
- To Analyze requirements to create use case and interaction diagram
- To design the projects using class, object and component diagrams
- To learn about the creation of deployment model

Course Outcomes

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

CO1 – Analyze the software requirements using Specification techniques **(K3)**

CO2 – Planning the project development using various project management tool **(K3)**

CO3 - Elicit requirements and design a user interface model (**K3)**

CO4 – Construct software design using class, object and component diagrams **(K3)**

CO5 - Create a deployment model for given requirement **(K3)**

List of Experiments

1. Requirements Engineering
2. Writing Problem Statement
3. Writing Requirement Specification
   a. SRS
   b. Use Case
4. Planning Project with PERT Diagram
5. Designing Project
   - Use Case Diagrams
   - Sequence and collaboration Diagrams
   - State chart Diagrams and Activity Diagrams
   - Class and Object Diagrams
   - Component Diagrams and Deployment Diagrams
6. Mapping Design to code

Reference Books

1. Grady Booch, Robert Maksimchuk, Michael Engle, Bobbi Young Ph.D. (Author), Jim Conallen Kelli Houston,Object-Oriented Analysis and Design with Applications,Addison-Wesley,2007
2. Craig Larman, “Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development”, 3rd Edition, Pearson Education, 2005.
3. Simon Bennett, Steve Mc Robb and Ray Farmer, “Object Oriented Systems Analysis and Design Using UML”, Fourth Edition, Mc-Graw Hill Education, 2010
4. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, Third edition, Addison Wesley, 2003

Web References

1. https://www.ibm.com/support/pages/ibm-rational-rose-enterprise-7004-ifix001

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
4	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
5	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

		L	T	P	C	H
U20CBP508	COMPILER DESIGN LABORATORY	0	0	2	1	30

Course objectives

- To understand the concepts of lexical analyzer.
- To learn about the LEX for designing application.
- To explore about the expression identification.
- To know about the expression evaluation.
- To study about code optimization Techniques

Course Outcomes

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

CO1 – Implement lexical analyzer **(K3)**
CO2 – Design application using LEX **(K3)**
CO3 - Identify expression using LEX and YACC **(K3)**
CO4 - Evaluate expression using LEX and YACC **(K3)**
CO5 - Implement Code Optimization Techniques **(K3)**

LIST OF EXPERIMENTS

1. Implement a lexical analyzer to recognize tokens in C. (Ex. identifiers, constants, operators, keywords etc.).
2. Design a Calculator using LEX.
3. Identify an arithmetic expression using LEX and YACC.
4. Evaluate expression that takes digits, *, + using YACC.
5. Generate Three address codes for a given expression (arithmetic expression, flow of control).
6. Implement Code Optimization Techniques like copy propagation, dead code elimination, common sub expression elimination.
7. Generate Target Code (Assembly language) for the given set of Three Address Code..

Text Books

1. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, “Compilers – Principles, Techniques and Tools”, Second Edition, Pearson Education, 2007.
2. Kenneth C. Louden (1997), Compiler Construction– Principles and Practice, 1st edition, PWS Publishing.
3. K. L. P Mishra, N. Chandrashekaran (2003), Theory of computer science- Automata Languagesand computation, 2nd edition, Prentice Hall of India, New Delhi, India.

Reference Books

1. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence-based Approach”, First Edition, Morgan Kaufmann Publishers, 2002..
2. Steven S. Muchnick, “Advanced Compiler Design and Implementation”, First Edition, Morgan Kaufmann publishers, 2003.
3. D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, “Modern Compiler Design”, Wiley, 2008
4. Allen I. Holub, “Compiler Design in C”, Prentice Hall of India, 2003.

Web References

1. https://www.tutorialspoint.com/compiler_design/
2. https://www.javatpoint.com/compiler-tutorial
3. https://www.geeksforgeeks.org/introduction-of-compiler-design/ 4.

https://nptel.ac.in/courses/106/105/106105190/

5. https://www.guru99.com/compiler-design-tutorial.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP509	MINI PROJECT	L	T	P	C	H
		0	0	2	1	30

Course objectives

To understand the application of case tools, which focuses on the following software engineering activities:

- Software requirements analysis and specification
- Software design
- Software implementation
- Software testing and maintenance
- Communication skills and teamwork

Course Outcomes

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

CO1 – Solve any given problem by identifying appropriate Domain/Area **(K3)**
CO2 – Prepare SRS for projects **(K3)**
CO3 – Prepare SDS for projects **(K3)**
CO4 – Developing application using any known implementation platform **(K3)**
CO5 – Prepare testing report for projects **(K3)**

LIST OF EXPERIMENTS

Students in convenient groups of not more than three members in a group are to take up sample project development activities with the guidelines given below using some of the Computer Aided Software Engineering Tools (CASE):

- Preparing a project – brief proposal including
  - Problem Identification
  - Developing a model for solving the problem
  - A statement of system / process specifications proposed to be developed (Data Flow
  - Diagram)
  - List of possible solutions including alternatives and constraints
  - Cost benefit analysis
  - Time line activities
- A report highlighting the design finalization [based on functional requirements & standards
- (if any)]
- A presentation including the following
  - Implementation phase (Hardware / Software / both)
  - Testing & Validation of the developed system
  - Learning in the project
- Consolidated report preparation

Text Books

1. Roger S. Pressman," Software Engineering – A Practitioner's Approach", Seventh edition, 2010
2. Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino," Fundamentals of Software Engineering", second edition,2002
3. SrinivasanDesikan and Gopalaswamy Ramesh, " Software Testing – Principles and Practices", Pearson education, 2006..

Reference Books

1. Bernd Bruegge and Allen H. Dutoit, Object-Oriented Software Engineering: using UML, Patterns, and Java,Third Edition, Pearson, 2010.
2. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Addison Wesley, 1994
3. AdityaP.Mathur, “Foundations of Software Testing”, Pearson Education, 2008.Allen I. Holub, “Compiler Design in C”, Prentice Hall of India, 2003.

Web References

1. http://vlabs.iitkgp.ernet.in/se/
2. https://www.ibm.com/support/pages/ibm-rational-rose-enterprise-7004-ifix001l

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST610	BUSINESS COMMUNICATION & VALUE SCIENCE - IV	L	T	P	C	H
		1	0	2	2	30

Course Objectives

- To recognize the importance of diversity in workplace and practise communicative writing
- To understand the significance of emotional intelligence in personal and professional lives
- To identify the prominence of corporate social responsibility as well as corporate etiquettes
- To distinguish the best practices to share and receive feedback and manage conflicts
- To know how stress impacts life and learn to manage stress and time

Course Outcomes

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

CO1 - Understand the importance of diversity in workplace **(K2)**
CO2 - Apply emotional intelligence in real life scenarios **(K2)**
CO3 - Remember the attributes needed to function and grow in a corporate environment **(K1)**
CO4 – Recall the best practices to share and receive feedback **(K3)**
CO5 – Comprehends how stress impacts life and work **(K1)**

UNIT – I DIVERSITY IN WORK PLACE (9 Hrs)

Diversity - Importance of diversity in workplace- Discussion - role plays - communicative writing: Principles of Communicative Writing – letters- types-Formal and Business letters, Proposal - templates for writing proposal - create a business proposal, charts and graphs in communicative writing: Tell a story with charts and graphs

UNIT – II EMOTIONAL INTELLIGENCE (9 Hrs)

Define - importance of emotional intelligence in personal and professional lives - 10 Ways to Build EI by Daniel Goleman – Need for public speaking – Importance - public speaking at workplace – Swami Vivekananda's Chicago speech - Steve Jobs' first iPhone launch -Martin Luther King Jr (I have a dream…)- Apply public speaking in real life scenarios - Group Discussion - sell your start-up ideas - group to pitch their start-up idea to a panel

UNIT-III CORPORATE SOCIAL RESPONSIBILITY (9 Hrs)

Importance of corporate social responsibility - Ubuntu story - Recognize some of the stalwarts in CSR-Meeting of JNT and Swami Vivekananda, Societal connect of JNT. Stalwarts in CSR (Led by Tatas), Tata Group CSR stories --- from Titan and Tata Chemicals . Attributes needed to function and grow in a corporate environment: Resilience - Flexibility - Strategic thinking and planning - Decision making - Resolving conflicts.

UNIT – IV LEARNING STYLES IN INTERPERSONAL INTERACTIONS (9 Hrs)

Who am I? - Participant to reflect upon the questions - Examination Result Activity - Locus of control - Scenario –Students reaction on mock grades in an examination, Role play on feedback - teachers discuss with students sharing their feedback on their reactions - tips to receive and give feedback - Activity for applying Emotional Intelligence using scenarios within each start-up group.

UNIT – V MULTIPLE INTELLIGENCE (9 Hrs)

Conflicts - Understanding conflicts - scenario : conflicts in work place - manage conflicts at work - Corporate etiquette : Mock interview followed by discussions on corporate etiquette - Business idioms and Corporate Terms - Managing Stress **-** Brainsmart – BBC (2:24 mins) - impact of stress in life and work - The Long-term Effects of Stress (5 mins) - stress impacts health- Tips to manage stress - Time management - importance of time management - Managing your time better - A valuable lesson for a happy life(video)- participants to identify the rocks, pebbles and sands in their life. Time Squared Activity

PROJECT

Each group to create a POC (Proof of Concept) for their start-up applying their learning from the CSBS course (core subjects + BCVS)

Reference Books

1. Daniel Goleman, Emotional Intelligence: Why it can Matter More Than IQ, Publisher: Kindle Edition, 27 September 2005
2. Ryback David, Putting Emotional Intelligence to Work, Publisher: Kindle Edition, 2 December 1997
3. Dale Carnegie, How to Develop Self Confidence and Improve Public Speaking - Time - Tested Methods of Persuasion, Publisher: Kindle Edition, 1 July 2017
4. Chris Anderson, TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations, Nicholas Brealey Publishing, 4 January 2018.

Web References

1. https://www.tata.com/about-us/tata-group-our-heritage
2. https://economictimes.indiatimes.com/tata-success-story-is-based-on-humanity-philanthropy-and- ethics/articleshow/41766592.cms
   https://www.amazon.in/Putting-Emotional-Intelligence-Work-Successful/dp/0750699566
3. https://www.verywellmind.com/gardners-theory-of-multiple-intelligences-2795161
4. https://thecsrjournal.in/top-indian-companies-for-csr-in-2020/

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST611	FINANCIAL AND COST ACCOUNTING	L	T	P	C	Hrs
		2	0	0	2	30

Course Objectives

- To make the student conversant with Fundamentals of Accounting and its process.
- To make the student familiar with the preparation of final Accounts.
- To empower them with deeper understanding on Fund flow and Cash flow Statement.
- To familiarise the student with the key analyses for cost and their applications in real case studies.
- To provide them with the understanding on the role of Financial Statements given in an annual report of a corporate entity.

Course Outcomes

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

CO1 - Understand the Fundamentals of Accounting and its processes. **(K2)**
CO2 –Understand accounting cycle and gain knowledge about final accounts preparation (K2)
CO3 - Construct funds and cash flow statements and interpret them meaningfully. **(K3)**
CO4- Understand the cost concepts and their application in costing estimates. **(K2)**
CO5 –Evaluate the financial statements given in an annual report of a corporate entity. **(K5)**

UNIT-I ACCOUNTING CONCEPTS AND PROCESS (6 Hrs)

Definition of Accounting – Accounting Principles- Accounting concepts and conventions – Accounting standards- Branches of Accounting - Book Keeping - Double Entry System- Accounting equation- Types of Accounts – Groups interested in Accounting information.

UNIT- II ACCOUNTING CYCLE AND FINAL ACCOUNTS (6 Hrs)

Asset and Liability –Types - Accounting Cycle – Journal – Ledger - Trial Balance – Final Accounts - Trading, P & L - Balance sheet - (Simple Problem)- Annual Reports - Rectification of Errors - Subsidary Books – Practical's using Tally

UNIT- III FINANCIAL STATEMENT ANALYSIS (6 Hrs)

Financial Statements- Meaning- Types and Techniques- Comparative statement- Common size statement - Trend analysis – Ratio Analysis. Funds Flow Analysis – Concept of Funds and Flow – Statement of Changes in Working Capital – Funds From Operations – Funds Flow Statement – Uses and Limitations of Funds Flow Statements. Cash Flow Analysis – Meaning and Significance of Cash Flow Statements. Preparation of Cash Flow Statement as per Accounting Standard 3 – Format. Uses and Limitations of cash flow analysis (Practical Problems) – Application of Tally in Financial Statement Analysis

UNIT- IV COST ACCOUNTING (6 Hrs)

Definition and Meaning of Cost Accounting- Elements of Cost - Cost behaviour- Cost allocation- Over Head allocation- Types - Unit Costing- Job Costing- Process Costing-Marginal Costing- absorption Costing-Preparation of Cost Sheet (Simple Problems) - Application of Costing Concept in the Service Sector (Case Study) - ABC analysis.

UNIT-V BUDGETS AND ANNUAL REPORTS (6 Hrs)

Definition of Budget - Need for Business Budgeting - Forecast and a Budget- Budgeting and budgetary Control- Meaning of Annual Reports- Statutory Requirements- Directors Report - Auditors Report - Notes to Accounts - Pitfalls in accounts.

Text Books

1. T.S. Reddy and Y. Harim Prasad Reddy, Financial and Management Accounting- Margham Publications
2. S.P. Iyengar , Cost and Management Accounting , S. Chand
3. The Case Study Handbook, Revised Edition: A Student's Guide Paperback –Wiiliam Ellate

Reference Books

1. Robert Libby , patrica Libby and Daniel short ,Financial Accounting with Annual report- Mcgraw Hill Education.
2. Charles T. Horngren, Gary L. Sundem, Jeff O. Schatzberg & Dave Burgstahler. Introduction to Management Accounting. Prentice Hall India.
3. Drury Colin. Management and Cost Accounting. International Thomson Business Press, London.
4. Jan Williams, Financial and Managerial Accounting – The basis for business Decisions. Tata McGraw Hill Publishers.
5. Stice & Stice, Financial Accounting Reporting and Analysis. Cengage Learning
6. Ravi M. Kishore. Cost and Managerial Accounting. Taxmann Publishers, New Delhi. 2018

Web Resources

1. https://icmai.in/icmai/contact_us.php
2. https://home.kpmg/in/en/home/services/advisory/management-consulting/financial-management/cost-accounting-management.html
3. https://www.accounting.com/
4. https://www.erpgreat.com/general/case-study-financial-and-cost-accounting.htm
5. https://www.hzu.edu.in/uploads/Case_Studies_of_Cost_and_Works_Accounting.pdf

COs/POs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
2	1	2	1	-	-	-	1	-	-	-	-	-	1	1	-
3	1	2	1	1	-	-	1	-	-	-	1	-	1	1	-
4	1	2	2	1	-	-	1	-	-	1	-	-	1	1	-
5	1	2	1	1	-	-	1	-	-	1	-	-	1	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT611	COMPUTER NETWORKS	L	T	P	C	HRS
		3	0	0	3	45

Course Objectives

- To understand the concepts of computer networks and learn techniques for bandwidth utilization
- To study about the various error detection-correction of data and flow control mechanisms
- To Learn the network layer concepts and its protocols
- To introduce the concepts of transport layer concepts and its protocols
- To understand about the application layer concepts and its security.

.

Course Outcomes

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

CO1 – Demonstrate computer network concepts and bandwidth utilization techniques. **(K2)**
CO2 – Analyze the error detection-correction of data and flow control mechanisms. **(K3)**
CO3 – Use of network layer protocols for real time data transmission. **(K3)**
CO4 – Use of transport layer protocols for real time data transmission. **(K3)**
CO5 – Understand the concepts application layer and its security. **(K2)**

UNITI INTRODUCTION TO DATA COMMUNICATION NETWORKS (9 Hrs)

Introduction: Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures.
Data communication Components: Representation of data and its flow, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media.
LAN: Wired LAN, Wireless LAN, Virtual LAN
Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

UNIT II DATA LINK LAYER AND MEDIUM ACCESS SUB LAYER (9 Hrs)

Fundamentals of Error Detection and Error Correction, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go-back–N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA

UNIT III NETWORK LAYER (9 Hrs)

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP– Delivery, Forwarding and Unicast Routing protocols.

UNIT IV TRANSPORT LAYER (9 Hrs)

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving techniques - Leaky Bucket and Token Bucket algorithms.

UNIT V APPLICATION LAYER AND ITS SECURITY (9 Hrs)

DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls.
Electronic mail, directory services and network management, Basic concepts of Cryptography.

Text Books

1. Andrew S. Tanenbaum and David J. Wetherall, “Computer Networks”, 5th edition, Pearson education, 2016.
2. William Stallings, “Data and Computer Communication”, 10th edition, Pearson education, 2017.
3. Behrouz A .Forouzan, Data communication and Networking, 5thEdition, Mc Graw-Hill, India, 2014 .

Reference Books

1. Kaufman, R. Perlman and M. Speciner, “Network Security”, Pearson education, 2017.
2. W. Richard Stevens, “UNIX Network Programming, Vol. 1,2 & 3”, Prentice-Hall of India, 2004..
3. Davie Bruce S. and Peterson Larry L., “Computer Networks - A System Approach”, 5th Edition, Morgan Kaufmann, 2012, Elsevier Inc

Web References

1. https://nptel.ac.in/courses/106/105/106105183/
2. https://www.javatpoint.com/computer-network-tutorial
   https://www.tutorialspoint.com/data_communication_computer_network/
3. https://www.geeksforgeeks.org/computer-network-tutorials/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT612	INFORMATION SECURITY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the overview of computer security.
- To understand the Access control models and security policies.
- To understand techniques of system security.
- To learn about various applications of system security.
- To learn about operating system and database security..

Course Outcomes

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

CO1 – Understand the fundamentals of computer security (K2)
CO2 - Describe the various access control models and security policies (K2)
CO3 - Apply the concepts of system design (K3)
CO4 - Use of logic based system to protect from intruders (K3)
CO5 – Understand about the operating system and database security (K3)

UNIT I OVERVIEW OF INFORMATION SECURITY (9 Hrs)

Overview of Security Parameters: Confidentiality, integrity and availability; Security violation and threats; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and Operational Issues; Security Life Cycle.

UNIT II ACCESS CONTROL MODELS AND SECURITY POLICIES (9 Hrs)

Access Control Models: Discretionary, mandatory, roll-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models.
Security Policies: Confidentiality policies, integrity policies, hybrid policies, non-interference and policy composition, international standards

UNIT III SYSTEM DESIGN (9 Hrs)

Design principles, representing identity, control of access and information flow, confinement problem. Assurance: Building systems with assurance, formal methods, evaluating systems**.**

UNIT IV LOGIC-BASED SYSTEM (9 Hrs)

Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications: Network security, operating system security, user security, program security. Special Topics: Data privacy, introduction to digital forensics, enterprise security specification**.**

UNIT V OPERATING SYSTEMS AND DATABASE SECURITY (9 Hrs)

Operating Systems Security: Security Architecture, Analysis of Security in Linux/Windows.
Database Security: Security Architecture, Enterprise security, Database auditing**.**

Text Books

1. Ross Anderson, “Security Engineering: A Guide to Building Dependable Distributed Systems”, Third Edition, Wiley, 2021.
2. M. Bishop, “Computer Security: Art and Science”, 2nd Edition, Pearson Education, 2019.
3. M. Stamp, “Information Security: Principles and Practice”, 2nd Edition, Wiley, 2011..

Reference Books

1. C.P. Pfleeger, S.L. Pfleeger, J. Margulies, “Security in Computing”, 5th Edition, Prentice Hall, 2015.
2. David Wheeler, “Secure Programming HOW TO”, v3.010 Edition, 2003.
3. Michael Zalewski, “Browser Security Handbook”, Google Inc., 2009.
4. M. Gertz, S. Jajodia, “Handbook of Database Security”, Springer, 2008.

Web References

1. https://nptel.ac.in/courses/106/106/106106129/
2. https://www.omnisecu.com/security/index.php
3. https://www.w3schools.com/cybersecurity/index.php
4. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Byte_Karma/index.html
5. https://www.javatpoint.com/cyber-security-tutorial

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT613	ARTIFICIAL INTELLIGENCE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Study the Concepts of Artificial Intelligence.
- To learn the methods of solving problems using Artificial Intelligence.
- To learn logics to represent knowledge and techniques to infer the knowledge for any problem domain
- To identify various types of reasoning under uncertain problem domain
- To introduce the concepts of Expert Systems and planning strategies.

.

Course Outcomes

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

CO1 - Understand agent and environment (K2)
CO2 - Recognize appropriate search algorithms for any AI problem (K2)
CO3 - Represent and inferring knowledge in propositional and predicate logic (K2)
CO4 - Apply various reasoning techniques in uncertain domain (K3)
CO5 - Use various Planning strategies to solve a problem (K3)
CO6 –Understand knowledge representation and acquisition in Expert system (K2)

UNIT I OVERVIEW OF ARTIFICIAL INTELLIGENCE AND PROBLEM SOLVING (9 Hrs)

Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

UNIT II SEARCH TECHNIQUES (9 Hrs)

Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search

UNIT III KNOWLEDGE & REASONING (9 Hrs)

Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge**.**

UNIT IV UNCERTAINTY (9 Hrs)

Reasoning Under Uncertainty:Inference - Probabilistic inference - Types of Reasoning- Expectation Maximization - Bayesian networks - Hidden Markov models - Reasoning Systems for Categories - Reasoning with Default Information**.**

UNIT V PROBABILISTIC REASONING AND EXPERT SYSTEMS (9 Hrs)

Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques

Representing and using domain knowledge, expert system shells, and knowledge acquisition**.**

Text Books

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2009.
2. Deepak Khemani “Artificial Intelligence”, Tata McGraw Hill Education 2013.
3. Joseph C. Giarratano, Gary D. Riley,”Expert Systems: Principles and Programming”, Fourth Edition, Cengage, 2007.

Reference Books

1. Ritch & Knight, ”Artificial Intelligence”, Third Edition, Tata McGraw Hill, 2009..
2. Patterson, “Introduction to Artificial Intelligence & Expert Systems”, First Edition, Pearson, 2015.
3. Saroj Kaushik, “Logic & Prolog Programming”, First Edition, New Age International, 2008..

Web References

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://www.javatpoint.com/artificial-intelligence-tutorial
3. https://www.tutorialspoint.com/artificial_intelligence/index.htm
4. https://www.guru99.com/artificial-intelligence-tutorial.html
5. https://data-flair.training/blogs/ai-tutorials-home/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

		L	T	P	C	H
U20CBP610	COMPUTER NETWORKS LABORATORY	0	0	2	1	30

Course Objectives

- To understand the basics of networking commands and network configuration
- To study about the subnet Masking and setting up local area network
- To Learn about the socket programming
- To implement the sliding window protocol
- To simulate the Address Resolution Protocol(ARP) .

.

Course Outcomes

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

CO1 – Configure network using commands. **(K2)**
CO2 – Implement subnet masking and setting up local area network. **(K3)**
CO3 – Implement socket programming using TCP and UDP protocols. **(K3)**
CO4 – Simulate sliding window protocol. **(K3)**
CO5 – Implement address resolution protocol. **(K2)**

LIST OF EXPERIMENTS

1. Learn to use basic commands
2. Configuration of Network in Linux Environment.
3. Assignment of IP Address to computers.
4. Implementation of Subnet mask in IP addressing.
5. Implementation of setup of a Local Area Network (using Switches) – Minimum 3 nodes and Internet
6. To capture, save, and analyse network traffic on TCP / UDP / IP / HTTP / ARP /DHCP /ICMP /DNS using Wireshark Tool.
7. Write a socket PING program to test the server connectivity.
8. Study of system administration and network administration
9. Study of socket programming and client server model using TCP and UDP.
10. Programs using TCP Sockets (like date and time server & client, echo server & client, chat etc.)
11. Programs using UDP Sockets (like echo server, chat, simple DNS).
12. Simulation of sliding window.
13. Implementation of ARP..

Text Books

1. Andrew S. Tanenbaum and David J. Wetherall, “Computer Networks”, 5th edition, Pearson education, 2016.
2. William Stallings, “Data and Computer Communication”, 10th edition, Pearson education, 2017.
3. Behrouz A .Forouzan, Data communication and Networking, 5thEdition, Mc Graw-Hill, India, 2014

.

Reference Books

1. Kaufman, R. Perlman and M. Speciner, “Network Security”, Pearson education, 2017.
2. W. Richard Stevens, “UNIX Network Programming, Vol. 1,2 & 3”, Prentice-Hall of India, 2004..
3. Davie Bruce S. and Peterson Larry L., “Computer Networks - A System Approach”, 5th Edition, Morgan Kaufmann, 2012, Elsevier Inc

Web References

1. http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php
2. http://vlabs.iitkgp.ernet.in/ant/
3. https://www.javatpoint.com/computer-network-tutorial
   https://www.tutorialspoint.com/data_communication_computer_network/
4. https://www.geeksforgeeks.org/computer-network-tutorials/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP611	INFORMATION SECURITY LABORATORY	L	T	P	C	H
		0	0	2	1	30

Course objectives

- To learn about security concerns of different operating systems
- To monitor and assign privileges to users
- To understand the IT audit, malware analysis and vulnerability assessment
- To learn about the mobile audit and digital forensics
- To know about the basics of web vulnerabilities

Course Outcomes

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

CO1 – Analysis the security in different operating systems **(K3)**
CO2 – Administrate the different users, setting up privileges and roles **(K3)**
CO3 – Implement IT audit, Malware analysis and perform vulnerability assessment **(K3)**
CO4 – Implement mobile audit and digital forensics tools for disk imaging, data acquisition, data extraction and data analysis and recovery **(K3)**
CO5 – Identify web vulnerabilities **(K3)**

LIST OF EXPERIMENTS

1. Analysis of security in Unix/Linux.
2. Administration of users, password policies, privileges and roles.
3. Implementation of discretionary access control and mandatory access control.
4. Demonstrate intrusion detection system (ids) using any tool Eg. Snort or any other software.
5. Implementation of IT audit, malware analysis and vulnerability assessment and generate the report.
6. Implementation of mobile audit and generate the report of the existing artifacts.
7. Implementation of OS hardening and RAM dump analysis to collect the artifacts and other information.
8. Implementation of digital forensics tools for disk imaging, data acquisition, data extraction and data analysis and recovery.
9. Perform mobile analysis in the form of retrieving call logs, SMS log, all contacts list using the forensics tool like SAFT.
10. Implementation to identify web vulnerabilities, using OWASP project.

Text Books

1. Ross Anderson, “Security Engineering: A Guide to Building Dependable Distributed Systems”, Third Edition, Wiley, 2021.
2. M. Bishop, “Computer Security: Art and Science”, 2nd Edition, Pearson Education, 2019.
3. M. Stamp, “Information Security: Principles and Practice”, 2nd Edition, Wiley, 2011..

Reference Books

1. C.P. Pfleeger, S.L. Pfleeger, J. Margulies, “Security in Computing”, 5th Edition, Prentice Hall, 2015.
2. David Wheeler, “Secure Programming HOW TO”, v3.010 Edition, 2003.
3. Michael Zalewski, “Browser Security Handbook”, Google Inc., 2009.
4. M. Gertz, S. Jajodia, “Handbook of Database Security”, Springer, 2008.

Web References

1. https://nptel.ac.in/courses/106/106/106106129/
2. https://www.omnisecu.com/security/index.php
3. https://www.w3schools.com/cybersecurity/index.php
4. https://searchsecurity.techtarget.com/tutorial/Information-security-tutorials
5. https://www.javatpoint.com/cyber-security-tutorial

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP612	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C	H
		0	0	2	1	30

Course objectives

- To learn depth first search strategy to solve AI problems
- To understand about minimax and and A* algorithm
- To study various inference algorithm in PROLOG
- To learn about the various planning algorithms
- To understand about the various learning algorithm

Course Outcomes

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

CO1 - Use of search strategies to solve problems **(K3)**
CO2 – Implement of minimax and A* algorithm **(K3)**
CO3 - Implement inference algorithm using prolog **(K3)**
CO4 – Implement of planning algorithm **(K3)**
CO5 – Implement of learning algorithm **(K3)**

LIST OF EXPERIMENTS

1. **Programs on Problem Solving**
   a. Write a program to solve 8 Queens problem.
   b. Solve any problem using depth first search.
   c. Implement MINIMAX algorithm.
   d. Implement A* algorithm
2. **Programs on Decision Making and Knowledge Representation**
   a. Introduction to PROLOG
   b. Implementation of Unification and Resolution Algorithm.
   c. Implementation of Backward Chaining
3. **Programs on Planning and Learning**
   a. Implementation of Blocks World program.
   b. Implementation of SVM for an application using python.
   c. Implementing Artificial Neural Networks for an application using python.
   d. Implementation of Decision Tree
   e. Implementation of K-mean algorithm

Text Books

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2009.
2. Deepak Khemani “Artificial Intelligence”, Tata McGraw Hill Education 2013.
3. Joseph C. Giarratano, Gary D. Riley,”Expert Systems: Principles and Programming”, Fourth Edition, Cengage, 2007.

Reference Books

1. Ritch & Knight, ”Artificial Intelligence”, Third Edition, Tata McGraw Hill, 2009..
2. Patterson, “Introduction to Artificial Intelligence & Expert Systems”, First Edition, Pearson, 2015.
3. Saroj Kaushik, “Logic & Prolog Programming”, First Edition, New Age International, 2008..

Web References

1. https://levelup.gitconnected.com/mastering-tic-tac-toe-with-minimax-algorithm-3394d65fa88f
2. https://www.baeldung.com/java-a-star-pathfinding
3. https://www.geeksforgeeks.org/prolog-an-introductio
4. https://github.com/CoGian/Blocks_World
5. https://towardsdatascience.com/artificial-neural-network-implementation-using-numpy-and-classification-of-the-fruits360-image-3c56affa4491
6. https://www.section.io/engineering-education/k-means-from-scratch-r/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST712	FINANCIAL MANAGEMENT	L	T	P	C	H
		2	0	0	2	30

Course Objectives

- To understand the fundamental concepts of financial management.
- To gain knowledge of the valuation of securities.
- To appreciate basic concepts such as time value of money, cost of capital, risk, and return.
- To know about capital budgeting and working capital management.
- To Leverage the concept for deciding the financial angle of IT projects.

Course Outcomes

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

CO1 - Enables the budding Technocrat Managers to understand the Financial Management concepts and to appreciate the concepts of "time value of money" in the decision-making process. **(K2)**

CO2- Evaluates the Securities and know the concept of Risk and return. **(K3)**

CO3 - Evaluates the "Leverage" "cost of capital" & the projects using the Capital budgeting concepts. **(K3)**

CO4 - Understands the concepts of Capital components, their implications and Working Capital requirements. **(K2)**

CO5 - Analyze the Components of Working Capital. **(K4)**

UNIT – I INTRODUCTION (6 Hrs)

Introduction: Introduction to Financial Management - Goals of the firm - Financial Environments.

Time Value of Money: Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor

UNIT – II VALUATION OF SECURITIES / RISK & RETURN (6 Hrs)

Valuation of Securities: Bond Valuation, Preferred Stock Valuation, Common Stock Valuation, Concept of Yield and YTM.

Risk & Return: Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM), Practical Applications using MS Excel

UNIT-III LEVERAGE / COST OF CAPITAL (6 Hrs)

Operating & Financial Leverage: Operating Leverage, Financial Leverage, Total Leverage, Indifference Analysis in leverage study

Cost of Capital: Concept, Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital 4L

UNIT – IV CAPITAL BUDGETING AND WORKING CAPITAL MANAGEMENT (6 Hrs)

Capital Budgeting: The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Capital Budgeting Techniques, Project Evaluation, and Selection - Alternative Methods

Working Capital Management: Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Estimation of Working Capital.

UNIT – V CASH MANAGEMENT AND ACCOUNTS RECEIVABLE MANAGEMENT (6 Hrs)

Cash Management: Motives for Holding cash, Speeding Up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring.

Accounts Receivable Management: Credit & Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period.

Text Books

1. Chandra, Prasanna - Financial Management - Theory & Practice, Prentice Hall/Pearson Education.2019.
2. I.M. Pandey, Financial Management, Vikas Publishing House, 2016.
3. James C. Van Horne and John M. Wachowicz, Jr. Fundamentals of Financial Management. Prentice Hall – Financial Times, New York. (Latest available edition).

Reference Books

1. Eugene F. Brigham and Joel F. Houston. Fundamentals of Financial Management. Cengage Learning, New York. (Latest available edition).
2. Eugene F. Brigham and Michael C. Ehrhardt. Financial Management: Theory & Practice. Thomson Western Learning, New York. (Latest available edition).
3. Vishwanath. S.R. Corporate Finance: Theory and Practice. Sage Response, New Delhi. (2015 or later edition).
4. Bhabatosh Banerjee. Fundamentals of Financial Management. Prentice-Hall of India, New Delhi. (2015 or later edition).

Web References

1. https://www.khanacademy.org/economics-finance-domain/core-finance/interest-tutorial
2. https://efinancemanagement.com/financial-management/capital-budgeting-techniques-with-an-example
3. https://static.careers360.mobi/media/uploads/froala_editor/files/Dividend-Decisions.pdf
4. https://efinancemanagement.com/costing-terms/inventory-management-techniques
5. https://booksc.org/book/71927964/4e63e6
6. https://silo.tips/queue/working-capital-management-of-bajaj-auto-ltd-with-special-reference-to-automobil?&queue_id=-1&v=1626159679&u=MTA2LjIwMy41MC4xMzk=

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20HST713 HUMAN RESOURCE MANAGEMENT

L	T	P	C	H
2	0	0	2	30

Course Objectives

- Familiarize the basic concepts functional areas and activities of Human Resource Management.
- Understand the Functional areas of HRM concepts in an organizational context.
- Understand how to measure the Human Resources Forecasting.
- To develop relevant SHRM related issues in an organizational environment.
- Understand the components of HRM pertinent to the Service Sector.

Course Outcomes

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

CO1 - Understand the basic concepts of HRM. **(K2)**

CO2 - Understand the HR functions and activities in organizations. **(K2)**

CO3 - Align HRM activities with a real-time organizational environment. **(K1)**

CO4 - Comprehend Strategic Management of Human Resources and HR activities. **(K2)**

CO5 - Understand the impact of HR activities on the Service Sector. **(K2)**

UNIT – I HUMAN RESOURCE MANAGEMENT (6 Hrs)

Concept and Challenges, HR Philosophy, Policies, Procedures and Practices. Human Resource System Design**:** HR Profession, and HR Department, Line Management Responsibility in HRM, Human resources accounting and audit

UNIT – II FUNCTIONAL AREAS OF HRM (6 Hrs)

recruitment and staffing, benefits, compensation, employee relations, HR compliance, training and development, human resource information systems (H.R.I.S.), and payroll.

UNIT – III HUMAN RESOURCE PLANNING (6 Hrs)

Demand Forecasting, Practical Applications using SPSS software**,** Action Plans– Retention, Training, Redeployment & Staffing, Succession Planning

UNIT-IV STRATEGIC MANAGEMENT OF HUMAN RESOURCES (6 Hrs)

SHRM, the relationship between HR strategy and overall corporate strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace

UNIT – V HUMAN RESOURCE MANAGEMENT IN SERVICE SECTOR (6 Hrs)

Special considerations for Service Sector including

- Managing the Customer – Employee Interaction
- Employee Empowerment and Customer Satisfaction
- Service Failure and Customer Recovery – the Role of Communication and Training
- Similarities and Differences in Nature of Work for the Frontline Workers and the Backend
- Support Services - Impact on HR Practices Stressing Mainly on Performance
- Flexible Working Practices – Implications for HR

Text Books

1. Dessler G, Varkey B. Human Resource Management, 16th edition. Pearson Education India, 2020.
2. Joseph J. Martocchio, Human Resource Management, 15th edition, Pearson Education Champaign, 2019.
3. Mathis RL, Jackson JH. Human resource management, 15th edition, Jakarta: Salemba Empat, 2021.

Reference Books

1. Armstrong, M., & Taylor, S. Armstrong's handbook of human resource management practice. 15th Edition, Kogan Page Publishers, 2020.
2. Raymond A. Noe, John R. Hollenbeck, Gerhart, B., & Patrick M. Wright. Fundamentals of human resource management. 6th Edition, McGraw-Hill Higher Education, 2015.
3. Gary Dessler, Human Resource Management,15th edition, Pearson, 2017.

Web References

1. https://www.journals.elsevier.com/human-resource-management-review
2. https://swayam.gov.in/nd1_noc20_mg15/preview
3. http://www.sciencepublishinggroup.com/j/jhrm
4. https://journals.sagepub.com/home/hrm
5. https://www.hrdguru.com/
6. https://www.citehr.com/

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT714	USABILITY DESIGN OF SOFTWARE APPLICATIONS	L	T	P	C	Hrs
		2	0	0	2	30

Course Objectives

- To gain knowledge of the User Centered Design.
- To familiarize User Centric Design to the facets of User Experience (UX) Design.
- To design and develop applications with smart designs.
- To familiarize with the Research techniques of UX.
- To analyze and identify the methods to offer a better UI experience.

Course Outcomes

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

CO1 - Gain knowledge of the User Centered Design. **(K2)**
CO2 - Familiarize User Centric Design to the facets of User Experience (UX) Design. **(K2)**
CO3 - Design and develop applications with smart designs. **(K3)**
CO4 – Familiarize with the research techniques of UX. **(K2)**
CO5 - Analyze and identify the methods to offer a better UI experience. **(K3)**

UNIT I INTRODUCTION **(6Hrs)**

Introduction to User Centered Design - Basics of User Centered Design
Aspects of User Centered Design - Product Appreciation Assignment – Evaluating the product from user centered design aspects such as functionality, ease of use, ergonomics, and aesthetics.

UNIT II PRODUCT DESIGN LIFECYCLE **(6Hrs)**

Redesign project through the design lifecycle – Discovery - Define – Design - Implement (Design Prototype) - Usability Testing.

UNIT III PERSONAS, SCENARIOS, DEVELOPMENT AND PROTOTYPING **(6Hrs)**

Scenarios and Persona Technique – Overview of Design Thinking Technique - Discovery and Brainstorming.
Concept Development - Task flow detailing for the Project – Prototyping Techniques - Paper, Electronic, and Prototyping Tools.

UNIT IV UX RESEARCH **(6Hrs)**

Understanding users, their goals, context of use, and environment of use.
Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX.

UNIT V HEURISTIC EVALUATION **(6Hrs)**

10 Heuristic Principles, Examples Heuristic Evaluation: Group Assignment initiation (Website and App)Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.

Text Books

1. Jennifer Preece, Helen Sharp, Yvonne Rogers, “Interaction Design: Beyond Human-Computer Interaction”, 4th Edition, Wiley publications, 2015
2. Alan Cooper and Robert Riemann, “About Face The Essentials of Interaction Design”, 4th Edition, Wiley Publications,2014.
3. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, “Observing the User Experience - A Practitioner's Guide to User Research”, Second Edition, Morgan Kaufmann Publications,2012.

Reference Books

1. Jesse James Garrett, "The Elements of User Experience: User-Centered Design for the Web and Beyond - Voices That Matter" New Riders; 2nd edition, 2010
2. Jonny Schneide, Understanding Design Thinking, Lean, and Agile, O'Reilly Media, Inc. 2017
3. Everett N McKay, UI is Communication: How to Design Intuitive, User Centered Interfaces by Focusing on Effective Communication, 1st Edition, 2013

Web References

1. https://nptel.ac.in/courses/124/107/124107008/
2. https://www.tutorialspoint.com/
3. cs.stir.ac.uk/courses/ITNP023/lectures/03-web.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	1	-	-	-	-	-	-	-	-	1	1	-
2	1	1	1	2	-	-	-	-	-	-	-	-	2	1	-
3	1	1	2	2	2	-	-	-	-	-	-	-	2	1	1
4	1	1	1	2	3	-	-	-	-	-	-	-	2	1	1
5	1	1	2	1	-	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBT715	IT WORKSHOP SCILAB / MATLAB	L	T	P	C	Hrs
		2	0	0	2	30

Course Objectives

- To introduce the basic features of MATLAB for problem solving
- To understand the Mathematical functions like matrix generation and array operations and solving Linear equations in MATLAB
- To gain the knowledge of Plotting with multiple data sets, line styles and colors.
- To comprehend about the writing M-file scripts and Debugging M-files
- To learn about the control flow and operators using if-end structures and loops.

Course Outcomes

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

CO1 - Familiarize the fundamentals of MATLAB to create variables, manage workspace. **(K1)**

CO2 - Understand matrix operations, array operations, linear equations and mathematical functions. **(K2)**

CO3 - Apply the concepts of basic Plotting tof simple and multiple data sets. **(K3)**

CO4 - Understand how to program using M-file scripts, M- file functions, Input –output Arguments. **(K2)**

CO5 - Use of control flow operators, loops, flow structures, debugging M-files to develop applications. **(K3)**

UNIT I INTRODUCTION TO MATLAB (6Hrs)

History, basic features, strengths and weaknesses, good programming practices and plan your code

Working with variables, workspace and miscellaneous commands

Creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands,

UNIT II MATRIX, ARRAY AND BASIC MATHEMATICAL FUNCTIONS (6Hrs)

Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix generators, special matrices, array and array operations, solving linear equations, other mathematical functions.

UNIT III BASIC PLOTTING (6Hrs)

Overview, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifying line styles and colours

UNIT IV INTRODUCTION TO PROGRAMMING (6Hrs)

Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands

UNIT V CONTROL FLOW, OPERATORS AND DEBUGGING (6Hrs)

Control flow and operators - ``if ... end'' structure, relational and logical operators, ``for ... end'' loop, ``while ... end'' loop, other flow structures, operator precedence, saving output to a file

Debugging M-files - Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values, correcting and ending debugging, correcting an M-file

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins*, Digital Image Processing using MATLAB*., Pearson Education, Inc., 2004.
2. Stormy Attaway, Butterworth-Heinemann. *MATLAB: A Practical Introduction to Programming and Problem Solving*.
3. Parmar Kulwinder Singh, Fundamental Concepts of MATLAB Programming, BPB Publications,2020

Reference Books

1. Bansal/Goel/Sharma, MATLAB and its Applications in Engineering, 2nd edition, Pearson March 2016.
2. Amos Gilat, MATLAB: An Introduction with Applications, 4ed, Wiley 2012.
3. Rudra Pratap, Getting started with MATLAB A quick Introduction for scientists Engineers, Oxford University Press.

Web References

1. https://www.tutorialspoint.com/matlab/index.htm
2. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ge02/
3. https://www.mathworks.com/content/dam/mathworks/mathworks-dot-com/moler/exm/book.pdf
4. https://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	-	1	-	-	-	-	-	-	-	1	1	1
2	1	2	1	-	1	-	-	-	-	-	-	-	1	1	1
3	2	2	2	-	1	-	-	-	-	-	-	-	2	1	1
4	2	2	2	-	1	-	-	-	-	-	-	-	2	1	1
5	2	2	2	-	1	-	-	-	-	-	-	-	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP713	USABILITY DESIGN OF SOFTWARE APPLICATIONS LABORATORY	L	T	P	C	Hrs
		0	2	0	1	30

Course Objectives

- To know about the concepts of redesign to improve the user interface
- To familiarize about the mobile app or the website through the design and development lifecycle
- To Understand about the various methods for developing better User interface
- To understand about concept and task flow
- To gain the knowledge about testing and demonstrating the application

Course Outcomes

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

CO1 - Redesigning an existing Application or website for better user experience. **(K3)**
CO2 - Analyze the mobile app or the website through the design and development life cycle. **(K4)**
CO3 - Analyze and identify the methods to offer a better UI experience. **(K4)**
CO4 – Develop concept and task flow detail. **(K3)**
CO5 – Test and demonstrate the application. **(K4)**

List of Experiments

1. Identify a website or an App to redesign, with justification.
2. Analysis of the mobile app or the website through the design life cycle.
3. Identifying Personas and Scenarios for the App or the website.
4. Concept development and task flow detailing.
5. Prototype development with Iterations and justification.
6. Usability testing and demonstration.

Reference Books

1. Jesse James Garrett, "The Elements of User Experience: User-Centered Design for the Web and Beyond - Voices That Matter" New Riders; 2nd edition, 2010.
2. Jonny Schneide,n Understanding Design Thinking, Lean, and Agile, O'Reilly Media, Inc. 2017.
3. Everett N McKay, UI is Communication: How to Design Intuitive, User Centered Interfaces by Focusing on Effective Communication, 1st Edition, 2013.

Web References

1. https://nptel.ac.in/courses/124/107/124107008/
2. https://www.tutorialspoint.com/
3. cs.stir.ac.uk/courses/ITNP023/lectures/03-web.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	2
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	2
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBP714	IT WORKSHOP SCILAB / MATLAB LABORATORY	L	T	P	C	Hrs
		0	2	0	1	30

Course Objectives

- To Study about the image fundamentals, mathematical transforms necessary for image processing
- To understand the various techniques of image enhancement and reconstruction,
- To gain knowledge about the compression and segmentation techniques
- To Know about sampling and reconstruction procedures
- To Design image processing systems

Course Outcomes

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

CO1 - Use of mathematical skills for image transformation. **(K3)**
CO2 - Understand about the image enhancement and reconstruction process. **(K2)**
CO3 - Identify the use of compression and segmentation techniques. **(K4)**
CO4 - Gain about the sampling and reconstruction procedures. **(K2)**
CO5 - Use of image processing technique to develop real world applications. **(K3)**

List of Exercise

- Display of Gray scale Images.
- Extract Different Attributes of an Image.
- Histogram Mapping and Equalization.
- Image Smoothening and Sharpening.
- Edge Detection Using Sobel, Prewitt and Roberts Operators.
- Morphological Operations on Binary Images.
- Pseudo Coloring.
- Chain Coding.
- 2-D DFT and DCT.
- Segmentation using watershed transform.

Reference Books

1. Jain A.K, “Fundamentals of Digital Image Processing”, 4th Edition, Prentice hall of India, 2004.
2. B.Chanda, D. Dutta Majumder, “Digital Image Processing and Analysis”, 2ndEdition, Phi learning, 2011.
3. William K Pratt, “Digital Image Processing”, 4th Edition, Wiley, 2012.

Web References

1. https://cse19-iiith.vlabs.ac.in/List%20of%20experiments.html
2. http://www.dcs.gla.ac.uk/~wpc/diP/Algorithms.htm
3. https://www.mathworks.com/content/dam/mathworks/mathworks-dot-com/moler/exm/book.pdf
4. https://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	1	2
4	3	2	1	1	3	-	-	-	-	-	-	-	3	1	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	1	2

Correlation Level: 1-Low, 2-Medium, 3- High.

U20CBW701	INTERNSHIP/INDUSTRIAL PROJECTS	L	T	P	C	Hrs
		0	0	0	2	30

In the course of study, during 6th semester holidays, each student is expected to undertake minimum of 2 weeks or one month of industry internship/industrial project (in a reputed concern). Based on the industrial internships / Projects, the student has to submit a report prior to the commencing of seventh semester highlighting the exposure he/she gained. The report will be evaluated by the departmental committee for 100 marks. The proofs for having undergone internship / training are to be enclosed along with report as enclosures.

U20CBW702	PROJECT PHASE - I	L	T	P	C	Hrs
		0	0	4	2	30

Course Objectives

- To make a literature survey.
- To identify problem definition.
- To build a project design.
- To carry out project implementation.
- To perform project testing and documentation.

Course Outcomes

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

CO1 - State the problem definition clearly. **(K3)**
CO2 - Prepare SRS for projects. **(K3)**
CO3 - Prepare SDS for projects. **(K3)**
CO4 - Develop presentation skills. **(K3)**
CO5 - Develop project management skills. **(K3)**

Exercises

The project group is required to do the following

- literature survey,
- Problem formulation
- Forming a methodology of arriving at the solution of the problem.
- Documentation of each step

Reference Books

- Papers published in reputed journals, conferences related to the project

U20HST814	IT Project Management	L	T	P	C	H
		3	0	0	3	45

Couse Objectives

1. Gain knowledge on fundamental concepts of project and project scheduling.
2. Understand Project Cost Control, Scheduling and Management Features.
3. Obtain knowledge on Agile Project Management.
4. Know about the Scrum framework in detail.
5. Obtain knowledge on DevOps and its related concepts

Course Outcomes

CO1 - Learn to effectively plan, and schedule projects within time and cost targets **(K2)**
CO2 - Have Knowledge in Cost Control, Scheduling and Management Features **(K2)**
CO3 - Be aware of different Agile Project Methodologies **(K3)**
CO4 - Know in detail about Scrum.**(K3)**
CO5 - Obtain good knowledge in DevOps **(K2)**

Unit – I Project Overview and Project Scheduling **(9 Hrs)**

Project Overview and Feasibility Studies- Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal. Project Scheduling concepts and methods, CMM, PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity

UNIT – II Cost Control and Scheduling and Management Features **(9 Hrs)**

Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling. Project Management Features: Risk Analysis, Project Control, Project Audit and Project Termination.

UNIT – III Agile Project Management **(9 Hrs)**

Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL). Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal.

UNIT – IV Scrum **(9 Hrs)**

Scrum: Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum.

UNIT – V Devops **(9 Hrs)**

DevOps: Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring, Case study.

Workshop

Workshops will be conducted as a part of this course which is mandatory for students to attend. The primary objective of the workshops is to teach the students the agile project management including Scrum and DevOps through group activities.

Assignment: To make the students to prepare the projects using scrum tools as open source for Agile process. Jitamin, KADOS open source scrum tools.

Text Books

1. Mike Cohn, *Succeeding with Agile: Software Development Using Scrum*
2. Notes to be distributed by the course instructor on various topics

Reference Books

1. Roman Pichler, "Agile Product Management with Scrum",
2. Ken Schwaber, ,"Agile Project Management with Scrum (Microsoft Professional)"

Web References

1. https://www.investopedia.com/terms/p/pert-chart.asp
2. https://www.toptal.com/project-managers/agile/ultimate-introduction-to-agile-project-management
3. https://www.wrike.com/project-management-guide/faq/what-is-scheduling-in-project-management/
4. https://www.atlassian.com/agile/scrum
5. https://www.atlassian.com/devops

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20HSP801	IT Project Management laboratory	L	T	P	C	H
		0	0	2	1	30

Course Objectives

1. To plan and manage project at each stage of software development
2. To manage IT projects and control IT deliverables
3. To develop skills to manage various phases involved in project management and the importance of PERT is to be analysed.
4. To deliver successful IT projects that support organizations strategic goals
5. To understand to be familiar with the use of open source tools and DevOps

Course Outcomes

CO1 - Learn to effectively plan, and schedule projects within time and cost targets. **(K2)**
CO2 - Have Knowledge in Cost Control, Scheduling and Management Features. **(K2)**
CO3 - Be aware of different Agile Project Methodologies. **(K3)**
CO4 - Know in detail about Scrum. **(K3)**
CO5 - Obtain good knowledge in DevOps. **(K3)**

List of Exercises

1. Estimate the IT Project Cost and Control using open-source tools
2. Scheduling a Project with PERT and CPM
3. Estimation of the total time required to complete the project if no delay
4. The individual activities to meet the project completion time.
5. Identify the critical bottleneck activities where any delays must be avoided to prevent delaying project completion.
6. IT project risk analysis (includes planning during uncertainty) using open-source tools
7. Design IT Project Audit Template
8. Agile Project Management Tools (Open source)
9. Design IT Service Management (ITIL) Templates
10. Scrum: IT Project Management, DevOps and Automated Testing Tools

Text Books

1. Mike Cohn, “succeeding with Agile: Software Development Using Scrum”, 2015, 1stEdition Addison-Wesley Professional.

Reference Books

1. Roman Pichler, “Agile Product Management with Scrum: Creating Products that Customers Love”, 2011, First edition, Addison-Wesley.
2. Ken Schwaber, Agile Project Management with Scrum”, 2014,1st edition, Microsoft Press US.

Web References

1. https://www.tutorialspoint.com/top-10-tools-and-techniques-to-estimate-project-cost
2. https://www.scirp.org/journal/paperinformation.aspx?paperid=110980
3. https://www.projectmanager.com/training/project-management-audit
4. https://www.wrike.com/project-management-guide/agile-project-management-tools-techniques/
5. https://www.smartsheet.com/itil-templates

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBW803	PROJECT EVALUATION II	L	T	P	C	Hrs
		0	0	16	8	240

Course Objectives

- To make a literature survey.
- To identify problem definition.
- To build a project design.
- To carry out project implementation.
- To perform project testing and documentation.

Course Outcomes

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

CO1 – Detailed literature survey related to the problem definition. **(K3)**

CO2 – Implementaion of Existing System **(K3)**

CO3 – Implementation of Proposed Work **(K3)**

CO4 – Comparion of Existing with the proposed system and quantification **(K3)**

CO5 – Future work. **(K3)**

List of Exercises

The project group is required to do the following

1. Detailed literature survey,
2. Problem Definition and Research model preparation (conceptual model)
3. Data Collection tool design
4. Data Collection
5. Data Analysis
6. Interpretation and Results
7. Scope for Future Work

Reference Books

- Papers published in reputed journals, conferences related to the project

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	3	3	2	2	3
2	3	2	1	1	3	-	-	-	-	-	3	3	2	2	3
3	3	2	1	1	3	-	-	-	-	-	3	3	2	2	3
4	3	2	1	1	3	-	-	-	-	-	3	3	2	2	3
5	3	2	1	1	3	-	-	-	-	-	3	3	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Employability Enhancement Course

		L	T	P	C	Hrs
U20CBS806	**Skill Development Course 6: NPTEL/ MOOC-II**	**0**	**0**	**0**	**0**	**30**

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

Professional Elective I

U20CBE501	CONVERSATIONAL SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To be familiar with the basic knowledge about conversational systems.
- To understand the different techniques of natural language processing
- To learn the working knowledge of a chatbot and the prerequisite knowledge.
- Study the fundamental role of machine learning in building conversational systems.
- To know the various applications of conversational systems and its future developments.

.

Course Outcomes

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

CO1 - Understand the basic technologies required for building a conversational system. **(K2)**

CO2 - Learn the NLTK tool kit and the pre-processing techniques of natural language processing. **(K2)**

CO3 - Build a chatbot for any application and deploy it. **(K3)**

CO4 - Involve AI in building conversational system and build advanced systems that can be cognitively inclined towards human behaviour. **(K3)**

CO5 - Develop a real time working conversational system for social domain that can intelligently process inputs and generate relevant replies. **(K2)**

UNITI FUNDAMENTALS OF CONVERSATIONAL SYSTEMS (9 Hrs)

Overview, Explanation about different modes of engagement for a human being, History and impact of AI - Underlying technologies: Natural Language Processing, Artificial Intelligence and Machine Learning, Natural Language Generation, Speech-To-Text, Text-To-Speech, Computer Vision. Introduction to Top players in Current Market – Messaging Platforms. Ethical and Legal Considerations in AI Overview.

UNIT II NATURAL LANGUAGE PROCESSING (9 Hrs)

Introduction: Brief history, Basic Concepts, Phases of NLP, Application of chatbots. General chatbot architecture, Basic concepts in chatbots: Intents, Entities, Utterances, Variables and Slots, Fulfilment. Lexical Knowledge Networks (WordNet, Verbnet, PropBank, etc). Lexical Analysis, Part-of-Speech Tagging, Parsing/Syntactic analysis, Semantic Analysis, Word Sense Disambiguation. Information Extraction, Sentiment Analysis.

UNIT III BUILDING A CHATBOT/CONVERSATIONAL AI SYSTEMS (9 Hrs)

Fundamentals of Conversational Systems (NLU, DM and NLG) - Chatbot framework & Architecture, Conversational Flow & Design, Intent Classification (ML and DL based techniques), Dialogue Management Strategies, Natural Language Generation - UX design, APIs and SDKs, Usage of Conversational Design Tools - Introduction to popular chatbot frameworks – Google Dialog flow, Microsoft Bot - Framework, Amazon Lex, RASA Channels: Facebook Messenger, Google Home, Alexa, WhatsApp, Custom Apps - Overview of CE Testing techniques, A/B Testing, Introduction to Testing Frameworks - Botium /Mocha ,Chai Security & Compliance – Data Management, Storage, GDPR, PCI..

UNIT IV ROLE OF ML/AI IN CONVERSATIONAL TECHNOLOGIES (9 Hrs)

Understanding on how conversational systems uses ML technologies in ASR, NLP - Advanced Dialog management - Language Translation - Emotion/Sentiment Analysis - Information extraction to effectively converse..

UNIT V CONVERSATIONAL ANALYTICS & FUTURE OF COVERSATIONAL SYSTEMS (9 Hrs)

Introduction to contact centers – Impact & Terminologies - Case studies & Trends, How does a Virtual Agent/Assistant fit in here? - Conversation Analytics: The need of it. Introduction to Conversational Metrics - Summary, Robots and Sensory Applications overview - XR Technologies in Conversational Systems , XR-Commerce - What to expect next? – Future technologies and market innovations overview..

Text Books

1. Michael McTear, “Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots”, Second Edition, Moran and Claypool Publishers, 2020..
2. Cathy Pearl, “Designing Voice User Interfaces: Principles of Conversational Experiences”, O’REILLY, 2016.

Reference Books

1. Srini Janarthanam,Hands-On Chatbots and Conversational UI Development,Packt, Dec 2017
2. D'Haro, Luis Fernando, Callejas, Zoraida, Nakamura, Satoshi,Conversational Dialogue Systems for the Next Decade,Springer ,2021

Web References

1. https://www.ibm.com/cloud/learn/conversational-ai
2. https://www.interactions.com/conversational-ai/
3. https://www.artificial-solutions.com/
4. https://www.uniphore.com/
5. https://rasa.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE502	CLOUD, MICROSERVICES & APPLICATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know basic components and fundamentals of cloud computing
- To develop an application using various services in cloud.
- Understand how to design the web application development in cloud.
- To learn the basic and important concepts of python to implement in an application.
- Understand the issues and solutions for cloud security and cloud monitoring.

.

Course Outcomes

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

CO1 - Demonstrate the main concepts of cloud, its characteristics, advantages, key technologies and its various delivery and deployment models. **(K2)**

CO2 - Develop and design an application using various tools in cloud environment.. **(K2)**

CO3 - Acquire the basic and important design concepts and issues of web application development techniques in cloud. **(K3)**

CO4 - Structure simple python program for developing an application in cloud. **(K3)**

CO5 - Analyze the issue of cloud such as security, energy efficiency and interoperability, and provide an insight into future prospects of computing in the cloud monitoring. **(K2)**

UNITI INTRODUCTION (9 Hrs)

Cloud Fundamentals-Cloud Service Components-Cloud Service, Deployment Models-Cloud components-Guiding principle with respect to utilization, Security, Pricing- Application of Cloud Computing. Case Study: Design and Implementation of Public and Private Cloud Environments – Open Stack and AWS.

UNIT II CLOUD BASED APPLICATIONS DEVELOPMENT (9 Hrs)

Application Architectures-Monolithic & Distributed, Microservice Fundamental and Design Approach-Cloud Native Applications-12 Factors App-Application Integration Process and APIfication Process- API Fundamental-Microservice and API Management- Spring Boot Fundamental and Design of Microservice - API Tools - Developer Portal-Applications of Microservice and APIfication

UNIT III WEB DEVELOPMENT TECHNIQUES (9 Hrs)

Devops fundamentals - Devops Role and Responsibility-Tools and Applications- Containerization Process and Application-Evolution of APP Deployment- Docker Fundamentals - Docker Architecture- Docker Commands. Case study Orchestration, Kubernetes, Docker Container.

UNIT IV CLOUD SECURITY AND MONITORING TOOL (9 Hrs)

Cloud Security-Cloud Security Shared Responsibility Architecture-Security By Design Principles-Identity And Access Management-Cloud Security Layers Illustration-Cloud Network, Host And Data Security Concepts-Security Operations and Major Cloud Service Provider Tools-Security Compliance and Regulations-Cloud Monitoring-Benefits of Cloud Monitoring-Overview of Cloud Monitoring Tools.

UNIT V BUILDING AN APPLICATION USING PYTHON (9 Hrs)

Developing and Deploying an Application in the Cloud- Building a python project based on Design-Development-Testing-Deployment of an application in the cloud using a development framework and deployment platform.

Case Study: Python Use case and Python Framework.

Text Books

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, “Cloud Computing Concepts, Technology & Architecture”, Prentice Hall, 2013.
2. Guo Ning Liu, Qiang Guo Tong, Harm Sluiman, Alex Amies, "Developing and Hosting Applications on the Cloud", IBM Press, 2012.
3. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, “Cloud Computing: Principles and Paradigms”, Wiley, 2011.

Reference Books

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, “Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet”, First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.
2. Michael J. Kavis “Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)”, 1st Edition, Wiley, 2014.
3. Lizhe Wang, Rajiv Ranjan, Jinjun Chen, Boualem Benatallah,Cloud Computing, CRC Press, 2017

Web References

1. https://azure.microsoft.com/
2. https://aws.amazon.com/
3. https://nptel.ac.in/courses/106/105/106105167/
4. Azure Virtual Machines https://docs.microsoft.com/en us/azure/virtual machines/
5. Google App Engine https://cloud.google.com/appengine#all features
6. Google Kubernetes Engine https://cloud.google.com/kubernetes engine#all features
7. Docker Tutorial : https://docker curriculum.com
8. Google Cloud Infrastructure security setup overview: https://cloud.google.com/security/infrastructure/design

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE503	MACHINE LEARNING TECHNIQUES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Have a thorough understanding of the existing machine learning techniques
- Know the basic concepts of supervised learning techniques.
- Study the working of neural networks and similar models.
- Familiarize with unsupervised learning algorithms.
- Understand the concepts of mining and applications based on it.

.

Course Outcomes

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

CO1 - Distinguish between, supervised, unsupervised and semi-supervised learning. **(K2)**

CO2 - Modify existing machine learning algorithms to improve classification efficiency. **(K2)**

CO3 - Build a basic neural network for real-time data. **(K3)**

CO4 -. Use of temporal models for classification **(K3)**

CO5 - Use unsupervised models for clustering data and design a system that uses the information mining models of machine learning. **(K3)**

UNITI INTRODUCTION TO MACHINE LEARNING (9 Hrs)

Introduction to Machine Learning (ML); Relationship between ML and human learning; A quick survey of major models of how machines learn; Example applications of ML..

UNIT II SUPERVISED LEARNING ALGORITHMS (9 Hrs)

Supervised Learning; The problem of classification; Feature engineering; Training and testing classifier models; Cross-validation; Model evaluation (precision, recall, F1-mesure, accuracy, area under curve); Statistical decision theory including discriminant functions and decision surfaces;

UNIT III CLASSIFICATION TECHNIQUES (9 Hrs)

Naive Bayes classification; Bayesian networks; Decision Tree and Random Forests; k-Nearest neighbor classification; Support Vector Machines

Artificial neural networks including back propagation; Applications of classifications; Ensembles of classifiers including bagging and boosting

UNIT IV HIDDEN MARKOV MODELS AND REGRESSION TECHNIQUES (9 Hrs)

Hidden Markov Models (HMM) with forward-backward and Vierbi algorithms; Sequence classification using HMM; Conditional random fields; Applications of sequence classification such as part-of-speech tagging

Regression: Multi-variable regression; Model evaluation; Least squares regression; Regularization; LASSO; Applications of regression.

UNIT IV UNSUPERVISED LEARNING AND MINING LGORITHMS (9 Hrs)

Clustering: Average linkage; Ward's algorithm; Minimum spanning tree clustering; K-nearest neighbours clustering; BIRCH; CURE; DBSCAN..

Association rule mining algorithms including apriori - Expectation-Maximization (EM) Algorithm for unsupervised learning anomaly and outlier detection methods.

Text Books

1. E. Alpaydin, "Introduction to Machine Learning", Third Edition, Prentice-Hall, 2014.
2. A. Rostamizadeh, A. Talwalkar, M. Mohri, "Foundations of Machine Learning", MIT Press.
3. Andriy Burkov,The Hundred-Page Machine Learning Book, first edition

Reference Books

1. R.O. Duda, P.E. Hart, D.G. Stork, “Pattern Classification”, Second Edition, Wiley, 2001.
2. C. Bishop,”Pattern Recognition and Machine Learning”, Springer, 2007.
3. Webb, “Statistical Pattern Recognition”, Third Edition, Wiley, 2011..
.

Web References

1. https://www.javatpoint.com/machine-learning
2. https://www.geeksforgeeks.org/machine-learning/
3. https://www.kaggle.com/learn/intro-to-machine-learning
4. https://machinelearningmastery.com/start-here/
5. https://intellipaat.com/blog/tutorial/machine-learning-tutorial/
6. https://nptel.ac.in/courses/106/106/106106139/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBCM01	BUSINESS INTELLIGENCE AND APPLICATIONS (Common to CSBS, AIDS)	L	T	P	C	HRS
		3	0	0	3	45

Course Objectives

- Be familiar with the concepts of business intelligence and Decision support systems.
- Be acquainted with mathematical models for decision making and data mining process
- To understand classification and clustering techniques.
- To know about the various business intelligence applications
- To understand the knowledge management process

Course Outcomes

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

CO1 - Describe business intelligence and decision support systems **(K2)**
CO2 – Use the mathematical models for decision making process **(K3)**
CO3 – Implement the techniques involving classification and clustering **(K3)**
CO4 – Summarize the various business intelligence applications **(K2)**
CO5 - Explain the context of knowledge management systems **(K2)**

UNIT I INTRODUCTION TO BUSINESS INTELLIGENCE **(9 Hrs)**

Effective and timely Decisions-Data, information and knowledge-The role of mathematic al models-Business Intelligence Architectures-Ethics and business Intelligence-Definition of System-Representation of the decision making Process-Evolution of information Systems-Def inition of decision support System-Development of a decision support system

UNIT II DATA MINING & DATA PREPARATION **(9 Hrs)**

Structure of mathematical Models-Development of Model-Classes of models–Definitio n of data Mining-Representation of input Data-Data Mining Process-Analysis Methodologies-Data Validation-Data Transformation-Data reduction

UNIT III CLASSIFICATION & CLUSTERING **(9 Hrs)**

Classification Problems-Evaluation of classification Models-Bayesian Methods-Logistic R gression-Neural Networks-Support Vector Machines-Clustering Methods-Partition Methods-H erarchical Methods-Evaluation of clustering models

UNIT IV BI APPLICATIONS, LOGISTIC & PRODUCTION MODELS **(9 Hrs)**

Marketing models**:** Relational Marketing-Sales Force Management-Supply chain op timization-Optimization models for logistics Planning-Revenue management systems. –Efficiency Measures-Efficient frontier-The CCR Model-Identification of good operating practices

UNIT V KNOWLEDGE MANAGEMENT **(9 Hrs)**

Introduction to Knowledge Management-Organizational Learning and Transformation- Knowledge Management Activities-Approaches to Knowledge Management-Information Technolog y (IT) In Knowledge Management-Knowledge Management Systems Implementation-Roles of People in Knowledge Management.

Text Books

1. Carlo Vercellis, “Business Intelligence: Data Mining and Optimization for decision ma king”, 1st Edition, Wiley, 2009.
2. Efraim Turban, Ramesh Sharda, Dursun Delen “Decision Support and Business Intelligence Systems”, Pearson, 9th Edition 2011.
3. Ramesh Sharda, Dursun Delen, Efraim Turban, & David King, "Business Intelligence: A Managerial Approach", Global Edition, November 2017.

Reference Books

1. Grossmann W, Rinderle-Ma “Fundamental of Business Intelligence” Springer, 1st Edition, 2015.
2. Galit Shmueli, Nitin R. Patel, Peter C. Bruce,"Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner",Wiley, November 2010

Web References

1. www.cio.com/article/2439504/business-intelligence-definition-and-solutions.html
2. https://data-flair.training/blogs/business-intelligence/
3. https://www.javatpoint.com/power-bi
4. https://www.datapine.com/blog/business-intelligence-concepts-and-bi-basics/
5. https://nptel.ac.in/courses/110/107/110107092/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	3	1	-	3	1
2	3	2	1	-	3	-	-	-	-	-	3	1	-	3	1
3	3	2	1	-	3	-	-	-	-	-	3	1	-	3	1
4	2	1	-	-	3	-	-	-	-	-	3	1	-	3	1
5	2	1	-	-	-	-	-	-	-	-	3	1	-	3	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE505	BUSINESS PROCESS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the fundamental concepts of Business Process
- To learn about Business process management modeling
- To understand about the how to manage the business process using metrics and dashboards
- To comprehend about the process innovation features
- To understand the usage of the Business Process in the current industry scenario.

.

Course Outcomes

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

CO1 - Understand the concepts of business process. **(K2)**
CO2 - Comprehend Business process management and model a business process. **(K2)**
CO3 - Analyze the semantics of business process models. **(K3)**
CO4 - Illustrate the features of Process innovation. **(K3)**
CO5 - Simulate a Process model following the lifecycle of Business Process Management. **(K2)**

UNIT I INTRODUCTION TO BUSINESS PROCESS (9 Hrs)

Introduction – Definition of Business Process- the need and the importance of Business Process – Examples of Business Process - Business Process Excellence.

UNIT II BUSINESS PROCESS MANAGEMENT (BPM) (9 Hrs)

Business process management -Process architecture, process modelling , People Centric and System Centric Process – Preparing a process for execution, Execution Process, Stimulating Processes, Rules Vs Processes

UNIT III METRICS AND EVENT IN BUSINESS PROCESS MODELING (9 Hrs)

Managing Processes: Metrics & Dashboards -Managing the Runtime, Designing a BPM Dashboard Process Mining – Events in Business Process Modeling – Semantics of Events.

UNIT IV PROCESS INNOVATION (9 Hrs)

Process Innovation- Process Improvement, Process Invocation, Advanced Process Improvement, Business Process Specification.

UNIT V BPM SCENARIOS (9 Hrs)

BPM Maturity & Governance - Case Study: Designing Technology Support for a Process- Oriented Organization –Business Process Management Maturity – Process Governance– Business Process Management – Life Cycle of Business Process Management –Tools of BPM.

Text Books

1. Dirk Draheim–Business Process Technology: A unified view on Business Processes, Workflows and Enterprise Solutions, Springer 2010.
2. Harmon, Paul: Business Process Change. A Guide for Business Managers and BPM and Six Sigma Professionals. 2nd Edition, Morgan Kaufmann, San Francisco, ISBN-10: 0123741521 ISBN-13: 978-0123741523.

Reference Books

1. M.Weske, Business Process Management : Concepts, Languages, Architectures Springer , 2012
2. Martyn A Ould, Business Process Management: A Rigorous Approach,British Computer Society, 2004.
3. Becker, J., v. Uthmann, C., zur Muehlen, M., and Rosemann, M. "Identifying the Workflow Potential of Business Processes," 32nd Hawaii International Conference on System Sciences (HICSS 1999), IEEE, Wailea (HI), 1999.

.

Web References

1. https://www.process.st/bpmn-tutorial/
2. https://www.visual-paradigm.com/tutorials/business-process-modeling-tutorial/
3. https://creately.com/blog/diagrams/business-process-modeling-tutorial/
4. https://www.heflo.com/blog/process-modeling/business-process-modeling-tutorial/
5. https://www.processmaker.com/blog/bpmn-2-0-tutorial-and-examples/
6. https://sparxsystems.com/downloads/whitepapers/businessProcessModelTutorial.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP51	CONVERSATIONAL SYSTEMS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To be familiar with the basic concepts required for building a conversational system.
- To understand the NLTK tool kit and the pre-processing techniques of NLP
- To learn the working POS of words and Sentiment analysis for given dataset.
- Study about the neural networks algorithms for building conversational systems.
- To know about how to Build a chatbot for any application and deploy it.

.

Course Outcomes

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

CO1 - Understand the basic concepts required for building a conversational system. **(K2)**
CO2 - Learn the NLTK tool kit and the pre-processing techniques of NLP. **(K2)**
CO3 -. Perfom Part of speech (POS) of words and Sentiment anlaysis for given dataset**(K3)**
CO4 – Apply neural networks algorithms for build applications. **(K3)**
CO5 - Build a chatbot for any application and deploy it. **(K2)**

LIST OF EXPERIMENTS

1. Write a program to identify morphological features of a word by analysing it.
2. Write a program to generate word forms from root and suffix information.
3. Write a program to perform morphological analysis of a word by the use of Add-Delete table.
4. Write a program to calculate the bigrams from a given corpus and calculate probability of a sentence.
5. Write a program to perform sentiment analysis for the given dataset and to classify sentences based on their categories.
6. Write a program to find Parts – of - Speech tags of words in a sentence.
7. Write a program to know the importance of context and size of training corpus in learning Parts of Speech and understand the concept of chunking and get familiar with the basic chunk tagset.
8. Write a program to detect the entities from the dataset and tag them based on their categories.
9. Write a program to build a Neural Network to recognize handwritten digits using MNIST dataset.
10. Write a program to build a Recurrent Neural Model with Keras.
11. Formulate a problem statement for mini-project to build a chatbot for an application that proves its importance from a social perspective.

Text Books

1. Michael McTear, “Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots”, Second Edition, Moran and Claypool Publishers, 2020..
2. Cathy Pearl, “Designing Voice User Interfaces: Principles of Conversational Experiences”, O’REILLY, 2016.

Reference Books

1. Srini Janarthanam,Hands-On Chatbots and Conversational UI Development,Packt, Dec 2017
2. D'Haro, Luis Fernando, Callejas, Zoraida, Nakamura, Satoshi,Conversational Dialogue Systems for the Next Decade,Springer ,2021

Web References

1. https://www.ibm.com/cloud/learn/conversational-ai
2. https://www.interactions.com/conversational-ai/
3. https://www.artificial-solutions.com/
4. https://www.uniphore.com/
5. https://rasa.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	1	2	-	1
5	3	2	1	1	3	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP52	CLOUD, MICROSERVICES & APPLICATION LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To know about the procedures to create and backup virtual machine instances
- To Design and develop an PAAS application.
- Understand how to Setup a private cloud environment.
- To learn the procedure to develop a DevSecOps – Cloud (AWS, GCP, Azure).
- Understand the procedure to develop a DevSecOps – Cluster (Kubernetes).

.

Course Outcomes

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

CO1 - Demonstrate the procedure to create virtual machine instances. **(K2)**
CO2 - Design and develop an PAAS application. **(K2)**
CO3 – Setup a private cloud environment. **(K3)**
CO4 – Demonstrate the procedure to develop a DevSecOps – Cloud (AWS, GCP, Azure) **(K3)**
CO5 - Demonstrate the procedure to develop a DevSecOps – Cluster (Kubernetes). **(K2)**

LIST OF EXPERIMENTS

1. Find procedure to run the virtual machine of different configuration using virtual-manager.
2. Virtualize a machine and check how many virtual machines can be utilized at a particular time.
3. Create a VM Clone and attach virtual block to the cloned virtual machine and check whether it holds the data even after the release of the virtual machine.
4. Create a Snapshot of a VM at a given point in time and test the snapshot by restoring the VM to that time. (Note: Testing can be done by installing an application and then restore it.)
5. Develop a simple application to understand the concept of PAAS using GAE/Amazon Elastic Beanstalk/IBM Blue Mix and launch it.
6. Test how a SaaS applications scales in response to demand.
7. Find the procedure to launch a Cloud instance using a Public IaaS cloud like AWS/GCP.
8. Setup a Private Cloud by performing the procedure using a Single node OPENSTACK implementation.
9. Find the procedure to develop a DevSecOps – Cloud (AWS, GCP, Azure).
10. Find the procedure to develop a DevSecOps – Cluster (Kubernetes).
11. Find the procedure to develop a Container (Docker).
12. To Build and Test Your Docker Images in the Cloud with Docker commands.

Text Books

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, “Cloud Computing Concepts, Technology & Architecture”, Prentice Hall, 2013.
2. Guo Ning Liu, Qiang Guo Tong, Harm Sluiman, Alex Amies, "Developing and Hosting Applications on the Cloud", IBM Press, 2012.
3. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, “Cloud Computing: Principles and Paradigms”, Wiley, 2011.

Reference Books

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, “Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet”, First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.
2. Michael J. Kavis “Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)”, 1st Edition, Wiley, 2014.

3. Lizhe Wang, Rajiv Ranjan, Jinjun Chen, Boualem Benatallah,Cloud Computing, CRC Press, 2017

Web References

1. https://azure.microsoft.com/
2. https://aws.amazon.com/
3. https://nptel.ac.in/courses/106/105/106105167/
4. Azure Virtual Machines https://docs.microsoft.com/en us/azure/virtual machines/
5. Google App Engine https://cloud.google.com/appengine#all features
6. Google Kubernetes Engine https://cloud.google.com/kubernetes engine#all features
7. Docker Tutorial : https://docker curriculum.com
8. Google Cloud Infrastructure security setup overview: https://cloud.google.com/security/infrastructure/design

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	1	2	-	1
5	3	2	1	1	3	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP53	MACHINE LEARNING TECHNIQUES LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- Have a thorough understanding of the existing machine learning platforms
- To familiarize with various online domain datasets
- To know the basic concepts of supervised learning techniques.
- To Familiarize with unsupervised learning algorithms.
- To study the working of neural networks and similar models.

.

Course Outcomes

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

CO1 - Demonstrate the machine learning platforms**(K2)**
CO2 – Use of online domain datasets. **(K2)**
CO3 – Use of supervised learning technique for classification **(K3)**
CO4 - Use of unsupervised models for clustering data. **(K3)**
CO5 - Apply suitable machine learning technique for anomaly detection. **(K2)**

LIST OF EXPERIMENTS

1. Introduction to WEKA and R
2. Classification of some public domain datasets in UCI ML repository
3. Implementation of one clustering algorithm
4. Implementation of one association rule mining algorithm
5. Implementation of one anomaly detection algorithms
6. Implementation of EM algorithm for some specific problem

Text Books

1. E. Alpaydin, “Introduction to Machine Learning”, Third Edition, Prentice-Hall, 2014.
2. A. Rostamizadeh, A. Talwalkar, M. Mohri, “Foundations of Machine Learning”, MIT Press.
3. Andriy Burkov,The Hundred-Page Machine Learning Book, first edition

Reference Books

1. R.O. Duda, P.E. Hart, D.G. Stork, “Pattern Classification”, Second Edition, Wiley, 2001.
2. C. Bishop,”Pattern Recognition and Machine Learning”, Springer, 2007.
3. A. Webb, “Statistical Pattern Recognition”, Third Edition, Wiley, 2011..

Web References

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://www.javatpoint.com/machine-learning
3. https://www.geeksforgeeks.org/machine-learning/
4. https://www.kaggle.com/learn/intro-to-machine-learning
5. https://machinelearningmastery.com/start-here/
6. https://intellipaat.com/blog/tutorial/machine-learning-tutorial/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	1	2	-	1
5	3	2	1	1	3	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP54	BUSINESS INTELLIGENCE LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To have a thorough understanding handling of legacy data and migrate into BI platform
- To know the basic concepts of ETL process.
- To study about the visualization techniques.
- To familiarize with supervised and unsupervised learning algorithms.
- To know linear and logistic regression techniques .

.

Course Outcomes

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

CO1 -. Demonstrate the handling of legacy data and migrate into BI platform **(K2)**
CO2 -. Perform ETL Process **(K2)**
CO3 – Report data using suitable visualization techniques. **(K3)**
CO4 - Use supervised and unsupervised models for classification and clustering data. **(K3)**
CO5 – Apply linear and logistic regression techniques on given dataset. **(K3)**

LIST OF EXPERIMENTS

1. Import the legacy data from different sources such as (Excel , SqlServer, Oracle etc.) and load in the target system. (You can download sample database such as Adventureworks, Northwind, foodmart etc.)
2. Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver.
3. a). Create the Data staging area for the selected database.

   b). Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model
4. a). Create the ETL map and setup the schedule for execution.

   b). Execute the MDX queries to extract the data from the datawarehouse.
5. a). Import the datawarehouse data in Microsoft Excel and create the Pivot table and Pivot Chart

   b). Import the cube in Microsoft Excel and create the Pivot table and Pivot Chart to perform data analysis.
6. Apply the what – if Analysis for data visualization. Design and generate necessary reports based on the data warehouse data.
7. Perform the data classification using classification algorithm.
8. Perform the data clustering using clustering algorithm.
9. Perform the Linear regression on the given data warehouse data.
10. Perform the logistic regression on the given data warehouse data.

Reference Books

1. Carlo Vercellis, “Business Intelligence: Data Mining and Optimization for decision making”, 1st Edition, Wiley, 2009..
2. Efraim Turban, Ramesh Sharda, Dursun Delen “Decision Support and Business Intelligence Systems”, Pearson, 9th Edition 2011.
3. Grossmann W, Rinderle-Ma “Fundamental of Business Intelligence” Springer, 1st Edition, 2015.

Web References

1. www.microsoft.com/en-us/sql-server/sql-business-intelligence

2. https://www.datapine.com/blog/business-intelligence-concepts-and-bi-basics/
3. www.cio.com/article/2439504/business-intelligence-definition-and-solutions.html
4. https://data-flair.training/blogs/business-intelligence/
5. https://www.javatpoint.com/power-bi

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	1	2	-	1
5	3	2	1	1	3	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP55	BUSINESS PROCESS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce the fundamental modeling process using BPMN
- To learn about creation of workflow specific tasks for given process
- To understand about the modeling of business rules
- To comprehend about the creation of BPM Dashboard
- To understand the procedure for discovering process performance from log files.

.

Course Outcomes

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

CO1 - Demonstrate the fundamental modeling process using BPMN. **(K3)**
CO2 - creation of workflow specific tasks for given process. **(K3)**
CO3 – Model to business rules. **(K3)**
CO4 – Creation of BPM Dashboard. **(K3)**
CO5 - Simulate a procedure for discovering process performance from log files. **(K3)**

LIST OF EXPERIMENTS

1. Model a Process in BPMN
2. BPM game-Advanced BPMN Exercise
3. Refine a BPMN model with Workflow specific Activities
4. Add Data a nd Decisions to Workflow Model
5. Add Simulation Scenario information to your Workflow Model
6. Model Business Rules using SBVR
7. Preparing a process for Execution-Build a Stimulation Model.
8. Designing a BPM Dashboard-Process Mining Exercise.
9. Discover Process Performance from a Log File
10. Process Innovation
11. Case Study Discussion-Final Presentation

Text Books

1. Dirk Draheim–Business Process Technology: A unified view on Business Processes, Workflows and Enterprise Solutions, Springer 2010.
2. Harmon, Paul: Business Process Change. A Guide for Business Managers and BPM and Six Sigma Professionals. 2nd Edition, Morgan Kaufmann, San Francisco, ISBN-10: 0123741521 ISBN-13: 978-0123741523.

Reference Books

1. M.Weske, Business Process Management : Concepts, Languages, Architectures Springer , 2012
2. Martyn A Ould, Business Process Management: A Rigorous Approach,British Computer Society, 2004.
3. Becker, J., v. Uthmann, C., zur Muehlen, M., and Rosemann, M. "Identifying the Workflow Potential of Business Processes," 32nd Hawaii International Conference on System Sciences (HICSS 1999), IEEE, Wailea (HI), 1999.

Web References

1. https://www.process.st/bpmn-tutorial/

2. https://www.visual-paradigm.com/tutorials/business-process-modeling-tutorial/
3. https://creately.com/blog/diagrams/business-process-modeling-tutorial/
4. https://www.heflo.com/blog/process-modeling/business-process-modeling-tutorial/
5. https://www.processmaker.com/blog/bpmn-2-0-tutorial-and-examples/
6. https://sparxsystems.com/downloads/whitepapers/businessProcessModelTutorial.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	1	2	-	1
5	3	2	1	1	3	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Professional Elective II

U20CBE606	ROBOTICS AND EMBEDDED SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To acquire knowledge about microcontrollers embedded processors and their applications.
- To understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
- To understand the design concept of embedded systems.
- To gain knowledge about the real time operating systems
- To gain knowledge about the robotics and kinematics

.

Course Outcomes

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

CO1 – Understand the key concepts of microcontrollers embedded processors and their applications. **(K2)**

CO2 –Know about the internal architecture and interfacing of different peripheral devices with Microcontrollers. **(K2)**

CO3 – Design embedded systems using modeling concepts. **(K3)**

CO4 - Use of real time operating system for various application. **(K3)**

CO5 - Design and engineer autonomous robots using various sensors. **(K3)**

UNITI INTRODUCTION TO EMBEDDED SYSTEM (9 Hrs)

Embedded system Vs General computing systems, History of Embedded systems, Purpose of Embedded systems, Microprocessor and Microcontroller, Hardware architecture of the real time systems..

UNIT II DEVICES AND COMMUNICATION BUSES (9 Hrs)

I/O types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols, parallel communication network using ISA, PCI, PCT-X, Intrnet embedded system network protocols, USB, Bluetooth

UNIT III PROGRAM MODELLING CONCEPTS (9 Hrs)

Fundamental issues in Hardware software co-design, Unified Modelling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.

UNIT IV REAL TIME OPERATING SYSTEMS & EXAMPLES OF EMBEDDED SYSTEM (9 Hrs)

Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS.

Examples of Embedded System: Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc. Popular microcontrollers used in embedded systems, sensors, actuators

UNIT V ROBOTICS AND KINEMATICS (9 Hrs)

Introduction to robotics, Elements of robots -- joints, links, actuators, and sensors ,Kinematics of serial robots, Kinematics of parallel robots, Motion planning and control, Sensing distance and direction, Line Following Algorithms, Feedback Systems, Recent trends and open challenges

Text Books

1. Shibu K. V , “Introduction to Embedded Systems”, 2nd Edition, McGraw Hill, 2017
2. Ashitava Ghosal, “Robotics: Fundamental Concepts and Analysis”, Oxford University Press, 2006
3. MAZIDI,"The 8051 Microcontroller and Embedded Systems: Using Assembly and C"Pearson,second Edition, January 2007

.

Reference Books

1. L. B. Das, “Embedded Systems: An Integrated Approach”,1st edition, Pearson Education India, 2012.
2. Raj Kamal, “Embedded Systems- Architecture, Programming and Design”, 3rd Edition, McGraw Hill Education, 2017.
3. Frank Vahid and Tony Givargis,"Embedded System Design: A Unified Hardware/Software Introduction"ohn Wiley & Sons,2002.

Web References

1. https://nptel.ac.in/courses/108/102/108102045/
2. https://www.embeddedrelated.com/tutorials.php
3. https://www.tutorialspoint.com/embedded_systems/index.htm
4. https://www.javatpoint.com/robotics-tutorial
1. http://www.robotictutorials.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE607	MODERN WEB APPLICATIONS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand key concepts of internet and world wide web.
- To know the importance of client side scripting languages.
- To understand about the client side validation using javascript and document object model
- To familiarize with PHP fundamentals
- To know the procedure for database connectivity using PHP and MySQL.

.

Course Outcomes

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

CO1 - Demonstrate the key concepts of internet. **(K2)**
CO2 – Comprehend the various client side scripting languages. **(K2)**
CO3 - . Use of javascript and XML for application development **(K3)**
CO4 - . Familiar with PHP fundamentals **(K3)**
CO5 - Do database manipulation using PHP and MySQL. **(K2)**

UNITI INTRODUCTION TO INTERNET & WORLD WIDE WEB (9 Hrs)

History of the Internet & World- Wide Web, Web Browsers, Web Servers, Uniform Resource Locator, Tools and Web, Programming Languages. Web Standards, Categories of Web Applications, Characteristics of Web Applications, Tiered Architecture.

UNIT II HYPERTEXT MARKUP LANGUAGE (HTML) AND CASCADING STYLE SHEETS (CSS) (9 Hrs)

HTML: Basic HTML page, Text Formatting, Table, Headers, Linking, Images, List, Meta Elements.
CSS: Inline, Internal and External Style Sheet, Bootstrap-CSS Text, CSS forms, CSS components drop down

UNIT III JAVASCRIPT AND EXTENSIBLE MARKUP LANGUAGE(XML) (9 Hrs)

JavaScript: Introduction to Java Scripts, Objects in Java Script, Dynamic HTML with Java Script, Bootstrap- JS Alert,JS Button, JS popover.
XML: Introduction, Structuring Data, Document Type Definition, XML Vocabularies, Document Object Model (DOM) with JavaScript, Extensible Stylesheet Language Transforms (XSL)..

UNIT IV PHP BASICS (9 Hrs)

Writing Basic PHP Programs: Creating PHP Programs, Numbers and Strings, Literals and Variables, Operators and Functions.
Form & PHP: Creating Form Controls, Using Values Returned From, Forms Using PHP

UNIT V PHP DATABASE CONNECTIVITY (9 Hrs)

PHP Database Connectivity: Connecting to MySQL Server, Selecting Databases, Checking for Errors, Closing the MySQL Server Connection.
Manipulating Data in MySQL Using PHP: Inserting, Viewing, Updating and Deleting Records, Manipulating joined tables.
User Authentication: Creating Session, Authorization Level.

Text Books

1. Deitel P. J., Deitel H. M. and Deitel A., “Internet and World Wide Web: How to Program”, Fifth Edition, Pearson Prentice Hall, 2012.
2. Jon Duckett, “HTML & CSS: Design and Build Websites”, First Edition, John Wiley & Sons, 2011.
3. Naramore E., Gerner J., Scouarnec Y.L., et al., “Beginning PHP5, Apache, MySQL Web Development:Programmer to Programmer”, John Wiley & Sons Inc., 2005.

.

Reference Books

1. Sebesta R. W.," Programming the World Wide Web", Eight Edition, Pearson, 2014.
2. Pressman R. and Lowe D.," Web Engineering: a practitioner's approach", First Edition, Mc GrawHill, 2008.
3. Kappel G., et al.," Web Engineering: The Discipline of systematic Development of Web Applications", First Edition, John Wiley & Sons, 2006.
4. Suh W., "Web Engineering: Principles and Techniques", Idea Group Inc., 2005.
5. Ullman L ," PHP for the Web: Visual Quick Start Guide", Fifth Edition, Peach pit Press, 2016..

.

Web References

1. https://www.w3schools.com/
2. https://www.tutorialspoint.com/internet_technologies/websites_development.htm
3. https://developer.mozilla.org/en-US/docs/Learn
4. https://nptel.ac.in/courses/106/105/106105084/
5. https://nptel.ac.in/courses/106/106/106106222/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE608	DATA MINING AND ANALYTICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the fundamental concepts of data mining and data representation.
- To learn the data preprocessing task and attribute oriented analysis
- To understand the association rules, classification and prediction algorithms
- To learn and apply the linear models of data analysis
- To understand the time series analysis and aspects of prescriptive analysis.

.

Course Outcomes

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

CO1 - Understand the fundamentals of data mining and data representation. **(K2)**
CO2 - Perform preprocessing tasks for the data set. **(K2)**
CO3 - Apply association rules and predictive methods for data mining. **(K3)**
CO4 - Build data models using linear regression techniques. **(K3)**
CO5 - Gain knowledge on time series analysis and prescriptive analysis. **(K2)**

UNITI INTRODUCTION AND KNOWLEDGE REPRESENTATION (9 Hrs)

Introduction - Related technologies - Machine Learning, DBMS, OLAP, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques, Applications..

UNIT II DATA PREPROCESSING (9 Hrs)

Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies.
Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures

UNIT III ASSOCIATION AND MINING METHODS 9 Hrs)

Association rules: Motivation and terminology, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis. Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R, algorithm, Decision trees, covering rules.
Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance based methods (nearest neighbor), linear models

UNIT IV LINEAR MODELS (9 Hrs)

Descriptive analytics: Data Modeling, Trend Analysis, Simple Linear Regression Analysis
Forecasting models: Heuristic methods, predictive modeling and pattern discovery,
Logistic Regression: Logit transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression, multiple logistic regression, forward, backward method, interpretation of parameters, relation with categorical data analysis. Interpreting Regression Models, Implementing Predictive Models.
Generalized Linear model: Link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma.

UNIT V TIME SERIES ANALYSIS 9 Hrs)

Time Series Analysis: Auto - Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt – Winter smoothing, forecasting based on smoothing.
Linear time series models: Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARIMA models such as Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARIMA Processes, Forecasting using ARIMA models.
Prescriptive Analytics: Mathematical optimization, Networks modeling-Multi-objective optimization-Stochastic modeling, Decision and Risk analysis, Decision trees.

Content beyond Syllabus
Non Linear Regression Models

Text Books

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.
2. Lior Rokach and Oded Maimon, “Data Mining and Knowledge Discovery Handbook”, Springer, 2nd edition, 2010.
3. Ian H. Witten, Eibe Frank and Mark A. Hall “Data Mining: Practical Machine Learning Tools and Techniques”,Fourth Edition, Elsevier, 2017..
.

Reference Books

1. Box, G.E.P and Jenkins G.M. (1970) Time Series Analysis, Forecasting and Control, Holden-Day.
2. Draper, N. R. and Smith, H., “Applied Regression Analysis”, Third Edition, John Wiley, 1998.
3. Hosmer, D. W. and Lemeshow, S., “Applied Logistic Regression”, Third Edition, Wiley, 2003..
.

Web References

1. https://nptel.ac.in/courses/106/105/106105174/
2. https://nptel.ac.in/courses/110/106/110106072/
3. https://www.tutorialspoint.com/data_mining/index.htm
4. https://www.javatpoint.com/data-mining
5. https://www.guru99.com/data-mining-tutorial.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE609	E-COMMERCE AND E-PAYMENT SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the fundamental concepts of e-commerce.
- To learn the various e-commerce models
- To understand the payment systems
- To learn and use the retail and digital payment systems
- To understand the security concepts in e-commerce.

.

Course Outcomes

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

CO1 - Learn how companies use e-commerce to gain competitive advantage. **(K2)**
CO2 - Learn different models of e-commerce. **(K2)**
CO3 - Understand about e-payment systems. **(K3)**
CO4 – Understand about the various retail and digital payment systems. **(K3)**
CO5 - Gain knowledge Security aspects in e-payment systems. **(K2)**

UNITI INTRODUCTION **(9 Hrs)**

Introduction to e-Commerce: Framework – Architecture - Benefits of e-Commerce - Anatomy of e-Commerce applications- e-Commerce applications, e-Commerce Applications - e-commerce in India.

UNIT II E-COMMERCE MODELS **(9 Hrs)**

Business-to-Business – Hubs - Market Places - Business-to-Business Exchange -Business-to-Consumer - Consumer-to-consumer - Business-to-Government - Government-to-Government.

UNIT IV PAYMENT SYSTEMS **(9 Hrs)**

Payment System – Background – Business Models – Technology Models - National Payments Corporation of India (NPCI) – Roles – Functions

High value Payments - Automated clearing and settlement systems – Payment graphs. Real-time gross settlement: Fedwire. Check clearing. SWIFT, SFMS- Real Time Gross Settlement System (RTGS) - Securities Settlement System (SSS) -Electronic Clearing Service (ECS) – National Electronic Fund Transfer (NEFT) – Money Transfer Service Scheme (MTSS) - Electronic Bill Payment and Presentment

UNIT V RETAIL AND DIGITAL PAYMENT SYSTEMS **(9 Hrs)**

Automated Teller Machines (ATMs) - Electronic Funds Transfer – Immediate Payment Service (IMPS) - The Unified Payments Interface (UPI) - Bharat Bill Payment System (BBPS) – Card Payments - Mobile Payments - Aadhar Pay - UPI Payments - Bharat QR Code - Digital Wallets – Bank Wallets – Private Wallets

RuPay card - Aadhar Payment Systems - Aadhaar Payments Bridge (APB) - Aadhaar Enabled Payment System (AEPS) – Micro Payments - micro ATM – Other Digital Payment Systems -Electoral bond - Digital Currencies - Blockchain technology – Bitcoin

UNIT V SECURITY IN E-COMMERCE **(9 Hrs)**

Securing the Business on Internet - Security Policy - Procedures and Practices - Transaction Security, Cryptology - Digital Signatures - Security Protocols for Web Commerce
E-payment Security – AI and Machine Learning – Smart Payments – Future Payments Systems

Text Books

1. Jeffrey F.Rayport and Bernard J.Jaworski, Introduction to E-commerce, TMH, 2003.
2. Kalakota and Winston, Frontiers of E-commerce, Pearson Education, Mumbai, 2002.
3. Jaspal Singh , Digital Payments in India: Background, Trends and Opportunities, New Century Publications, November 2019.

.

Reference Books

1. Elias M.Awad, Electronic Commerce, Prentice-Hall India, New Delhi,.2007.
2. Susanne Chishti, Tony Craddock, Robert Courtneidge, Markos Zachariadis,The PAYTECH Book: The Payment Technology Handbook for Investors, Entrepreneurs, and FinTech Visionaries, Wiley, December 2019.
3. Skip Allums,Designing Mobile Payment Experiences: Principles and Best Practices for Mobile Commerce, O'Reilly, June 2019.

.

Web References

1. https://www.tutorialspoint.com/e_commerce/
2. https://nptel.ac.in/content/storage2/courses/106108103/pdf/PPTs/mod13.pdf
3. https://study.com/academy/course/e-commerce-help-tutorials.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE610	BIG DATABASES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the fundamental concepts of Bigdata.
- To learn about the Bigdata analytic methods and modeling
- To understand the technology and tools used in Bigdata
- To study the Bigdata security concepts
- To understand the real time scenarios of Bigdata.

.

Course Outcomes

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

CO1 - Understand the fundamentals of Bigdata. **(K2)**
CO2 - Perform bigdata analytics for the given data set. **(K3)**
CO3 – Use of technology and tools for various Bigdata related tasks. **(K3)**
CO4 – Create Bigdata environment with proper security policies. **(K3)**
CO5 - Gain knowledge use of Bigdata on real time cases. **(K3)**

UNITI INTRODUCTION TO BIG DATA **(9 Hrs)**

Big Data – The Evolution of Big data - Basics - Big Data Analytics and its Importance – challenges- Issues- Future of Big Data**.**

UNIT II BIG DATA ANALYTIC METHODS AND MODELING **(9 Hrs)**

Introduction to “R”, analyzing and exploring data with “R”-Modeling: Architecture - Hybrid Data Modeling – Data Computing Modeling

UNIT III TECHNOLOGY AND TOOLS **(9 Hrs)**

MapReduce/Hadoop – NoSQL: Cassandra,HBASE – Apache Mahout – Tools

UNIT IV BIG DATA SECURITY **(9 Hrs)**

Big Data Security, Compliance, Auditing and Protection: Pragmatic Steps to Securing Big Data, Classifying Data, Protecting Big Data Analytics, Big Data and Compliance, The Intellectual Property Challenge –Big Data in Cyber defense

UNIT V CASE STUDIES **(9 Hrs)**

MapReduce: Simplified Data Processing on Large Clusters- RDBMS to NoSQL: Reviewing Some Next-Generation Non-Relational Database's - Analytics: The real-world use of big data - New Analysis Practices for Big Data

Text Books

1. Frank.J.Ohlhorst, “Big Data Analytics : Turning Big Data into Big Money”, Wiley & Sas Business Series, 2013.
2. Paul C. Zikopoulos, Chris Eaton, Dirk deRoos, Thomas Deutsch, George Lapis, “Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, The McGraw Hill, 2012.

Reference Books

1. .Big Data Now Current Perspectives, O’Reilly Media, 2011.
2. “Planning for Big Data”, O’Reilly Radar Team, 2012.

Web References

1. https://www.softwaretestinghelp.com/big-data-tutorial/
2. https://www.tutorialspoint.com/hadoop/hadoop_big_data_overview.htm
3. https://www.guru99.com/what-is-big-data.html
4. https://towardsdatascience.com/tutorial-building-your-own-big-data-infrastructure-for-data-science-579ae46880d8?gi=a952fa69e354
5. https://www.tutorialride.com/big-databases/big-database-tutorial.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP61	ROBOTICS AND EMBEDDED SYSTEMS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To acquire knowledge about microcontrollers embedded processors and their applications.
- To understand the interfacing of different peripheral devices with Microcontrollers.
- To understand the design concept of embedded systems.
- To gain knowledge about the robotics and kinematics
- To gain knowledge about building self-driving robot and obstacle avoiding robot

.

Course Outcomes

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

CO1 – Peform Arithmetic operation using 8051. **(K2)**
CO2 – Interface ADC, DAC, LED and PWN. **(K2)**
CO3 – Interface with real time clock, serial port, keyboard and LCD. **(K3)**
CO4 - Build a Self-Driving Robot. **(K3)**
CO5 - Build a basic obstacle-avoiding robot. **(K3)**

LIST OF EXPERIMENTS

1. Arithmetic Operations using 8051
2. Interfacing ADC and DAC
3. Interfacing LED and PWM
4. Interfacing real time clock and serial port
5. Interfacing keyboard and LCD
6. Flashing of LEDS
7. Interfacing stepper motor and temperature sensor.
8. Study of robotic arm and its configuration
9. Study the robotic end effectors
10. Build a Self-Driving Robot that can automatically follow a line
11. Build a basic obstacle-avoiding robot and improve the design to help it avoid getting stuck

Text Books

1. Introduction to Embedded Systems : Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)
3. Embedded Systems : Rajkamal (TMH)
4. Embedded Systems : L. B. Das (Pearson)
5. The 8051 Microcontroller and embedded systems by Muhammad Ali Mazidi, PHI.
6. Robotics: Fundamental Concepts and Analysis, Oxford University Press

.

Reference Books

1. Embedded System design : S. Heath (Elsevier)
2. Embedded microcontroller and processor design: G. Osborn (Pearson)
3. Embedded systems design by Steve Heath, Newnes..

.

Web References

1. https://nptel.ac.in/courses/108/102/108102045/
2. https://www.embeddedrelated.com/tutorials.php
3. https://www.tutorialspoint.com/embedded_systems/index.htm
4. https://www.javatpoint.com/robotics-tutorial
5. http://www.robotictutorials.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	1	2	-	1
5	3	2	1	1	3	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP62	MODERN WEB APPLICATIONS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand key concepts of internet and world wide web.
- To know the importance of client side scripting languages.
- To understand about the client side validation using javascript and document object model
- To familiarize with PHP fundamentals
- To know the procedure for database connectivity using PHP and MySQL.

Course Outcomes

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

CO1 - Construct a basic website using HTML and Cascading Style Sheets. **(K3)**
CO2 - Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms. **(K3)**
CO3 - Construct simple web pages in PHP and to represent data in XML format. **(K3)**
CO4 - Design and implement server side programs using PHP. **(K3)**
CO5 - o database manipulation using MySQL and authenticate data. **(K3)**

LIST OF EXPERIMENTS

1. Create a HTML page with frames, links, tables and other tags for highlighting the facilities in the Department in your College. State the assumptions you make (business logic you are taking into consideration).
2. Create a web page with the following using HTML:

a. To embed a map in a web page.
b. To fix the hot spots in that map.
c. Show all the related information when the hot spots are clicked.

Embed an image map picture (India map) on a Web page that provides different links to other Web pages (different states) and show the all the related information depending on where a user clicks on the image.

Create a webpage to embed a human body image, identify and display all the related information about the human body parts (head, eye, nose, finger etc.) based on the user clicks on the human body image map.

3. Create a web page with the following:

a. Cascading style sheets.
b. Embedded style sheets.
c. Inline style sheets.
d. Use your college information for the web pages.

4. Create a User Registration form with First Name, Last name, Address, City, State, Country, Pincode, Username and Password fields for a General login webpage and satisfy the following criteria:

a. Create a validate() function that does the following:
b. Checks that the First Name, Last Name, City, Country, Username, and Password fields are filled out.
c. Checks that the Pincode is exactly 6 numeric.
d. Checks that the state is exactly two characters.
e. Checks that the email is a valid email address.

- false if email has fewer than 6 characters
- false if email does not contain an @ symbol
- false if email does not contain a period (.)
- true otherwise

5. Write a DTD for a XML document that declares an address book containing contacts. Each contact has a name and address. An address should contain attributes for street name, state and phone number. Write a XML document and validate it against this DTD.
6. Create and save a XML document at the server, which contains 10 users information. Write a Program, which takes user Id as an input and returns the user details by taking the user information from the XML document.
7. Create a XML to represent the BOOKS catalog that has the following elements (TITLE, ISBN NO, AUTHOR, PUBLISHER, and PRICE). Display the book details styled with XSLT.
8. Create an Extensible markup language to represent the students mark information of a class. Create a webpage to display all the students consolidated mark statement with pass (green color) or fail (red color) using XSLT
9. Write programs in PHP to create three-tier applications:

a. for conducting on-line examination.

b. for displaying student mark list. Assume that student information is available in a database which has been stored in a database server.

10. Session tracking using hidden form fields and Session tracking for a hit count.
11. Convert the static webpages of programs 1 to 4 into dynamic web pages using PHP and cookies. Hint: Users information (user id, password, credit card number) would be stored in web.xml.
12. Write a PHP program for Employee Details which includes EmpID, Name, Designation, Salary, DOJ, etc., to connect with the database and execute queries to retrieve and update data. Prepare the report for single and group of employees based on the end user needs.
13. Consider a Library Management System. Develop a JavaScript program that will validate the controls in the forms you have created for the application. State the assumptions you make (business logic you are taking into consideration). Note: Your application must access a database using PHP.

Text Books

1. Deitel P. J., Deitel H. M. and Deitel A., “Internet and World Wide Web: How to Program”, Fifth Edition, Pearson Prentice Hall, 2012.
2. Jon Duckett, “HTML & CSS: Design and Build Websites”, First Edition, John Wiley & Sons, 2011.
3. Naramore E., Gerner J., Scouarnec Y.L., et al., “Beginning PHP5, Apache, MySQL Web Development:Programmer to Programmer”, John Wiley & Sons Inc., 2005.

.

Reference Books

4. Sebesta R. W.,” Programming the World Wide Web”, Eight Edition, Pearson, 2014.
1. Pressman R. and Lowe D.,” Web Engineering: a practitioner's approach”, First Edition, Mc GrawHill, 2008.
2. Kappel G., et al.,” Web Engineering: The Discipline of systematic Development of Web Applications”, First Edition, John Wiley & Sons, 2006.
3. Suh W., “Web Engineering: Principles and Techniques”, Idea Group Inc., 2005.
4. Ullman L ,” PHP for the Web: Visual Quick Start Guide”, Fifth Edition, Peach pit Press, 2016..

.

Web References

1. https://www.w3schools.com/
2. https://www.tutorialspoint.com/internet_technologies/websites_development.htm
3. https://developer.mozilla.org/en-US/docs/Learn
4. https://nptel.ac.in/courses/106/105/106105084/
5. https://nptel.ac.in/courses/106/106/106106222/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	3	-	-	-	-	-	-	1	2	-	1
5	3	2	1	1	3	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP63	DATA MINING AND ANALYTICS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To know about the installation procedure of Weka and R Platform
- To Know the Loading and visualization of data.
- Study the Preprocessing mechanism.
- To familiarize linear and non-linear models of data analysis.
- To understand the concepts of time series analysis and aspects of prescriptive analysis.

.

Course Outcomes

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

CO1 – Demonstrate the installation Weka and R - platform. **(K3)**
CO2 - Perform loading and visualization of data. **(K3)**
CO3 - Perform preprocessing tasks for the data set. **(K3)**
CO4 – Develop applications using supervised and unsupervised algorithms. **(K3)**
CO5 - Develop applications using linear and non-linear techniques. **(K3)**

LIST OF EXPERIMENTS

1. Installing Weka and exploring a dataset.
2. Loading a dataset and visualizing the Data
3. Preprocessing a dataset from a real domain (Medical/Retail/Banking)
4. Building a classifier- Run Decision Tree, Naïve Bayesian Classifier, KNN classifier and SVM.
5. Mining Association Rules- Run Apriori Algorithm.
6. Building a statistical model using a sample dataset – preprocessing, hypothesis building, model fitting, modelvalidation and interpretation of results.
7. Implementation of linear regression technique for statistical model building.
8. Implementation of Non-linear regression technique for statistical model building.

Text Books

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.
2. Lior Rokach and Oded Maimon, “Data Mining and Knowledge Discovery Handbook”, Springer, 2nd edition, 2010.
3. Ian H. Witten, Eibe Frank and Mark A. Hall “Data Mining: Practical Machine Learning Tools and Techniques”,Fourth Edition, Elsevier, 2017..

.

Reference Books

1. Box, G.E.P and Jenkins G.M. (1970) Time Series Analysis, Forecasting and Control, Holden-Day.
2. Draper, N. R. and Smith, H., “Applied Regression Analysis”, Third Edition, John Wiley, 1998.
3. Hosmer, D. W. and Lemeshow, S., “Applied Logistic Regression”, Third Edition, Wiley, 2003..

.

Web References

1. https://nptel.ac.in/courses/106/105/106105174/
2. https://nptel.ac.in/courses/110/106/110106072/
3. https://www.tutorialspoint.com/data_mining/index.htm
4. https://www.javatpoint.com/data-mining
5. https://www.guru99.com/data-mining-tutorial.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP64	E-COMMERCE AND E-PAYMENT SYSTEMS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce the fundamental concepts of e-commerce models.
- To learn the validation features used in e-commerce portal
- To understand how to design search engine enabled e-commerce portal
- To understand the payment systems
- To understand the security concepts in e-commerce.

.

Course Outcomes

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

CO1 – Develop basic e-commerce portal. **(K3)**
CO2 – Perform validation on e-commerce portal. **(K3)**
CO3 – Include the search engine facility in e-commerce portal. **(K3)**
CO4 - Use of payment in e-commerce portal. **(K3)**
CO5 – Create online application using e-commerce models . **(K3)**

LIST OF EXPERIMENTS

1. Create an E- Commerce website (Take your own concepts to develop site.)
2. Create and validate a form for E- Commerce website using Java script & PHP
3. Design and implementation of E-Commerce portal for product catalog
4. Design and implementation of Search Engine for E- Commerce website
5. Develop a Shopping Cart with e-payment system.
6. Create an Online e-learning platform.

Text Books

4. Jeffrey F.Rayport and Bernard J.Jaworski, Introduction to E-commerce, TMH, 2003.
1. Kalakota and Winston, Frontiers of E-commerce, Pearson Education, Mumbai, 2002.
2. Jaspal Singh , Digital Payments in India: Background, Trends and Opportunities, New Century Publications, November 2019.

.

Reference Books

1. Elias M.Awad, Electronic Commerce, Prentice-Hall India, New Delhi,.2007.
2. Susanne Chishti, Tony Craddock, Robert Courtneidge, Markos Zachariadis,The PAYTECH Book: The Payment Technology Handbook for Investors, Entrepreneurs, and FinTech Visionaries, Wiley, December 2019.
3. Skip Allums,Designing Mobile Payment Experiences: Principles and Best Practices for Mobile Commerce, O'Reilly, June 2019.

.

Web References

1. https://www.tutorialspoint.com/e_commerce/
2. https://nptel.ac.in/content/storage2/courses/106108103/pdf/PPTs/mod13.pdf
3. https://study.com/academy/course/e-commerce-help-tutorials.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP65	BIG DATABASES LABORATORY	L	T	P	C	HRS
		0	0	2	1	30

Course Objectives

- To know the installation procedure of Hadoop framework
- To know the file management operations in Hadoop.
- To understand data analysis tasks using Hadoop
- To familiar develop application in Hadoop.
- To understand the concepts table, view, functions and indexes in Hive database

.

Course Outcomes

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

CO1 – Demonstrate the procedure for Hadoop Installation. **(K2)**
CO2 – Implement File Management Tasks in Hadoop. **(K3)**
CO3 – Perform analysis for real-time data using Map Reduce. **(K3)**
CO4 – Build application using Hadoop Map Reduce. **(K3)**
CO5 – Create tables, views, functions and indexes using Hive Database. **(K3)**

LIST OF EXPERIMENTS

1. Installation of Hadoop
2. File Management tasks in Hadoop
3. Word Count Map Reduce program to understand Map Reduce Paradigm
4. Weather Report POC-Map Reduce Program to analyse time- temperature statistics and generate report with max/min temperature.
5. Implementing Matrix Multiplication with Hadoop Map Reduce
6. Pig Latin scripts to sort,group,join,project, and filter your data
7. Hive Databases,Tables,Views,Functions and Indexes.

Text Books

1. Frank.J.Ohlhorst, “Big Data Analytics : Turning Big Data into Big Money”, Wiley & Sas Business Series, 2013.
2. Paul C. Zikopoulos, Chris Eaton, Dirk deRoos, Thomas Deutsch, George Lapis, “Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, The McGraw Hill, 2012.

Reference Books

1. .Big Data Now Current Perspectives, O’Reilly Media, 2011.
2. “Planning for Big Data”, O’Reilly Radar Team, 2012.

Web References

1. https://www.softwaretestinghelp.com/big-data-tutorial/
2. https://www.tutorialspoint.com/hadoop/hadoop_big_data_overview.htm
3. https://www.guru99.com/what-is-big-data.html
4. https://towardsdatascience.com/tutorial-building-your-own-big-data-infrastructure-for-data-science-579ae46880d8?gi=a952fa69e354
5. https://www.tutorialride.com/big-databases/big-database-tutorial.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

Professional Elective III

U20CBE711	COGNITIVE SCIENCE & ANALYTICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the way in which cognitive science is methodologically distinctive while at the same time is an interdisciplinary field where established fields of research—including Psychology, Computer Science, Linguistics, Neuroscience.
- To gain about memory-related concepts of cognitive sciences
- To develop skills in analyzing, interpreting, and assessing the empirical data and research techniques that contribute to cognitive science.
- To understand central modeling techniques in cognitive science
- To demonstrate the acquired inter-disciplinary knowledge in language processing and application of different research approaches with cognitive science

Course Outcomes

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

CO1 - Understand the basic principles and process of cognitive science. **(K2)**

CO2 - Understand the memory and learning model and apply the same to appropriate real-world applications. (**K2)**

CO3 - Demonstrate qualitative and quantitative skills and critical thinking in cognitive science by applying a suitable methodology to real-world applications. **(K3)**

CO4 – Analyse the usage of memory models and sensory information fusion techniques. **(K4)**

CO5 - Envisage the concept of cognitive learning. **(K2)**

UNIT I INTRODUCTION TO COGNITIVE SCIENCE (9Hrs)

Introduction to the study of cognitive sciences. Neural Network Models- language: definition Affordances Categories and concepts; Concept learning: Linguistic knowledge: Syntax, semantics, (and pragmatics) Direct perception, Logic; Machine learning.

.

UNIT II CONCEPT HIERARCHIES (9Hrs)

A brief history of cognitive science. Processing of sensory information in the brain, Linguistic knowledge: Syntax, semantics, (and pragmatics), Ecological Psychology, Constructing memories Methodological concerns in philosophy, Discretization and generating concept hierarchies, Data Mining System, Generative linguistic, Affordance learning in robotics, Explicit vs. implicit memory

UNIT III ANATOMY OF BRAIN (9Hrs)

Artificial intelligence and psychology, Brain Imaging, Brain and language, Affordance learning in robotics, Information processing (three-boxes) model of memory Structure and constituents of the brain fMRI, MEG, Language disorders, Development Information processing (three-boxes) model of memory.

UNIT IV MEMORY MODELS AND SENSORY INFORMATION FUSION (9Hrs)

Brief history of neuroscience, PET, EEG Lateralization Child and robotic development Sensory memory; Short term memory Mathematical models, Multisensory integration in cortex, Lateralization, Attention and related concepts, long term memory; Rationality

Mathematical models Information fusion, the great past tense debate, Human visual attention, Bounded rationality; Prospect theory; Heuristics and biases Looking at brain signals.

UNIT -V MODELLING AND INFORMATION PROCESSING (9Hrs)

From sensation to cognition, The great past tense debate, Computational models of attention, Reasoning in computers, Cybernetics, Cognitivist and emergent stand points, Computational models of attention, Key points in social cognition, Processing of sensory information in the brain. From physics to meaning, Analog vs. Digital: Code duality. A robotic perspective, Applications of computational models of attentional Context and social judgment; Schemas; Social signals

Text Books

1. Pradeep Kumar Mallick, Samarjeet Borah," Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers,2019.
2. Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind", Cambridge University Press, New York,2020.
3. Keith Frankish and William Ramsey, The Cambridge Handbook of Cognitive Science, 2012

Reference Books

1. José Luis Bermúdez, Cognitive Science: An Introduction to the Science of the Mind, 2nd edition, 2014
2. Smith/Kosslyn, Cognitive Psychology: Mind and Brain, Pearson, 2015
3. Judith S. Hurwitz and Marcia Kaufman, Cognitive Computing and Big Data Analytics,1st edition,2015

Web References

1. https://nptel.ac.in/courses/109/103/109103134/
2. https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-hs24/
3. https://academicconnections.ucsd.edu/onlinecourses/intro-cogsci.html
4. https://libguides.gatech.edu/c.php?g=53981&p=348459

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE712	INTRODUCTION TO IOT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand basic principles and concepts of Internet-of-Things use cases and its applications
- To learn about the concepts of IoT architecture.
- To understand the various sensors and their applicability
- To get an overview of an end-to-end IoT system encompassing the edge, cloud, and application tiers.
- To gain an understanding of the storage technologies specific to IoT Systems

Course Outcomes

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

CO1 - Understand basic principles and concepts of Internet-of-Things use cases, applications. (**K2)**
CO2 -Understand basic concepts of the Architecture of IoT. (**K2)**
CO3 -Describe Sensor and its applicability. (**K2)**
CO4 -Understand Networking and communication for IoT. (**K2)**
CO5 -Comprehend IoT data processing and storage. (**K2)**

UNIT– I INTRODUCTION TO IOT AND USE CASES (9 Hrs)

Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains.

UNIT– II ARCHITECTURE (9 Hrs)

IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing.

UNIT– III SENSORS AND INDUSTRIAL SYSTEMS (9 Hrs)

Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions.

UNIT– IV NETWORKING AND COMMUNICATION FOR IOT (9 Hrs)

Recap of OSI 7-layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications (web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers).

UNIT– V IOT DATA PROCESSING AND STORAGE (9 Hrs)

Time Series Data and their characteristics, time-series databases, basic time-series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection.

Text Books

1. Samuel Greengard , The Internet of Things, MIT Press Essential Knowledge Series, 2015
2. Arsheep Bahga and Vijay Madisetti, Internet Of Things: A Hands-On Approach,2015
3. Prof. Satish Jain and Shashi Singh, Internet of Things and its Applications,bpb publications, 2020

Reference Books

1. Ben Fry, Visualizing Data-Exploring and Explaining Data with the Processing Environment, O'Reilly Media, 2008.
2. Andrew K Dennis , Raspberry Pi Computer Architecture Essentials, Packt Publishing, 2016
3. Cuno Pfister, Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition,Orielly,2011

Web References

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-cs17/
3. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-cs66/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE713	CRYPTOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the fundamentals of cryptography and its services
- To learn about the symmetric key cryptosystems
- To gain significance of block ciphers and public-key cryptosystems
- To understand the scope of cryptosystems on different applications.
- To learn about the fundamentals of post-quantum cryptography

Course Outcomes

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

CO1 - Apply concepts of cryptography to provide security services. **(K3)**

CO2 - Understand the use of symmetric key cryptosystems. **(K2)**

CO3 - Gain knowledge about the various block ciphers and public-key cryptosystems. **(K2)**

CO4 - Analyze the applications of cryptosystems. **(K3)**

CO5 - Explore the concepts of post-quantum cryptography. **(K3)**

UNIT– I INTRODUCTION TO CRYPTOGRAPHY **(9 Hrs)**

Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation, Elementary cryptosystems.

Basic security services: confidentiality, integrity, availability, non-repudiation, privacy

UNIT– II SYMMETRIC KEY CRYPTOSYSTEMS **(9 Hrs)**

Stream Cipher: Basic Ideas, Hardware and Software Implementations, Examples with some prominent ciphers: A5/1, Grain family, RC4, Salsa and ChaCha, HC128, SNOW family, ZUC;

UNIT– III BLOCK CIPHERS **(9 Hrs)**

Block Ciphers: DES, AES, Modes of Operation; Hash Functions; Authentication

Public Key Cryptosystems: RSA, ECC; Digital signatures

UNIT– IV SECURITY APPLICATIONS **(9 Hrs)**

Electronic commerce (anonymous cash, micro-payments), Key management, Zero-knowledge protocols,

Cryptology in Contact Tracing Applications, Issues related to Quantum Cryptanalysis

UNIT– V POST-QUANTUM CRYPTOGRAPHY **(9 Hrs)**

Post-Quantum Cryptography, Public-Key Post-Quantum Cryptographic Algorithms, Stateful Hash-Based Signatures, Threshold Cryptography.

Text Books

1. D. R. Stinson*, Cryptography, Theory and Practice*, CRC Press.
2. W. Stallings *,Cryptography and Network Security*, Prentice Hall.
3. A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone*, Handbook of Applied Cryptography*, CRC Press

Reference Books

1. N. Koblitz*,A course in number theory and cryptography*, GTM, Springer.
2. G. Paul and S. Maitra *, RC4 Stream Cipher and Its Variants,* CRC Press, Taylor & Francis Group, A Chapman & Hall Book, 2012
3. C. S. Mukherjee, D. Roy, S. Maitra*, Design & Cryptanalysis of ZUC - A Stream Cipher in Mobile Telephony*, Springer 2020
4. P. Chakraborty, S. Maitra, M. Nandi, S. Talnikar*, Contact Tracing in Post-Covid World - A Cryptologic Approac.*, Springer 2020

Web References

1. www.theory.caltech.edu/ ~ preskill/ph229/
2. https://nptel.ac.in/courses/106/107/106107155/
3. https://www.tutorialspoint.com/cryptography/index.htm
4. https://www.khanacademy.org/computing/computer-science/cryptography

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE714	ROBOTICS PROCESS AUTOMATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the role of Artificial Intelligence in Automation
- To learn the evolution and future of Robotic Process Automation
- To comprehend about the UI Path features and its applicability
- To gain knowledge about the Blue Prism process and operations for operating system of Digital Workforce.
- To know about the concept of Automation Anywhere and automate any business process with intelligent, scalable software robots

Course Outcomes

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

CO1 - Apply basic principles of AI in solutions that require problem solving, knowledge and automation. **(K3)**

CO2 - Identify processes suitable for RPA and recognize how RPA is transforming businesses. **(K2)**

CO3 – Automate the process using UI Path. **(K3)**

CO4 – Demonstrate the use of Blue prism. **(K2)**

CO5 - Explore process team's consistency, automate workflows, create IQ bots and manage them effectively. **(K2)**

UNIT– I AI AND AUTOMATION **(9Hrs)**

AI Foundations- AI Data, AI Capabilities framework- Associated Technologies of AI - AI Prototyping- Industrializing AI - Cognitive Automation tools- Natural language processing- AI Resources -Future of AI.

UNIT– II INTRODUCTION TO RPA **(9Hrs)**

RPA Foundations- History of RPA-Difference between RPA and AI- Benefits of RPA-Components of RPA- RPA Architecture- RPA Skills- Process Methodologies in RPA- Planning for RPA-RPA Platforms- Types of Bots- Deployment platforms- Future of RPA.

UNIT– III UI PATH **(9Hrs)**

Introduction to UI Path: UI Path Studio-UI Path Robot-UI path Orchestrator-Task Recorder-Sequence, Flowchart, and Control Flow- Sequencing the workflow- Data Manipulation- Application with Plug-ins and Extensions Terminal Plug-in- Handling User Events and Assistant Bots- Deploying and Maintaining the Bot.

UNIT– IV BLUE PRISM **(9Hrs)**

Introduction-Process Studio- Pages, Actions, Decisions, Choices and collections-Implementing business objects-Spying Elements-Working with excel –Sending and receiving email, Control room and work queues-Exception Handling

UNIT– V AUTOMATION ANYWHERE **(9Hrs)**

Introduction of Automation Anywhere-Tasks-Tasks Editors-Integration and collaboration with Automation Anywhere- working with web pages and JSON Data- Citrix Automation- E-mail Automation- PDF integration- Web Recorder-Creating IQ bots -Deploying and Maintaining the Bot.

Text Books

1. Tom Taulli ,"Artificial Intelligence Basics: A Non-Technical Introduction ",First Edition,Apress,2019
2. Alok Mani Tripathi ,"Learning Robotic Process Automation Create Software robots and automate business proce1ses with the leading RPA tool – UiPath", First Edition, Packt Publishing ,2018
3. Lim Mei Ying ,"Robotic Process Automation with Blue Prism Quick Start Guide ",First Edition ,Packt Publishing ,2018
4. Tom Taulli ,"The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", First Edition,Apress,2020

Reference Books

1. Palgrave Macmillan," The Executive Guide to Artificial Intelligence: How to identify and impement application for AI in your organization", Springer press ,2018
2. Jonathan Sireci ,"The Practitioner's Guide to RPA: A Practical Guide for Deploying Robotics Process Automation,Kindle Edition,2020

Web References

1. https://www.uipath.com/solutions/technology/web-automation
2. https://www.uipath.com/developers/video-tutorials/web-data-extraction-automation
3. https://community.blueprism.com/communities/community-home/
4. https://www.blueprism.com/
5. https://www.automationanywhere.com/in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE715	DIGITAL MARKETING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To illustrate to concepts of digital marketing and its channels
- To understand the types of digital marketing
- To know about the use of social media for digital marketing
- To gain the knowledge of SEO and competitor analysis
- To learn about the CRM and its services

Course Outcomes

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

CO1 – Understand the concepts digital marketing and its channels. **(K2)**
CO2 – Gain knowledge about the types of digital marketing. **(K2)**
CO3 – Use of social media for digital marketing. **(K3)**
CO4 – Perform competitor analysis. **(K3)**
CO5 – Explore the concepts of CRM. **(K2)**

UNIT I: INTRODUCTION **(9Hrs)**

Digital Marketing Foundation: Introduction to marketing – Concepts - Theories Difference between traditional, inbound, and outbound marketing methodologies - Digital vs. Real Marketing - Digital Marketing Channels - Creating an initial digital marketing plan

Introduction of the digital marketing - Digital vs. Real Marketing - Digital Marketing Channels - Creating initial digital marketing plan - Content management - SWOT analysis - Target group analysis

UNIT II: DIGITAL MARKETING **(9Hrs)**

Resource planning - cost estimating - cost budgeting - cost control- E-mail marketing -E-mail marketing campaign analysis - Mobile Marketing – Content Marketing – App store Optimization – Affiliate Marketing – Adwords – Online display.

UNIT III: SOCIAL MEDIA MARKETING **(9Hrs)**

Understanding social media – Marketing Tools- Internet marketing – Facebook- LinkedIn – Twitter advertising and publishing - Blogging- Freelancing-Video Marketing Platform Specific Tools Strategies- Social Media Marketing architecture. Business opportunities and Instagram options - Optimization of Instagram profiles - Integrating Instagram with a Web Site and other social networks - Keeping up with posts - Business tools on LinkedIn - Creating campaigns on LinkedIn - Analyzing visitation on LinkedIn - Creating business accounts on YouTube - YouTube Advertising - YouTube Analytics, Facebook Ads - Creating Facebook Ads - Ads Visibility

UNIT IV: COMPETITOR AND WEBSITE ANALYSIS **(9Hrs)**

Competitor Research Tools- Website Analysis Tools – Web analytics - Levels – Keyword Research Tools- Back Analysis Tools- Search Engine Optimization (SEO) – Tools – On-Page and Off-page SEO – Google analytics

UNIT V: CRM **(9Hrs)**

CRM platform - CRM models – Exercise - CRM strategy - Customer Development Process Customer Retention- Customer satisfaction - Customer Retention Strategies - Relationship Management- CRM process for B2B markets - Technological Applications in CRM - Customer Databases and Information Systems - Emerging Trend in CRM - e-CRM in Service Marketing, e-CRM strategies, e-CRM architecture

Text Books

1. Ryan, D. . Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited,2014
2. Romuald Andrade ,Beginners Guide to Digital Marketing: How to Flood Your Website With Traffic in 30 Days,2015
3. Digital Marketer. Pulizzi, J. Epic Content Marketing, Mcgraw Hill Education,2014

Reference Books

1. Puneet Singh Bhatia ,Fundamentals of Digital Marketing , Pearson– 2017
2. Ryan Deiss, Russ Henneberry ,Digital Marketing For Dummies, 2020
3. Seema Gupta,Digital Marketing, Second Edition,2020
4. Kingsnorth, Simon. Digital marketing strategy: an integrated approach to online marketing. Kogan Page Publishers, 2019.

Web References

1. https://www.tutorialspoint.com/digital_marketing/index.htm
2. https://www.simplilearn.com/tutorials/digital-marketing-tutorial
3. https://www.javatpoint.com/digital-marketing

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Professional Elective IV

U20CBE716	QUANTUM COMPUTATION & QUANTUM INFORMATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the fundamental concepts of quantum computing
- To learn how to do computation using quantum algorithms
- To gain knowledge about the advanced quantum algorithms
- To gain knowledge about the quantum random number generation
- To understand the process of key distribution

Course Outcomes

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

CO1 - Understand the basic concepts of quantum computing. **(K2)**

CO2 - Able to implement quantum algorithms for performing computations on quantum computers. **(K3)**

CO3 - Generate perfectly unpredictable random numbers to ensure the strongest level of encryption. **(K3)**

CO4 - Ensure secure communication using the quantum key distribution method. **(K3)**

CO5 - Evaluate and standardize quantum-resistant public-key cryptographic algorithms. **(K3)**

UNIT I INTRODUCTION TO QUANTUM INFORMATION (9 Hrs)

States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits.

UNIT II QUANTUM ALGORITHMS BASIC (9Hrs)

Deutsch-Jozsa, Simon, Grover, Shor, Implication of Grover's and Simon's algorithms towards classical symmetric key cryptosystems

UNIT III QUANTUM ALGORITHMS ADVANCED (9 Hrs)

Implication of Shor's algorithm towards factorization and Discrete Logarithm based classical public-key cryptosystems

UNIT IV QUANTUM TRUE RANDOM NUMBER GENERATORS (QTRNG) (9 Hrs)

Quantum True Random Number Generators (QTRNG): Detailed design and issues of quantumness, Commercial products and applications

UNIT V BASIC AND ADVANCED QUANTUM KEY DISTRIBUTION (9 Hrs)

Quantum key distribution (QKD): BB84, Ekert, Semi-Quantum QKD protocols, Variations in Semi-Quantum QKD protocols, Issues of Device Independence, Commercial products

Text Books

1. M. A. Nielsen and I. L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press. 2010.
2. Chris Bernhardt, Quantum Computing for Everyone, MIT Press 2019.
3. Parag K. Lala, Quantum Computing - A Beginners Introduction, Mc Graw Hill,2019

Reference Books

1. Jack D. Hidary, Quantum Computing: An Applied Approach 1st ed. Edition, Springer 2019
2. Robert Loredo, Learn Quantum Computing with Python and IBM Robert Loredo, Quantum Experience: A hands-on introduction to quantum computing and writing your quantum programs with Python, Packt Publishing,2020

Web Resources

1. Presskil Lecture notes: Available online: http://www.theory.caltech.edu/~preskill/ph229/
2. NIST Post Quantum Cryptography, Available online: https://csrc.nist.gov/projects/post-quantum-cryptography/
3. https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs103/

COs/POs/PSOs Mapping

Co's	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE717	ADVANCED SOCIAL, TEXT AND MEDIA ANALYTICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the various tools for Text Mining and carry out Pattern Discovery, Predictive Modelling.
- To understand the importance of web mining
- To Explore the use of social media network to understand the growing connectivity and complexity in the world around us on different scales
- To perform social media analytics to identify important social actors, subgroups, and network properties in social media sites.
- To gain knowledge about the sentiment analysis and opinion mining

Course Outcomes

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

CO1 - Interpret the contribution of text mining to generate new knowledge from natural language text. **(K2)**

CO2 - Extract useful information from the textual data using various classifiers and Predictors **(K2)**

CO3 - Identify the various components of a web that can be used for the mining process **(K2)**

CO4 - Analyse social media data using appropriate using various analytical techniques **(K3)**

CO5 - Provide solutions to the emerging problems of social media analytics with sentiment analysis and opinion mining **(K4)**

UNIT I INTRODUCTION TO TEXT MINING (9 Hrs)

Introduction to Text Mining - Text Representation - Core text mining operations - Text mining applications. Text mining Pre-processing techniques - Text Clustering, Text Classification, Topic Modelling, Probabilistic models for information extraction

UNIT II WEB MINING (9 Hrs)

Web Analytics - Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval. Search engine optimization, Web crawling, Indexing, Ranking algorithms, Web traffic models

UNIT III SOCIAL MEDIA NETWORKS (9 Hrs)

Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization.

UNIT IV SOCIAL MEDIA ANALYTICS (9 Hrs)

Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis

UNIT V SENTIMENT ANALYSIS AND OPINION MINING (9 Hrs)

Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modelling; Sentiment Analysis; Sentiment Prediction.

Text Books

1. Bing Liu, Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data, Springer, Second Edition, 2011.
2. Reza Zafarani, Mohammad Ali Abbasi and Huan Liu, Social Media Mining-An Introduction, Cambridge University Press, 2014.
3. Bing Liu, Sentiment Analysis: Mining Opinions, Sentiments, and Emotions, Cambridge University Press, Second Edition, 2020.

Reference Books

1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, First Edition, 2009.
2. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics,2011.
3. Alex Gonçalves, Social Media Analytics Strategy: Using Data to Optimize Business Performance,2017.

Web Resources

1. https://www.tutorialspoint.com/social_media_marketing/social_media_analysis.htm
2. https://onlinecourses.nptel.ac.in/noc21_cs74/preview
3. http://r-tutorials.com/social-media-analysis-in-r/

COs/POs/PSOs Mapping

Co's	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE718	MOBILE COMPUTING TECHNIQUES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn about various wireless & cellular communication networks and various telephone and satellite networks.
- To study about the location and handoff management
- To know about wireless Transmission fundamentals
- To build knowledge on various wireless sensor network routing protocols, energy-efficient protocols and D2D Communication in cellular networks.
- To explore the suitability of mobile computing models

Course Outcomes

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

CO1 - Understand the working principles of mobile networks and Contrast different types of telecommunication networks. **(K2)**

CO2 - Gain knowledge about the location and handoff management. **(K2)**

CO3 - Comprehend the fundamentals of wireless transmission. **(K2)**

CO4 – Explore the concepts of wireless sensor networks and D2D Communication. **(K3)**

CO5 – Use of Mobile computing models for different applications. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Overview of wireless and mobile infrastructure; Preliminary concepts on cellular architecture; Design objectives and performance issues; Radio resource management and interface; Propagation and path loss models; Channel interference and frequency reuse; Cell splitting; Channel assignment strategies; Overview of generations:- 1G to 5G.

UNIT II LOCATION AND HANDOFF MANAGEMENT (9 Hrs)

Introduction to location management (HLR and VLR); Mobility models characterizing individual node movement (Random walk, Fluid flow, Markovian, Activity-based); Mobility models characterizing the movement of groups of nodes (Reference point-based group mobility model, Community based group mobility model); Static and Dynamic location management schemes

Location management and Mobile IP; Overview of handoff process; Factors affecting handoffs and performance evaluation metrics; Handoff strategies; Different types of handoffs (soft, hard, horizontal, vertical).

.

UNIT III WIRELESS TRANSMISSION FUNDAMENTALS (9 Hrs)

Introduction to narrow and wideband systems; Spread spectrum; Frequency hopping; Introduction to MIMO; MIMO Channel Capacity and diversity gain; Introduction to OFDM; MIMO-OFDM system; Multiple access control (FDMA, TDMA,

CDMA, SDMA); Wireless local area network; Wireless personal area network (Bluetooth and Zigbee).

Mobile Ad-hoc networks

Characteristics and applications; Coverage and connectivity problems; Routing in MANETs.

UNIT IV WIRELESS SENSOR NETWORKS & D2D COMMUNICATION (9 Hrs)

Concepts, basic architecture, design objectives and applications; Sensing and communication range; Coverage and connectivity; Sensor placement; Data relaying and aggregation; Energy consumption; Clustering of sensors; Energy-efficient Routing (LEACH).

D2D Communications in 5G Cellular Networks

Introduction to D2D communications; high-level requirements for 5G architecture; Millimeter-wave communication in 5G.

UNIT V MOBILE COMPUTING MODELS (9 Hrs)

Mobile Computing Models: Client-Server model – Client/Proxy/Server Model – Disconnected Operation Model – Mobile Agent Model – Thin Client Model – Tools: Java, Brew, Windows CE, WAP, Sybian, and EPOC

Content Beyond Syllabus

Cognitive radio networks and their applications

Text Books

1. Jochen Schiller, Mobile Communications. Pearson Education, 2009.
2. Andrea Goldsmith, Wireless Communications. Cambridge University Press, 2012.
3. Prasant KumPattnaik and Rajiib Mall, Fundamentals Of Mobile Computing, Prentice-Hall of India Pvt.Ltd

Reference Books

1. Ivan Stojmenovic, Handbook of Wireless Networking and Mobile Computing, Wiley, 2002.
2. Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan Mandayam and H. Vincent Poor, Principles of Cognitive Radio. Cambridge University Press, 2012.
3. Raj Kamal, Mobile Computing, 2nd edition, 2011

Web Resources

1. https://nptel.ac.in/courses/106/106/106106147/
2. https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/
3. http://www.digimat.in/nptel/courses/video/106106147/L15.html

COs/POs/PSOs Mapping

Co's	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE719	BLOCKCHAIN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the fundamentals of blockchain and its impacts on crypto-economics
- To gain an understanding of smart contracts
- To know about the various cryptography mechanism and other technologies related to blockchain
- To be familiar with Implementation aspects of blockchain
- To familiarize with bitcoin and its platform

Course Outcomes

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

CO1 - Gain the visibility of blockchain concepts **(K2)**
CO2 - Use of smart contracts for blockchain application **(K3)**
CO3 - Apply cryptography techniques for suitable applications **(K3)**
CO4 - Design the blockchain use cases using implementation platforms **(K3)**
CO5 - Familiarize with bitcoin and its platform **(K2)**

UNIT I BLOCKCHAIN - INTRODUCTION TO CRYPTO ECONOMICS (9Hrs)

Byzantine agreement - Extensions of BFT (Ripple, Stellar) - Blockchain Dynamics - Public and private blockchains - Hard and soft forks - Sharding Side chain - Verifiers – trust, cost, and speed - Proof of work and other models.

UNIT II SMART CONTRACTS (9Hrs)

Distributed Virtual Machines, Smart Contracts, Oracles - Basics of contract law – Smart contracts and their potential Trust in Algorithms, - Integration with existing legal systems - OpenZeplin, OpenLaw- Writing smart contracts.

UNIT III CRYPTOGRAPHY AND OTHER TECHNOLOGIES (9Hrs)

Application of Cryptography to Blockchain – Using hash functions to chain blocks - Digital Signatures to sign transactions - Using hash functions for Proof-of-Work. - Putting the technology together – examples of implementations with their tradeoffs.

UNIT IV IMPLEMENTATION (9Hrs)

Supply Chain and Identity on Blockchain - Blockchain interaction with existing infrastructure – Trust in blockchain data - Scaling Blockchain – reading and writing data. Differentiate nodes, sparse data, and Merkle trees - Fixing on the fly – Layer 2 solutions - Lightning and Ethereum state channels.

UNIT V BITCOIN (9Hrs)

The big picture of the industry – size, growth, structure, players - Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT) - Strategic analysis of the space –Major players: Blockchain platforms, regulators, application providers, etc. - Bitcoin, Hyper Ledger, Ethereum, Litecoin, Zcash.

Text Books:

1. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies Is
2. Changing the World, Don Tapscott and Alex Tapscott, Portfolio, 2018.
3. The Age of Cryptocurrency: How Bitcoin and the Blockchain Are Challenging the Global Economic Order, Paul Vigna and Michael J. Casey, Picador. 2016.
4. Blockchain Technology Explained: The Ultimate Beginner's Guide About Blockchain Wallet, Mining.

Reference Books

1. Alan T. Norman, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA And Smart Contracts, CreateSpace Independent Publishing Platform, 2017.
2. Andy Dickson, Blockchain and Cryptocurrency 2 Books in 1: The Ultimate Guide to Bitcoin and its Technology – Learn how to profit for the coming Bull Run!,2020.
3. Chandramouli Subramanian, Blockchain Technology, Universities Press (India) Pvt. Ltd., First edition, 2020.

Web Resources

1. https://nptel.ac.in/courses/106/104/106104220/
2. https://onlinecourses.nptel.ac.in/noc22_cs44/preview
3. https://nptel.ac.in/courses/106/105/106105184/

COs/POs/PSOs Mapping

Co's	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE720	VIRTUAL REALITY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the concept of Virtual Reality.
- To know the concepts of Geometry, light and optics for Virtual Reality.
- To study about the Physiology of Human Vision.
- To create visual perception and rendering with Virtual World.
- To know about tracking, interaction and Audio.

Course Outcomes

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

CO1 - Understand the concept of Virtual Reality. **(K2)**
CO2 – Apply the Geometry for Virtual Reality. **(K3)**
CO3 – Understand the Physiology of Human Vision using VR. **(K3)**
CO4 - Create visual perception and rendering with Virtual World. **(K3)**
CO5 – Use of tracking, interaction and audio for VR applications. **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Virtual Reality: What is Virtual Reality - Modern VR Experiences - History Repeats. Bird's-Eye View: Hardware - Software - Human Physiology and Perception.

UNIT II GEOMETRY, LIGHT AND OPTICS (9 Hrs)

Geometric Models - Changing Position and Orientation - Axis-Angle Representation of Rotation - Viewing Transformations - Chaining the Transformations.
Light and Optics: Basic Behavior - Lenses - Optical Aberrations - The Human Eye - Cameras – Displays.

UNIT III PHYSIOLOGY OF HUMAN VISION (9 Hrs)

From the Cornea to Photoreceptors - From Photoreceptors to the Visual Cortex - Eye Movements - Implications for VR.

UNIT IV VISUAL PERCEPTION, VISUAL RENDERING AND MOTION IN REAL & VIRTUAL WORLD (9 Hrs)

Perception: Depth - Motion - Color - Combined sources of Information. Rendering: Ray Tracing and Shading Models - Rasterization - Correcting Optical Distortions. Motion: Velocities and Accelerations - The Vestibular System - Physics in the Virtual World - Mismatched Motion and Vection.

UNIT V TRACKING, INTERACTION AND AUDIO (9 Hrs)

Tracking: Tracking 2D Orientation - Tracking 3D Orientation - Tracking Position and Orientation - 3D Scanning of Environments. Interaction: Motor Programs and

Remapping - Locomotion - Social Interaction.
Audio: The Physics of Sound - The Physiology of Human Hearing - Auditory Perception - Auditory Rendering - Perceptual Training - Recommendations for Developers.

Text Books

1. StevanM.LaValle, "Virtual Reality", Cambridge University Press, 2020.
2. Burdea, "Virtual Reality Technology", Wiley India, 2nd edition, 2008.
3. John Vince, "Virtual Reality Systems", Pearson Edition, 2012.

Reference Books

1. Jonathan Linowes, "Unity Virtual Reality Projects", Packt publications, Second Edition, 2016.
2. Woodrow Barfield, Marc J. Blitz, "Research Handbook on the Law of Virtual Reality and Augmented Reality", Edward Elgar Publishing, 2020.
3. Jeff W Murray, "Building Virtual Reality with Unity and SteamVR", CRC Press, 2nd edition, 2020.
4. Erin Pangilinan, Steve Lukas, Vasanth Mohan, "Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing", O'Reilly Media, 1st edition, 2019.
5. Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", Morgan & Claypool Publishers, 2015.

Web Resources

1. https://www.investopedia.com/terms/v/virtual-reality.asp
2. https://www.iberdrola.com/innovation/virtual-reality
3. https://www.marxentlabs.com/what-is-virtual-reality
4. https://www.vrs.org.uk/virtual-reality/what-is-virtual-reality.html
5. https://arvr.google.com/vr

COs/POs/PSOs Mapping

Co's	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1-Low, 2-Medium, 3- High

Professional Elective IV Lab

		L	T	P	C	Hrs
U20CBEP71	QUANTUM COMPUTATION & QUANTUM INFORMATION LABORATORY	0	0	2	1	30

Course Objectives

- To understand the fundamental concepts of quantum computing.
- To learn how to do computation using quantum algorithms.
- To learn how to do computation using quantum optimization algorithms.
- To understand the use of quantum circuits to solve classical logic.
- To process secure information in various modern-day applications.

Course Outcomes

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

CO1 - Understand the basic concepts of quantum computing. **(K2)**
CO2 - Implement quantum algorithms. **(K3)**
CO3 - Implement classical logic using quantum circuits. **(K3)**
CO4 - Develop a program for Quantum optimization algorithms. **(K4)**
CO5 - Perform quantum computations to solve simple problems. **(K3)**

List of experiments:

1. Introduction of quantum Instruction Set Architecture for quantum computations.
2. Use of quantum instruction language such as Quil, etc. for performing any quantum Computations.
3. Programs using bits and qubits.
4. Implementation of quantum algorithms - Deutsch–Jozsa problem, Simon's algorithm and Shor's algorithm.
5. Implement classical logic using quantum circuits.
6. Program to implement Quantum counting.
7. Program for Quantum optimization algorithms.
8. Program for a quantum walk to solve problems include search and sampling without errors.
9. Implementation of Quantum algorithm for solving linear systems of equations.

Text Books

1. T.W. Anderson, "An Introduction to Multivariate Statistical Analysis", 2nd edition, 2003.
2. J.D. Jobson," Applied Multivariate Data Analysis", Vol I & II, 2nd edition,1991.
3. Magnus Lie Hetland," Beginning Python: From Novice to Professional", 9th. Edition, 2005.

Reference Books

1. D.A. Belsey, E. Kuh and R.E. Welsch, "Regression Diagnostics, Identifying Influential Data and
Sources of Collinearety", New York, 1980.

2. D.C. Montgomery and E.A. Peck, “Introduction to Linear Regression Analysis”,5th edition, 2012.
3. D.F. Morrison, “Multivariate Statistical Analysis”, 2013.

Web References

1. https://www.edx.org/course/statistical-modeling-and-regression-analysis
2. https://www.cin.ufpe.br/~embat/Python%20for%20Data%20Analysis.pdf
3. https://www.kdnuggets.com/2016/07/statistical-data-analysis-python.html
4. https://people.duke.edu/~ccc14/sta-663/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	2	1
4	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2
5	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP72	ADVANCED SOCIAL, TEXT AND MEDIA ANALYTICS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To interpret knowledge from natural language text.
- To extract useful information from the textual data.
- To analyze social media data using web mining techniques.
- To discover interesting patterns from Social Media Networks.
- To analyze social media using sentiment analysis and opinion mining.

Course Outcomes

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

CO1 - Interpret knowledge from natural language text. **(K3)**
CO2 - Extract useful information from the textual data. **(K2)**
CO3 - Analyse social media data using web mining techniques. **(K4)**
CO4 - Discover interesting patterns from Social Media Networks. **(K5)**
CO5 - Analyse social media using sentiment analysis and opinion mining. **(K4)**

List of Exercises

1. Text analysis - Facebook post comments/Youtube comments - using R/PYTHON.
2. scrape data from Facebook page posts for statistical analysis - using Python.
3. Mining Twitter Data with Python (Collecting data).
4. Perform link analysis on any social media platform.
5. Users Influential on Social media platforms
6. Implement an analytic application for Facebook/Twitter data to demonstrate Sentiment Analysis and Entity Recognition.

Text Books

1. Bing Liu, Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data, Springer, Second Edition, 2011.
2. Reza Zafarani, Mohammad Ali Abbasi and Huan Liu, Social Media Mining-An Introduction, Cambridge University Press, 2014.
3. Bing Liu, Sentiment Analysis: Mining Opinions, Sentiments, and Emotions, Cambridge University Press, Second Edition, 2020.

Reference Books

1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, First Edition, 2009.
2. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and

Using Metrics,2011.
3. Alex Gonçalves, Social Media Analytics Strategy: Using Data to Optimize Business Performance,2017.

Web Resources

1. https://www.tutorialspoint.com/social_media_marketing/social_media_analysis.htm
2. https://onlinecourses.nptel.ac.in/noc21_cs74/preview
3. http://r-tutorials.com/social-media-analysis-in-r/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	2	1
4	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2
5	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP73	MOBILE COMPUTING TECHNIQUES LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To design and development of various network protocols using simulation tools.
- To develop communication protocol for device-to-device communication in sensor.
- To design and develop routing, congestion, application and security protocol.
- To implement application using WML
- To implement mobile application for gaming.

Course Outcomes

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

CO1 - Design and develop various wireless network protocols using simulation tools **(k4)**
CO2 - Develop communication protocol for device-to-device communication in sensor **(k4)**
CO3 - Stimulate routing, congestion, application and security protocol **(k4)**
CO4 – Develop calculator and calendar application using WML. **(k4)**
CO5 - Develop gaming application using WML. **(k4)**

List of Exercises

1. Design and Development of different wireless network protocols using network simulators such as NS-3 / OMNET++.
- MAC Protocol
- Routing Protocol
- Transport Protocol
- Congestion Control Protocol
- Application Protocol
- Security Protocol

2. Design of simple Calculator having +,,,* and / using WML
3. Design of Calendar for any given month and year using WML
4. Design of simple game using WML
5. Animate an image using WML

Text Books

1. Jochen Schiller, Mobile Communications. Pearson Education, 2009.
2. Andrea Goldsmith, Wireless Communications. Cambridge University Press, 2012.
3. PrasantKumPattnaik and Rajib Mall, Fundamentals Of Mobile Computing, Prentice-Hall of India Pvt.Ltd

Reference Books

1. Ivan Stojmenovic, Handbook of Wireless Networking and Mobile Computing, Wiley, 2002.
2. EzioBiglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan Mandayam and H.

Vincent Poor, Principles of Cognitive Radio. Cambridge University Press, 2012.
3. Raj Kamal, Mobile Computing, 2nd edition, 2011

Web Resources

1. https://nptel.ac.in/courses/106/106/106106147/
2. https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs13/
3. http://www.digimat.in/nptel/courses/video/106106147/L15.html

COs/POs/PSOs Mapping

Co's	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	2	1
4	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2
5	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP74	BLOCKCHAIN LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To create and implement Blockchain concepts.
- To design and develop private Ethereum Blockchain.
- To build application in Hyperledger fabric platform.
- To create smart contracts using Hyperledger Platform.
- To implement private, public Blockchain, and smart contracts.

Course Outcomes

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

CO1 - Create and implement Blockchain. **(K5)**
CO2 - Implement private Blockchain on Ethereum. **(K3)**
CO3 - Build application in Hyperledger fabric platform **(K5)**
CO4 - Analyze the working of Smart Contracts **(K4)**
CO5 - Explore various aspects of Blockchain technology **(K3)**

List of Exercises

1. Create a Simple Blockchain in any suitable programming language.
2. Use Geth to Implement Private Ethereum BlockChain.
3. Build Hyperledger Fabric Client Application.
4. Build Hyperledger Fabric with Smart Contract.
5. Create a Case study of BlockChain being used in illegal activities in the real world.
6. Using Python Libraries to develop BlockChain Application

Text Books:

1. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies Is
2. Changing the World, Don Tapscott, and Alex Tapscott, Portfolio, 2018.
3. The Age of Cryptocurrency: How Bitcoin and the Blockchain Are Challenging the Global Economic Order, Paul Vigna and Michael J. Casey, Picador. 2016.
4. Blockchain Technology Explained: The Ultimate Beginner's Guide About Blockchain Wallet, Mining.

Reference Books

1. Alan T. Norman, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA And Smart Contracts, CreateSpace Independent Publishing Platform, 2017.
2. Andy Dickson, Blockchain and Cryptocurrency 2 Books in 1: The Ultimate Guide to Bitcoin and its Technology – Learn how to profit for the coming Bull Run!,2020.
3. Chandramouli Subramanian, Blockchain Technology, Universities Press (India) Pvt. Ltd., First edition (19 August 2020).

Web Resources

1. https://nptel.ac.in/courses/106/104/106104220/
2. https://onlinecourses.nptel.ac.in/noc22_cs44/preview
3. https://nptel.ac.in/courses/106/105/106105184/

COs/POs/PSOs Mapping

Co's	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	2	1
4	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2
5	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP75	VIRTUAL REALITY LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To explore virtual reality concepts and develop a 3D virtual environment.
- To demonstrate the working of HTC Vive, Google cardboard and Samsung Gear VR
- To create a comfortable, high-performance VR application using Unity.
- To create and deploy a VR application
- To Create gaming application using VR

Course Outcomes

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

CO1 – Explore the installation process of VR Software. **(K4)**

CO2 - Understand the physical principles of VR. **(K2)**

CO3 - Create a comfortable, high-performance VR application using Unity. **(K4)**

CO4 - Identify techniques for the design and deployment of VR experiences. **(K2)**

CO5 – Create gaming application using VR. **(K4)**

List of Exercises

1. Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
2. Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream, and Samsung Gear VR.
3. Develop a scene in Unity that includes:
    i. A cube, plane, and sphere, apply transformations on the 3 game objects.
    ii. Add a video and audio source.
4. Develop a scene in Unity that includes a cube, plane, and sphere. Create a new material and texture separately for three Game objects. Change the color, material, and texture of each Game object separately in the scene. Write a C# program in Visual Studio to change the game objects' color and material/texture dynamically on button click.
5. Develop a scene in Unity that includes a sphere and plane. Apply rigid body components, material, and Box collider to the game Objects. Write a C# program to grab and throw the sphere using a VR controller.
6. Develop a simple UI(User interface) menu with images, canvas, sprites, and buttons. write a C# program to interact with the UI menu through the VR trigger button such that each successful trigger interaction display a score on the scene.
7. Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available3D models.

Text Books

1. StevanM.LaValle, "Virtual Reality", Cambridge University Press, 2020.
2. Burdea, "Virtual Reality Technology", Wiley India, 2nd edition, 2008.
3. John Vince, "Virtual Reality Systems", Pearson Edition, 2012.

Reference Books

1. Jonathan Linowes, "Unity Virtual Reality Projects", Packt publications, Second Edition, 2016.
2. Woodrow Barfield, Marc J. Blitz, "Research Handbook on the Law of Virtual Reality and Augmented Reality", Edward Elgar Publishing, 2020.
3. Jeff W Murray, "Building Virtual Reality with Unity and SteamVR", CRC Press, 2nd edition, 2020.
4. Erin Pangilinan, Steve Lukas, VasanthMohan, "Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing", O'Reilly Media, 1st edition, 2019.
5. Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", Morgan & Claypool Publishers, 2015.

Web Resources

1. https://www.investopedia.com/terms/v/virtual-reality.asp
2. https://www.iberdrola.com/innovation/virtual-reality
3. https://www.marxentlabs.com/what-is-virtual-reality
4. https://www.vrs.org.uk/virtual-reality/what-is-virtual-reality.html
5. https://arvr.google.com/vr

COs/POs/PSOs Mapping

Co's	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	1
3	3	2	1	1	3	-	-	-	-	-	-	1	2	2	1
4	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2
5	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE821	Behavioral Economics	L	T	P	C	H
		2	1	0	3	45

Course Objectives

1. To understand the concept and theory of economics.
2. To acquire knowledge on the choices and behavior of firms, households and other economics entities.
3. To learn the behavioral science perspective in economics.
4. To know the current ideas and concepts regarding decision making in economics.
5. To study the inter temporal choice in economics

Course Outcomes

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

CO1 - Understand and apply various concepts in traditional and modern Microeconomic **(K3).**
CO2 - Focus on decision making, and develop a holistic understanding of these concepts and their interconnections **(K3).**
CO3 - Explore the knowledge on behavioural science perspective in Economics **(K3).**
CO4 - Understand current ideas and concepts regarding decision making in Economics**(K2).**
CO5 - Students will be able to understand the inter temporal choice in Economics **(K2).**

Unit I Introduction **(9Hrs)**

The neoclassical/standard model and behavioral economics in contrast; historical background; behavioral economics and other social sciences; theory and evidence in the social sciences and in behavioral economics; applications – gains and losses, money illusion, charitable donation.

Unit II Basics of choice theory **(9Hrs)**

Revisiting the neoclassical model; utility in economics and psychology; models of rationality; connections with evolutionary biology and cognitive neuroscience; policy analysis – consumption and addiction, environmental protection, retail therapy; applications – pricing, valuation, public goods, choice anomalies

Unit III Beliefs, heuristics and biases **(9Hrs)**

Revisiting rationality; causal aspects of irrationality; different kinds of biases and beliefs; self-evaluation and self-projection; inconsistent and biased beliefs; probability estimation; trading applications – trade in counterfeit goods, financial trading behavior, trade in memorabilia, policy analysis – norms and markets, labor markets, market clearing, public goods; applications – logic and knowledge, voluntary contribution, compensation design.

Unit IV Choice under uncertainty **(9Hrs)**

Background and expected utility theory; prospect theory and other theories; reference points; loss aversion; marginal utility; decision and probability weighting; applications – ownership and trade, income and consumption, performance in sports. **Strategic choice:** . Review of game theory and Nash equilibrium – strategies, information, equilibrium in pure and mixed strategies, iterated games, bargaining, signaling, learning; applications – competitive sports, bargaining and negotiation, monopoly and market entry

Unit V Intertemporal choice **(9Hrs)**

Geometric discounting; preferences over time; anomalies of inter-temporal decisions; hyperbolic discounting; instantaneous utility; alternative concepts – future projection, mental accounts, heterogeneous selves, procedural choice; policy analysis – mobile calls, credit cards, organization of government; applications – consumption and savings, clubs and membership, consumption planning. Individual preferences; choice anomalies and inconsistencies; social preferences; altruism; fairness; reciprocity; trust; learning; communication; intention; demographic and cultural aspects; social norms; compliance and punishment; inequity aversion;

Text Books

1. Philip Corr, Anke Plagnol, "Behavioral Economics: The Basic", Routledge; 1st edition, 2018.
2. N. Wilkinson and M. Klaes, "An Introduction to Behavioral Economics ", 2017.
3. Robert H. Frank, "Microeconomics and Behaviour", McGraw-Hill, 9th Edition, 2014.
4. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and AnindyaSen, "Economics", 19th edition,Tata McGraw Hill, 2010.
5. M.L.Trivedi, "Managerial Economics:Theory & Applications", Tata McGraw-Hill Education, 4th Edition, 2002.

Reference Books

1. William Boyes and Michael Melvin, "Textbook of Economics", DTECH, 6th Edition, 2004.
2. N. Gregory Mankiw, "Principles of Economics", Thomson learning, 3rd Edition, 2003.
3. Richard Lipsey and Alec Charystal, "Economics", Oxford, University Press, 12th Edition, 2011.

Web References

1. https://www.behavioraleconomics.com/resources/introduction-behavioral-economics/
2. https://wglasser.com/quickstart-guide-to-choice-theory/
3. https://wglasser.com/quickstart-guide-to-choice-theory/
4. https://www.youtube.com/watch?v=kPQcZgjHYtU
5. https://www.investopedia.com/terms/i/intertemporalchoice.asp

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE822	Computational Finance & Modeling	L	T	P	C	H
		2	1	0	3	45

Course Objectives

1. Understand existing financial models in a quantitative and mathematical way.
2. Apply these quantitative tools to solve complex problems in the areas of portfolio management, risk management and financial engineering.
3. Explain the approaches required to calculate the price of options.
4. Identify the methods required to analyse information from financial data and trading systems.

Course Outcomes

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

CO1 - Understand existing financial models in a quantitative and mathematical way**.(K2)**
CO2 - Apply these quantitative tools to solve complex problems in the areas of portfolio management, risk management and financial engineering**.(K4)**
CO3 - Explain the approaches required to calculate the price of options**.(K3)**
CO4 - Identify the methods required to analyse information from financial data and trading systems**.(K3)**
CO5 - Understand the various statistical methods to analyse the financial data.**(K2)**

UNIT – I **(9Hrs)**

Numerical methods relevant to integration, differentiation and solving the partial differential equations of mathematical finance: examples of exact solutions including Black Scholes and its relatives, finite difference methods including algorithms and question of stability and convergence, treatment of near and far boundary conditions, the connection with binomial models, interest rate models, early exercise, and the corresponding free boundary problems, and a brief introduction to numerical methods for solving multi-factor models.

UNIT – II Black-Scholes framework: Black-Scholes PDE **(9Hrs)**

simple European calls and puts; put-call parity. The PDE for pricing commodity and currency options. Discontinuous payoffs - Binary and Digital options. The Greeks: theta, delta, gamma, vega & rho and their role in hedging. The mathematics of early exercise - American options: perpetual calls and puts; optimal exercise strategy and the smooth pasting condition. Volatility considerations - actual, historical, and implied volatility; local vol and volatility surfaces.
Simulation including random variable generation, variance reduction methods and statistical analysis of simulation output. Pseudo random numbers, Linear congruential generator, Mersenne twister RNG. The use of Monte Carlo simulation in solving applied problems on derivative pricing discussed in the current finance literature. The technical topics addressed include importance sampling, Monte Carlo integration, Simulation of Random walk and approximations to diffusion processes, martingale control variables, stratification, and the estimation of the “Greeks”.

UNIT – III Financial Products and Markets **(9Hrs)**

Introduction to the financial markets and the products which are traded in them: Equities, indices, foreign exchange, and commodities. Options contracts and strategies for speculation and hedging.

UNIT – IV **(9Hrs)**

Application areas include the pricing of American options, pricing interest rate dependent claims, and credit risk. The use of importance sampling for Monte Carlo simulation of VaR for portfolios of options.

UNIT – V **Statistical Analysis of Financial Returns** **(9Hrs)**

Fat-tailed and skewed distributions, outliers, stylized facts of volatility, implied volatility surface, and volatility estimation using high frequency data. Copulas, Hedging in incomplete markets, American Options, Exotic options, Electronic trading, Jump Diffusion Processes, High-dimensional covariance matrices, Extreme value theory, Statistical Arbitrage.

Text Books

1. R. Seydel, “Tools for Computational Finance”, 2nd edition, Springer-Verlag, New York, 2004
2. P. Glasserman, “Monte Carlo Methods in Financial Engineering”, Springer-Verlag, New York, 2004.
3. A. Lewis, “ Option Valuation under Stochastic Volatility”, Finance Press, Newport Beach, California, 2000
4. A. Pelsser, “Efficient Methods for Valuing Interest Rate Derivatives”, Springer-Verlag, New York, 2000.
5. W. Press, S. Teukolsky, W. Vetterling and B. Flannery, “Numerical Recipes in C: The Art of Scientific Computing”, Cambridge University Press, Cambridge, UK. Available on-line at: http://www.nr.com/, 1997.

Reference Books

1. D. Ruppert and David S. Matteson, “Statistics and Data Analysis for Financial Engineering”,2015
2. R. Carmona, “Statistical Analysis of Financial Data in S-Plus”, 2014
3. N. H. Chan, “Time Series: Applications to Finance”, 2018.
4. R. S. Tsay, “Analysis of Financial Time Series”, 2002.
5. J. Franke, W. K. Härdle and C. M. Hafner, “Statistics of Financial Markets: An Introduction”, 2004.

Web References

1. http://www.nr.com/
2. https://en.wikipedia.org/wiki/Computational_finance
3. https://www.investopedia.com/terms/f/financial-market.asp
4. https://www.investopedia.com/terms/b/blackscholes.asp

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE823	PSYCHOLOGY	L	T	P	C	H
		2	1	0	3	45

Course Objectives

1. Introduces students to the content areas of industrial psychology and the application of psychological theory to organizational issues.
2. Includes an employment law, job analysis, recruitment and selection, training, performance appraisal and discipline, employee motivation, and workplace safety.
3. Using an applied approach, this course will help prepare students for their roles as employees and managers.
4. Includes motivation of an employee and level of satisfaction measurements.
5. Introduces leadership, work behaviour and handling of stress.

Course Outcomes

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

CO1 - Become conversant about the major content areas of Industrial Psychology (i.e., job analysis, recruitment, selection, employment law, training, performance management, and health/well-being issues in the workplace**).(K2)**

CO2 - Gain further comfort with statistical concepts in the context of making personnel decisions to Reinforce content learned in PSY203 or an equivalent introductory statistics course**.(K3)**

CO3- Gain practical experience by completing a series of hands-on projects involving job analysis, selection decisions, training programs and employee well-being**.(K3)**

CO4 - Deepen your understanding of tests and measurements so that you can collect accurate information and make sound data-based decisions**.(K4)**_

CO5 - Prepare for other focused seminar courses in Industrial/Organizational Psychology or Human Resource Management. **(K2)**

UNIT – I **(9 Hrs)**

What is I/O Psychology? Research Methods, Statistics, and Evidence-based Practice, Introduction & Legal Context of Industrial Psychology, Job Analysis & Competency Modeling, Job Evaluation & Compensation, Job Design & Employee Well-Being, Recruitment

UNIT – II **(9 Hrs)**

Identifying Criteria & Validating Tests and Measures, Screening Methods, Intensive Methods,

UNIT – III **(9 Hrs)**

Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance,

UNIT – IV **(9 Hrs)**

Employee Motivation, Satisfaction and Commitment, Fairness and Diversity

UNIT – V **(9 Hrs)**

Leadership, Organizational Climate, Culture, and Development, Teams in Organizations, The Organization of Work Behavior, Stress Management: Demands of Life and Work

Text Books

1. Stephen Robbins, Tim Judge, Neharika Vohra, “Organizational Behaviour”, Pearson, 18th Edition, 2019.
2. TV.Rao, “Performance Management towards Organizational Excellence”, Sage, 2nd Edition, 2016.
3. Pratibha Goyal , Alok Chakrawal , “Stress Management”, Studera Press, 1st Edition, 2016.
4. Landy, F. J. and Conte, J. M. “ Work in the 21st Century” (4th Edition). Oxford: Blackwell Publishing, 2013.
5. lmes, D., Kantowitz, B., & Roediger, H, “Research methods in psychology”, Cengage Learning, 9th Edition, 2011.

Reference Books

1. Breakwell, G.M., Smith, J.A., &Wright, D.B, “Research methods in psychology”, Sage, 4th Edition, 2012.
2. Charles Stangor and Jennifer Walinga, “Introduction to Psychology” 1st Canadian Edition, 2014.
3. Dr. Dan Ariely , “Predictably Irrational, Revised and Expanded Edition: The Hidden Forces That Shape Our Decisions”, kindle Edition, 2010.
4. Daniel Goleman, “Emotional Intelligence: Why It Can Matter More Than IQ “, kindle edition,2005.

Web References

1. https://en.wikipedia.org/wiki/Industrial_and_organizational_psychology
2. https://ip2012.blogspot.com/2012/02/job-analysis.html
3. https://opentextbc.ca/researchmethods/chapter/practical-strategies-for-psychological-measurement/
4. https://www.inc.com/encyclopedia/employee-motivation.html
5. https://positivepsychology.com/psychology-teamwork/

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE824	Marketing Research & Marketing Management	L	T	P	C	H
		3	0	0	3	45

Course Objectives

1. Understand the concepts of marketing with respect to the changing business environment.
2. Obtain knowledge from theoretical and practical aspects of marketing research
3. Learn the concepts of Pricing, Promotion and Distribution Strategy
4. Encourage the students to take up a critical and analytical thinking through research
5. Know about the Internet marketing and business to business marketing in detail

Course Outcomes

CO1 - Understand basic marketing concepts **(K2)**
CO2 - Comprehend the dynamics of marketing and analyse how its various components interact with each other in the real world **(K2)**
CO3 - Leverage marketing concepts for effective decision making **(K2)**
CO4 - Understand basic concepts and application of statistical tools in Marketing research **(K3)**
CO5 - Understand internet marketing, Business to Business marketing, Promotion in business markets, CRM and Strategies adopted in B2B markets. **(K3)**

UNIT – I Marketing Concepts **(9 Hrs)**

Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector.

Marketing Planning & Environment: Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social.

Understanding the consumer: Determinants of consumer behavior, Factors influencing consumer behaviour.

Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning.

UNIT – II Product Management **(9 Hrs)**

Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging

UNIT – III Pricing, Promotion and Distribution Strategy **(9 Hrs)**

Policies & Practices – Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising

UNIT – IV Marketing Research **(9 Hrs)**

Introduction, Type of Market Research, Scope, Objectives & Limitations

Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research

Data Analysis: Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis

UNIT – V Internet Marketing **(9 Hrs)**

Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing. **Business to Business Marketing:** Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy. Marketing of software products, ITIL functions and processes.

Home Assignments

1. **Written Analyses of Cases** – Students are expected to report on their analysis and recommendations of what to do in specific business situations by applying concepts and principles learned in class (Case Studies to be shared by Faculty) e.g. "Marketing Myopia"
2. Case study: To insist the students to study the software products and latest tools used in the marketing filed and comparison of tools also required.
3. Field visit & live project covering steps involved in formulating Market Research Project
4. Measuring Internet Marketing Effectiveness: Metrics and Website Analytics

Text Books

1. Philip Kotler, "Marketing Management (Analysis, Planning, Implementation & Control)", Paperback, 1993.
2. William J. Stanton & Others, "Fundamentals of Marketing",
3. Marketing Management – V.S. Ramaswamy and S. Namakumari
4. Marketing Research – Rajendra Nargundkar
5. Market Research – G.C. Beri
6. Market Research, Concepts, & Cases – Cooper Schindler

Reference Books

1. Marketing Management – Rajan Saxena
2. Marketing Management – S.A. Sherlekar
3. Service Marketing – S.M. Zha
4. Journals – The IUP Journal of Marketing Management, Harvard Business Review
5. Research for Marketing Decisions by Paul Green, Donald, Tull
6. Business Statistics, A First Course, David M Levine at al, Pearson Publication

Web References

1. https://www.questionpro.com/blog/what-is-market-research/
2. https://www.productplan.com/learn/what-is-product-management/
3. https://www.sheerid.com/business/resources/promotional_pricing/
4. https://en.wikipedia.org/wiki/Marketing_research
5. https://blog.hubspot.com/marketing/internet-marketing

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE825 **SMART SYSTEMS**

L	T	P	C	H
2	1	0	3	45

Course Objectives

1. Includes the basics of Deep Neural networks
2. Understand the architecture of processor
3. Comprises Design of Arduino board
4. Analyses the various security techniques.
5. To know the implementation of block chain technology

Course Outcomes

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

CO1 - Show an understanding of Smart Systems, their implementation and applications **(K2)**
CO2 - Interpret and explain the impact of Smart Systems, ethical, legal, social, environmental implications**. (K3)**
CO3 - Explain concepts used in Smart Systems and associated architectures**. (K2)**
CO4 - Explain the major Smart Systems application areas and techniques used within them **(K2).**
CO5 - Discuss examples of Smart Systems used in real life situations **(K3)**

Unit I Deep Learning **(9 Hrs)**

Basics of Neural Networks-Basic Concept of Neurons – Perceptron Algorithm – Feed Forward and Backpropagation Networks- CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning – Recurrent and Recursive Nets – Recurrent Neural Networks – Deep Recurrent Networks – Recursive Neural Networks – Applications.

Unit II IOT 8-bit embedded processor **(9 Hrs)**

8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling.

Unit III IOT and Arduino Programming **(9Hrs)**

ARM Processor – Introduction to the Concept of IOT Devices – IOT Devices Versus Computers – IOT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins -Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino

Unit IV Introduction of Cryptography and Block chain **(9 Hrs)**

Introduction about Block chain, Block chain Technology Mechanisms & Networks, Block chain Origins, Objective of Block chain, Block chain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Block chain

Unit V Solidity Programming **(9 Hrs)**

Solidity – Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address)

Text Books

1. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies”, 2016,
4. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, Second Edition, 2014.
5. Adrian McEwen, Hakim Cassimally “Designing the Internet of Things”, John Wiley and Sons, 2014.

References Books

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.
2. Andreas M. Antonopoulos,”Mastering Bitcoin”, 2016.
3. Michael J. Pont, “Embedded C”, Pearson Education, 2007.
4. Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006

Web References

1. https://nptel.ac.in/courses/106/104/106104220/#
2. https://onlinecourses.nptel.ac.in/noc22_cs53/preview 3.
https://nptel.ac.in/courses/200/204/306104564/#

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	2	2	2	1	1	1	1	2	1	2	2	2	2
2	1	1	2	2	2	1	1	1	1	2	1	2	2	2	2
3	1	1	2	2	2	1	1	1	1	2	1	2	2	2	2
4	1	1	2	2	2	1	1	1	1	2	2	2	2	2	2
5	1	1	2	2	2	1	1	1	1	2	2	2	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE826 **ENTERPRISE SYSTEMS**

L	T	P	C	H
3	0	0	3	45

Course Objectives

- Understand the components of an ERP system.
- Know the implementation stages and processes of an ERP system.
- Understand the process of integrating legacy systems and other current IT systems with an ERP system.
- Understand the infrastructure of ERP systems.
- Understand and know the modern Enterprise Information Systems

Course Outcomes

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

CO1 - Understand basic elements of Enterprise systems **(K2)**
CO2 - Develop skills in understanding architecture and non-functional requirements in developing Enterprise system development and their deployment **(K3)**
CO3 - Understand Enterprise Patterns **(K2)**
CO4 - To Develop enterprise applications. **(K3)**
CO5 - Understand future trends in Enterprise architectures **(K2)**

UNIT I Introduction **(9 Hrs)**

Introduction to Modern Enterprise Systems: Introduction to enterprise systems. Elements of enterprise systems – Business Information system, Decision support systems, Knowledge management systems, Financial and human resource systems. Kinds of Enterprise systems- B2C and B2B models. **Components of Enterprise systems:** Channels (Mobile, web, desktop, partner integration), Data management, workflow, Controlling and Auditing, Accounting etc. **Sample Enterprise systems:** ERP, SCM, CRM, Product Life cycle management (PLM), HR Systems (HRM), GL systems.

UNIT – II Enterprise Systems Architecture, Key Characteristics, Applications (9 **Hrs)**
Key characteristics Enterprise systems: Distributivity, Managed redundancy, Exception processing, Collaboration, Data transformation. **Enterprise System architectures:** Batch processing, Monolithic, client server, ecommerce, service oriented, micro service, and cloud architectures. **Introduction to Enterprise Application architectures:** Layer Architecture, Event driven Architecture, Service oriented Architecture, Micro service architecture, Plug-in architecture

UNIT – III Architecture Patterns, Integration Techniques **(9 Hrs)**
Application architecture Patterns: Layering, Organizing domain logic, Mapping to database, Web Presentation, Concurrency. Enterprise Application Integration: Introduction to Enterprise Integration, different integration styles. Elements of messaging-based Integration. Enterprise Integration patterns: Modern service integration techniques. Introduction to WSDL, SOAP. Introduction RESTful web services integration. Differences between SOAP and REST.

UNIT – IV Cloud Computing in Enterprise Systems **(9 Hrs)**
Deployment of Enterprise applications: Key requirements in deployment - Stability, capacity, Security, availability, Network, Availability, and Transparency (Basic Introduction only). Concepts of Cloud computing, cloud platforms and their role in Enterprise systems: Core Concepts – Types of Cloud: Private, public, and Hybrid clouds. Advantage of cloud computing – Scaling, Availability, and cost. Disadvantages – Technology overload, Security, Monitoring and

troubleshooting, Testing, Latency etc. Cloud service models: - Infrastructure, platform, Software as a Service in Cloud Computing. Major public clouds: Google cloud, AWS, Azure.

UNIT – V Cloud Application Development and Deployment (9 Hrs)
Application development and deployment in cloud – Dockers, micro services, Kubernetes, Serverless. Continuous Integration/Continuous Delivery Introduction to Enterprise Architecture: Importance of Enterprise Architecture. Enterprise architecture models. Zachman Framework, TOGAF Framework. **Enterprise Architecture Case study**: Implementing EA in secret service systems, Health care organization, Manufacturing Company, case study of University, case study of midsized municipal government.

Home Assignments

- Identify an open-source tools for developing application and ask students to study/develop/modify various elements of the application from enterprise systems architecture, development and deployment perspective. Architecture related case studies are available in Ref [3].

  Note: Open source tools for enterprise simulation are Minitab Workspace, Mimic Simulator, MATLAB, IGrafx.

Textbooks

1. Martin Fowler et al, “Pattern of Enterprise Application Architecture”, Addison-Wesley, 2012
2. Gregor Hohpe, Bobby Woolf, Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions,
3. Mark Richards, “Software Architecture patterns”, 2015, O’Reilly.
4. Sam Newman, “Building Microservices”, O’Reilly.0, 2015.

Reference Books

1. Ravi Shankar & S. Jaiswal, Galgotia, “Enterprise Resource Planning”, 1st Edition, 1999.
2. Alexis Leon, “Enterprise Resource Planning”, Tata McGraw Hill, 3rd Edition, 2017.

Web References

1. https://www.classcentral.com/course/enterprise-systems-12165
2. https://nptel.ac.in/courses/124/107/124107008/
3. https://www.tutorialspoint.com/

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE827	Services Science & Service Operational Management	L	T	P	C	H
		3	0	0	3	45

Course Objectives

1. Understand the services and service operations management concepts.
2. Comprehend the techniques of service operations.
3. Understand the service quality and service design aspects.
4. Understand the service innovation aspects.
5. To analyze how services are different from products by its characteristics.

Course Outcomes

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

CO1 - Understand concepts about Services and distinguish it from Goods **(K2)**
CO2 - Able to identify characteristics and nature of Services **(K2)**
CO3 - Comprehend ways to design Services and evaluate them using Service qualities **(K3)**
CO4 - Understand how various methods can be used to operate and manage Service businesses **(K2)**
CO5 - Understand how innovation can be approached from Services point of view **(k2)**

UNIT – I Introduction to Services **(9 Hrs)**

Introduction: Introduction to the course, Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector. **Nature of Services and Service Encounters:** Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters **Service-Dominant Logic:** From Goods-Dominant logic to Service-Dominant logic, Value Co-creation

UNIT – II Service Design **(9 Hrs)**

Service Strategy and Competitiveness: Development of Strategic Service Vision (SSV), Data Envelopment Analysis. **New Service Development**: NSD cycle, Service Blueprinting, Elements of service delivery system. **Service Design:** Customer Journey and Service Design, Design Thinking methods to aid Service Design. **Locating facilities and designing their layout:** models of facility locations (Huff's retail model), Role of service-scape in layout design. **Service Quality:** SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools

UNIT – III **(9 Hrs)**

Service Guarantee & Service Recovery: How to provide Service guarantee. Service Level Agreement (SLA), SLA Template, how to recover from Service failure?

UNIT – IV Forecasting, Managing capacity and Facilities **(9 Hrs)**

Forecasting Demand for Services: A review of different types of forecasting methods for demand forecasting. **Managing Capacity and Demand**: Strategies for matching capacity and demand,Psychology of waiting, Application of various tools used in managing waiting line in services.
Managing Facilitating Goods: Review of inventory models, Role of inventory in services. **Managing service supply relationship:** Understanding the supply chain/hub of service, Strategies for managing suppliers of service. **Vehicle Routing Problem:** Managing after sales service, understanding services that involve transportation of people and vehicle, Techniques for optimizing vehicle routes

UNIT – V Service Innovation and Case studies **(9 Hrs)**

Service Innovation: Services Productivity, Need for Services Innovation.

Student Project

Choose any two different service organization and present the report from the perspective of: nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add.

Text Books

1. Fitzsimmons & Fitzsimmons, "Service Management: Operations, Strategy, Information Technology", McGraw Hill publications (7th Edition)

Reference Books

1. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D," Services marketing: Integrating customer focus across the firm", McGraw Hill, 2012.
2. Lovelock, C, "Services Marketing", 7/e. Pearson Education India, 2011.
3. Reason, Ben, and Lovlie, Lavrans, "Service Design for Business: A Practical Guide to Optimizing the Customer Experience", Pan Macmillan India, 2 012.
4. Chesbrough, H, "Open services innovation: Rethinking your business to grow and compete in a new era", John Wiley & Sons, 2010.
5. Robert Johnson, Graham clark, "Service Operations Management", Pearson Education, 2nd Edition, 2005.

Web References

1. https://en.wikipedia.org/wiki/Operations_management_for_services
2. https://archive.nptel.ac.in/courses/110/106/110106046/
3. https://en.wikipedia.org/wiki/Service_innovation
4. https://careerfoundry.com/en/blog/ux-design/what-is-service-design-how-to-implement-service-design-processes/
5. https://www.youtube.com/watch?v=DYkwTBrpBtE

Reference Papers

1. Karmarkar, U. (2004). Will you survive the services revolution? Harvard Business Review, 100-107.
2. Vargo, S. L., & Lusch, R. F. (2008). From goods to service (s): Divergences and convergences of logics. Industrial marketing management, 37(3), 254-259.
3. Vargo, S. L., & Lusch, R. F. (2008). "Service-Dominant Logic: Continuing the Evolution," Journal of the Academy of Marketing Science (36:1), pp. 1-10
4. Silvestro, R., Fitzgerald, L., Johnston, R., & Voss, C. (1992). Towards a classification of service processes. International journal of service industry management, 3(3), 62-75.
5. Vargo, S. L., Maglio, P. P., & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. European management journal, 26(3), 145-152.
6. Shostack, G.L., (1984), "Designing Services That Deliver," Harvard Business Review, January-February 1984, pp. 132-139
7. Evenson, S., & Dubberly, H. (2010). Designing for service: Creating an experience advantage. Introduction to service engineering, 403-413.
8. Edvardsson, B., & Olsson, J. (1996). Key concepts for new service development. Service Industries Journal, 16(2), 140-164.
9. Goldstein, S. M., Johnston, R., Duffy, J., & Rao, J. (2002). The service concept: the missing link in service design research? Journal of Operations management, 20(2), 121-134.
10. Kumar, A., Zope, N. R., & Lokku, D. S. (2014, April). An approach for services design by understanding value requirements, identifying value carriers, developing value proposition, and subsequently realizing value. In Global Conference (SRII), 2014 Annual SRII (pp. 298-304). IEEE.

11. Parasuraman, A., Zeithaml, V.A., and Berry, L.L., (1985), “A Conceptual Model of Service Quality and Its Implications for Future Research,” The Journal of marketing, Vol. 49, No. 4, pp. 41-50
12. Cronin, J.J., and Taylor, S.A., (1992), “Measuring Service Quality: A Reexamination and Extension,” The Journal of Marketing, Vol. 56, No. 3, pp. 55-68
13. Van Ree, H. J., (2009), Service Quality Indicators for Business Support Services, Ph.D. Thesis, University College London, London.
14. Zope, N. R., Anand, K., & Lokku, D. S. (2014, April). Reviewing Service Quality for IT Services Offerings: Observations in the Light of Service Quality Models & Determinants. In Global Conference (SRII), 2014 Annual SRII (pp. 43-49). IEEE.
15. Heskett, J.L., Jones, T.O., Loveman, G.W., Sasser, W.E., and Schlesinger, L.A., (2008), “Putting the Service-Profit Chain to Work,” Best of HBR, Harvard Business Review, July-August 2008, pp. 118-128
16. Clatworthy, S. (2011). Service innovation through touch-points: Development of an innovation toolkit for the first stages of new service development. International Journal of Design, 5(2).
17. Barras, R. (1986). “Towards a Theory of Innovation in Services,” Research Policy (15), pp. 161-173.
18. Gustafsson, A., and Johnson, M. (2003). Competing in a Service Economy: How to Create a Competitive Advantage Through Service Development and Innovation, San Francisco: Jossey-Bass.
19. Barrett, M., Davidson, E., Prabhu, J., & Vargo, S. L. (2015). “Service innovation in the digital age: key contributions and future directions”. Mis Quarterly, 39(1), 135-154.
20. Lusch, R. F., and Nambisan, S. (2015). “Service Innovation; A Service-Dominant Logic Perspective,” MIS Quarterly (39:1), pp.155-175

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBE828 **Image Processing and Pattern Recognition**

L	T	P	C	H
3	0	0	3	45

Course Objectives

1. To learn the fundamentals of image formation and formats.
2. To understand the intensity transformations and filtering techniques.
3. To acquire knowledge on image segmentation operations.
4. To learn the feature extraction and image registration process.
5. To understand the components of colour image processing

Course outcomes
After completion of the course, the students will be able to

CO1 - Be familiar with the fundamentals of image formation and formats **(K2)**
CO2 - Perform image transformation functions and filtering operations**. (K3)**
CO3 - Apply the segmentation techniques on the images**(K3)**
CO4 - Extract the features of an image and perform image registration**(k4)**
CO5 - Able to do colour image processing and conversion operations **(K4)**

UNIT I Introduction and Image Formation **(9Hrs)**
Introduction: Image processing systems and its applications. Basic image file formats
Image formation: Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighbourhood metrics.

UNIT II Intensity transformations and spatial filtering **(9Hrs)**
Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG.

UNIT III Image Segmentation **(9Hrs)**
Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Otsu method; Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques, line detection, Hough transform.

UNIT IV Feature Extraction and Image Registration **(9Hrs)**
Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization / thinning, shape properties.
Registration: Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation.

UNIT V Colour image processing **(9Hrs)**
Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab; False colour; Pseudo colour; Enhancement; Segmentation.
Morphological Filtering Basics: Dilation and Erosion Operators, Top Hat Filters

Text Books

1. Jain Anil K., “Fundamentals Digital Image Processing” Prentice Hall India, 2010
2. R. C. Gonzalez and R. E. Woods, “Digital Image Processing” Prentice Hall,2008.

Reference Books

1. Maria Petrou and Panagiota Bosdogianni , “Image Processing: The Fundamentals”, John Wiley & Sons, Ltd, 2010.
2. A. Blake and A. Zisserman , “Visual Reconstruction”, MIT Press, Cambridge, 2003.
3. K. R. Castleman , “Digital Image Processing”, Prentice Hall, Englewood Cliffs, 1996
4. A. N. Netravali and B. G. Haskell , “Digital Pictures”, Plenum Press,1995.
5. A. B. Watson, “Digital Images and Human Vision”, MIT Press, Cambridge,1993.

Web References

1. https://bohr.wlu.ca/hfan/cp467/12/notes/cp467_12_lecture1_intro.pdf
2. https://core.ac.uk/download/pdf/231900695.pdf
3. https://www.researchgate.net/publication/328582830_Pattern_Recognition_and_Image_Processing

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20ITCM08 **Automation Techniques and Tools - Devops**

L	T	P	C	H
3	0	0	3	45

Course Objectives

- The Background and mind set of Devops
- To enable students appreciate the agile led development environment.
- To give the students a perspective to grasp the need for Minimum viable product led development using Sprints.
- To enable students acquire fundamental knowledge of CI/CD and CAMS.
- To enable learners realize various aspects of DevOps Ecosystem.

Course Outcomes

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

CO1 - Explain traditional software development methodologies like waterfall. **(K2)**
CO2 - Apply the Agile Methodology and comparing various other software development models with agile. **(K3)**
CO3 - Explain implementing Continuous Integration and Continuous Delivery. **(K2)**
CO4 - Illustrate CAMS for DevOps (Culture, Automation, Measurement and Sharing). **(K2)**
CO5 - Construct quick MVP prototypes for modules and functionalities. **(K3)**

UNIT I TRADITIONAL SOFTWARE DEVELOPMENT (9 Hrs)

The Advent of Software Engineering - Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation - Developers vs IT Operations conflict.

UNIT II RISE OF AGILE METHODOLOGIES (9 Hrs)

Agile movement in 2000 - Agile Vs Waterfall Method - Iterative Agile Software Development - Individual and team interactions over processes and tools - Working software over comprehensive documentation - Customer collaboration over contract negotiation - Responding to change over following a plan

UNIT III INTRODUCTION DEVOPS (9 Hrs)

Introduction to DevOps - Version control - Automated testing - Continuous integration - Continuous delivery - Deployment pipeline - Infrastructure management – Databases

UNIT IV PURPOSE OF DEVOPS (9 Hrs)

Minimum Viable Product- Application Deployment- Continuous Integration- Continuous Delivery

UNIT V CAMS (CULTURE, AUTOMATION, MEASUREMENT AND SHARING) (9 Hrs)

CAMS – Culture, CAMS – Automation, CAMS – Measurement, CAMS – Sharing, Test-Driven Development, Configuration Management-Infrastructure Automation- Root Cause Analysis- Blamelessness- Organizational Learning

Text Books

1. GrigGheorghiu, Alfredo Deza, Kennedy Behrman, Noah Gift, “Python for DevOps”, 2019.
2. Len Bass, Ingo Weber, Liming Zhu, “DevOps - A Software Architect’s Perspective”, Pearson Education, 2015.

Reference Books

1. Deepak Gaikwad, Viral Thakkar, DevOps Tools: from practioner’s point of view, Wiley, 1st Edition, 2019.
2. Gene Kim, Jez Humble, Patrick Debois, and Willis,” The DevOps Handbook”, IT Revolution Press, 2016.
3. JoakimVerona, “Practical DevOps”, O'Reilly, 2016.

Web References

1. www.ibm.com/cloud/devops.
2. www.softwaretestinghelp.com>devops-automation.
3. https://cloudify.co/devops-automation-tools-the-ultimate-list/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
2	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3
3	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
4	2	1	-	-	2	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	2	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U20CSCM03	AUGMENTED REALITY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

1. Understanding the System Architecture of Augmented Reality
2. Learn the Hardware for Augmented Reality
3. Learn the Software for Augmented Reality
4. Understanding the Augmented Reality and Mixed Reality
5. Understanding the AR Digital Entertainment

Course Outcomes

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

CO1 – Apply geometric concepts to understand Augmented Reality (K3)
CO2 – Utilize hardware components for Augmented Reality (K4)
CO3 – Make use of software components for Augmented Reality (K3)
CO4 – Apply AR with the Virtual Reality to provide Mixed Reality (K4)
CO5 – Apply AR in Digital Entertainment (K4)

UNIT I INTRODUCTION OF AUGMENTED REALITY (AR) (9 Hrs)

System Structure of Augmented Reality – Key Technology in AR – General Solution for Calculating Geometric – Illumination Consistency in the Augmented Environment.

UNIT II 3D USER INTERFACE INPUT HARDWARE (9 Hrs)

Input Device Characteristics – Desktop Input Devices – Tracking Devices – 3D Mice - Special Purpose Input Devices – Direct Human Input – Home-Brewed Input Devices - Choosing Input Devices for 3D Interfaces.

UNIT III SOFTWARE TECHNOLOGIES (9 Hrs)

Database-World Space, World Coordinate, World Environment, Objects-Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and Other Attributes, VR Environment-VR Database, Tessellated Data, LODs, Cullers and Occludes, Lights and Cameras, Scripts, Interaction-Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring, and Playback, VR toolkits.

UNIT IV AUGMENTED AND MIXED REALITY (9 Hrs)

Taxonomy, Technology and Features of Augmented Reality, Difference between AR and VR, Challenges with AR, AR Systems and Functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Wireless Displays in Educational Augmented Reality Applications, Mobile Projection Interfaces, Marker-less Tracking for Augmented Reality, Enhancing Interactivity in AR Environments, Evaluating AR Systems.

UNIT V DEVELOPMENT TOOLS AND FRAMEWORKS IN AR (9 Hrs)

Frameworks of Software Development Tools in AR. X3D Standard; Vega, MultiGen, Virtools etc. Applications of AR in Digital Entertainment: AR Technology in Film & TV Production.AR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by AR.

Assignments:

1. Hands on training should be conducted for each unit.
2. AR Assistance Licensed tool should be used

Text Books

3. Peddie, Jon, —Augmented Reality Where We Will All Livell, 1st Edition, 2017.
4. Dieter Schmalstieg and Tobias Hollerer, —Augmented Reality: Principles and Practice (Usability)|,
1. Addison-Wesley Educational Publishers, 1st Edition, 2016.
2. Alan B Craig, William R Sherman and Jeffrey D Will, Developing Virtual Reality applications: Foundations of Effective Design', Morgan Kaufmann publishers, 2009.

Reference Books

1. N. Honcharova, "Technology of augmented reality in textbooks of new generation", Boeing Corporation, 2019.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces: Theory and Practice", Addison Wesley, 2nd Edition, 2017.
3. Borko Furht, "Handbook of Augmented Reality", Springer, 2011.
2. Michael Haller, "Emerging Technologies of Augmented Reality: Interfaces and Design", Idea Group Publishing, 2007.
4. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", Springer, 2005.

Web References

1. https://www.8thwall.com/
2. https://developers.google.com/web/updates/2018/06/ar-for-the-web
3. https://www.sitepen.com/blog/augmented-reality-on-the-web-in-2019/
4. https://hacks.mozilla.org/2019/01/augmented-reality-and-the-browser%E2%80%8A-%E2%80%8Aan-appexperiment/

COs/POs/PSOs Mapping

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP81	ENTERPRISE SYSTEMS LABORATORY	L	T	P	C	H
		0	0	2	1	30

Course Objectives

1. To introduce the essential concepts of ERP involved in business processes
2. To impart skills in the design and implementation of ERP architecture
3. To familiarize with various tools and technologies for developing ERP for large project
4. To analyse VPN connections
5. To identify COTS configuration developing real time applications

Course Outcomes

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

CO1- Ability to design and deploy simple web applications using MVC architecture **(K3)**
CO2 - Evaluate SOA and ERP models **(K5)**
CO3 - Ability to design and implement CRM models **(K4)**
CO4 - Implement interactive network and application **(K4)**
CO5 - Evaluate organizational opportunities and challenges in the design system and Ability to develop model for ERP for large projects **(K5)**

List of Exercises

1. Introduction to ERP systems and review oon different ERP Packages
2. Find a procedure to transfer mthe files from one virtual machine to another virtual machine.
3. Implementation of SOAP Web services in C#/ JAVA applications
4. Develop a Hello World Application using Google APP Engine
5. Develop a Guest Book application using Google APP Engine
6. Develop a windows AZURE Hello world application
7. Case study Amazon Web Services.

Text Books

1. Alexis Leon, Enterprise Resource Planning, 4th Edition, Tata McGraw Hill, 2020.
2. Alexis Leon, "Enterprise Resource Planning", Tata McGraw Hill, 3rd Edition, 2017.
3. Alexis Leon, "Enterprise Resource Planning – Diversified", TMH, 2nd Edition, 2015.

.

Reference Books

1. Ravi Shankar & S. Jaiswal, Galgotia, "Enterprise Resource Planning", 1st Edition, 1999.
2. Alexis Leon, "Enterprise Resource Planning", Tata McGraw Hill, 3rd Edition, 2017.

Web References

1. https://www.gambitcomm.com/site/enterprise-vlab.php
2. https://www.its.ac.id/sp/lab-enterprise-system/
3. https://www.geeksforgeeks.org/introduction-to-erp/

4. https://www.tutorialspoint.com/management_concepts/enterprise_resource_planning.htm

5. http://nfra.eresourceerp.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	1	1	-	-	-	1	2	2	1	2	2	3
2	1	1	1	-	1	-	-	-	-	1	1	-	1	1	3
3	1	1	-	-	1	-	-	-	1	-	-	1	1	2	2
4	1	1	-	-	1	-	-	-	1	-	-	1	2	2	3
5	2	2	2	1	1	-	-	-	1	1	-	1	2	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP82

SERVICES SCIENCE & SERVICE OPERATIONAL MANAGEMENT LABORATORY

L	T	P	C	H
0	0	2	1	30

Course Objectives

1. Understand the services and service operations management concepts.
2. Comprehend the techniques of service operations.
3. Understand the service quality and service design aspects.
4. Understand the service innovation aspects.
5. To analyse how services are different from products by its characteristics.

Course Outcomes

CO1 - Understand concepts about services and distinguish it from goods.**(K2)**
CO2 - Able to identify characteristics and nature of services. **(K2)**
CO3 - Comprehend ways to design services and evaluate them using service qualities. **(K2)**
CO4 - Understand how various methods can be used to operate and manage service businesses. **(K2)**
CO5 - Understand how innovation can be approached from services point of view.**(K2)**

List of Exercises

1. Design a new super market in a cosmopolitan city (Identify important attributes, specify attribute levels, experimental design, presentation of alternatives to respondents and estimation of choice model)
2. Choose any service organization and present it from the perspective of nature of service, classification of service, blueprint or service design analysis, and service quality
3. Prepare a service blueprint for a fast food outlet (Service Design and Service Management Model)
4. Using data, software, user and mashup as services prepare a next gen service oriented architecture.
5. Prepare a review article after analyzing 5 relevant papers in services and explain your understanding and feedback on the same
6. Analyze a fortune 500 company in digital media and point out how these technologies could be effectively used in a startup in digital space
7. Analyze the booking policy of an international flight operator, assuming that the average number of no shows is 10%, explain why the best overbooking necessary isn't be 10% always.
8. Prepare a comparative chart analyzing any four food delivery agencies and rank them based on reliability, responsiveness, assurance, and empathy.

Text Books

1. Fitzsimmons & Fitzsimmons, "Service Management: Operations, Strategy, Information Technology", McGraw Hill publications, 7th Edition, 2017.
2. Christopher H.Lovelock and JochenWirtz, "Services Marketing", Pearson Education, New Delhi, 7th Edition, 2011.
3. Richard Metters, Karthryn King-Metters, Madeleine pullman, Steve Walton, "Successful Service Operations Management", South-Western, Cengage Learning, 2nd Edition, 2008.
4. Cengiz Haksever, Barry Render, Roberta S Russell, Pobert G Mirdick, "Service Management and Operations", Pearson Education, 2nd Edition, 2000.

Reference Books

1. Reason, Ben, and Lovlie, Lavrans, “Service Design for Business: A Practical Guide to Optimizing the Customer Experience”, Pan Macmillan India, 2016.
2. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D., “Services marketing: Integrating customer focus across the firm”, McGraw Hill, 2012
3. Lovelock, C,Services, “ Marketing”, Pearson Education India, 7 th Edition ,2011.
4. Chesbrough, H, “Open Services Innovation: Rethinking Your Business To Grow and Compete in a New Era”. John Wiley & Sons, 2010.
5. Robert Johnson, Graham clark, “Service Operations Management”, Pearson Education, 2nd Edition, 2005.

Web References

1. https://biblus.accasoftware.com/en/how-to-design-a-supermarket-the-complete-technical-guide/
2. https://creately.com/diagram/example/jomhemda/new-fast-food-and-quick-serve-restaurant-service-blueprint-classic
3. https://toppandigital.com/translation-blog/technology-behind-fortune-global-500-companies/
4. https://www.researchgate.net/publication/342765294_A_STUDY_ON_CONSUMERS_PERCEPTION_ON_FOOD_APPS

COs Mapping with POs and PSOs

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

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP83	IMAGE PROCESSING AND PATTERN RECOGNITION LABORATORY	L	T	P	C	H
		0	0	0	1	30

Course Objectives

1. To learn the fundamentals of image formation and formats.
2. To understand the intensity transformations and filtering techniques.
3. To acquire knowledge on image segmentation operations.
4. To learn the feature extraction and image registration process.
5. To understand the components of colour image processing

Course Outcomes

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

CO1 - Perform image transformation functions and filtering operations**. (K2)**
CO2 - Apply the segmentation techniques on the images**. (K3)**
CO3 - Extract the features of an image and perform image registration**. (K3)**
CO4 - Able to do colour image processing and conversion operations**. (K4)**
CO5 - Able to detect the face from the given set of images and determine the type of images **(K4)**

List of Exercises

1. Write a program for Histogram Mapping and Equalization.
2. Write a program for Image Smoothening and Sharpening.
3. Write a program for Morphological Operations on Binary Images
4. Write a program for Edge Detection using Sobel, Prewitt and Roberts Operators.
5. Write a program for Canny Edge Detector.
6. Write a program to calculate the GLCM of the given image.
7. Write a program to perform image registration of the given images.
8. Write a program to implement colour model conversion.
9. Write a program for pseudo-colour operation on the given image.
10. Write a program for Image Intensity slicing technique for image enhancement.
11. Write a program to analyze the given set of camera captured images and Identify the nature of the image.
12. Write a program to detect the face from the given set of images and determine the type of animal

Text Books

1. R. C. Gonzalez and R. E. Woods, “Digital Image Processing”, Pearson, 4th Edition, 2018.
2. Maria Petrou and Panagiota Bosdogianni, “Image Processing: The Fundamentals”, John Wiley & Sons, Ltd, 2nd Edition, 2010.
3. K. R. Castleman, “Digital Image Processing”, Prentice Hall, Englewood Cliffs, 1st Edition, 1995

Reference Books

1. Blake and A. Zisserman, “Visual Reconstruction”, MIT Press, Cambridge. https://doi.org/10.7551/mitpress/7132.001.0001
2. A. N. Netravali and B. G. Haskell, “Digital Pictures”, Plenum Press, 2nd Edition, 1995

3. A. B. Watson, “Digital Images and Human Vision”, MIT Press, Cambridge, 1993

Web References

1. http://ceng.metu.edu.tr/image-processing-and-pattern-recognition
2. https://towardsdatascience.com/image-processing-with-python-blurring-and-sharpening -for-beginners-3bcebec0583a
3. https://www.wiley.com/en- ai/Image+Processing+and+Pattern+Recognition: +Fundamentals+and+Techniques-p- 9780470404614

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	1	1	-	-	-	-	-	-	1	2	2	-
2	3	3	3	3	3	1	1	1	-	-	-	1	3	3	-
3	3	3	3	3	3	1	1	1	-	-	-	1	3	3	-
4	3	3	3	3	3	1	1	1	-	-	-	1	3	3	-
5	3	3	3	3	3	1	1	1	-	-	-	1	3	3	-

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP84	AUTOMATION TECHNIQUES AND TOOLS- DEVOPS LABORATORY	L	T	P	C	H
		0	0	0	1	30

Course Objectives

1. Insights of the DevOps environment
2. An overview of different DevOps tools
3. Continuous integration and testing
4. DevOps containerization
5. Analyse the deployment of an application

Course Outcomes

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

CO1 - Understand the basic concepts of construction of small programs **(K2)**
CO2 - Build a prototype of an application using tools **(K3)**
CO3 - Integrate DevOps with the Jenkins **(K3)**
CO4 - Build the application and apply testing **(K3)**
CO5 - Deploy the application and troubleshoot **(K3)**

List of Exercises

1. Use Version Control System for a document/program (check in/check out / update / pull / push modifications, create tags/branches)
2. Build a prototype of an application using tools (such as Maven). Prepare unit test case and execute
3. Test the prototype/application using Integration tests
4. Using Continuous Integration (CI) / Continuous Deployment (CD) automation tool (Jenkins), build pipeline. Integrate build stage. Integrate/API test stage with pipeline.
5. Set up DevOps environment for CI, CD (creation of non-root account, S3 bucket, IAM Role, attach policies, secret keys)
6. Integrate Jenkins with DevOps environment (secret keys exchange)
7. Define Jenkins pipeline incorporating, build, test and deploy (publish) stages – I
8. Define Jenkins pipeline incorporating, build, test and deploy (publish) stages - II
9. Deploy the application, run and troubleshoot

Text Books

1. Ethan Thorpe, “Devops: A comprehensive beginners guide to learn DevOps step by step”, Paperback, 2019.
2. Deepak Gaikwad, Viral Thakkar, “Devops Tools from Practioners” viewpoint, Wiley
3. Gene Kim, Jez Humble, Patrick Debois, John Allspaw and John Willis, “The DevOps Handbook”, Paperback, 2016.
4. Gene Kim, “The Phoenix Project A Novel about It, DevOps, and Helping Your Business Win”, Paperback, 2018.
5. Jennifer Davis and Ryn Daniels, “Effective DevOps,”, 2021.

Reference Books

1. David Johnson, “Devops for Beginners Handson guide”, CreateSpace Independent
2. Jez ,David “Continuous Delivery’

Web References

1. https://aws.amazon.com/devops/what-is-devops/
2. https://www.atlassian.com/blog/devops
3. https://www.youtube.com/watch?v=lpk7VpGqkKw
4. https://www.youtube.com/watch?v=hQcFE0RD0cQ
5. https://www.freecodecamp.org/news/devops-engineering-course-for-beginners/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	2	2	2	1	1	1	1	3	2	3	3
2	2	2	2	2	2	2	2	1	1	1	3	3	2	2	3
3	2	2	2	2	1	2	2	1	1	1	3	3	2	3	3
4	2	2	2	2	1	2	2	1	1	1	3	3	2	3	3
5	2	2	2	2	1	2	2	1	1	1	3	3	2	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBEP85	AUGMENTED REALITY LABORATORY	L	T	P	C	H
		0	0	0	1	30

Course Objectives

1. Model and animate 3D computer-generated objects, from preproduction to production to postproduction.
2. Apply the entire production pipeline for the application of 3D media in augmented and virtual reality interfaces.
3. Design and implement an interactive computer game, simulation, or tool to display and manipulate objects or data in 3D.
4. Propose novel, disruptive applications of augmented and virtual reality.

Course Outcomes

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

CO1 - Design, create, and integrate audio, visual, and interactive elements into a comprehensive immersive experience. **(K3)**

CO2 - Develop content for successful delivery across multiple platforms, including PC, mobile devices and head-mounted displays. **(K3)**

CO3 - Evaluate current trends of AR media delivery to propose options to potential clients, and discuss the benefits, challenges and misconceptions involved with working in AR **(K4)**

CO4 - Evaluate various interaction schemes common to AR experiences**. (K4)**

CO5 - Use immersive effects of visual and audio assets to AR experiences and evaluate implementation methods. **(K4)**

List of Exercises

Name of the Language is used for implementing the following exercises:

1. Understand different forms of Augmented Reality and their applications
2. Import & Animate 3D Models
3. Detect a real toy car using 3D Object tracking and superimposing a digital car on top of the real car.
4. Develop and AR Book app which will detect multiple image targets.
5. Develop an AR greeting card app, which plays sound, and animation once opened.
6. Create an interactive business card using AR Virtual buttons
7. Play / Pause video's in real world.

Text Books

1. Peddie, Jon, “Augmented Reality Where We Will All Live”, 1st Edition, 2017.
2. Dieter Schmalstieg and Tobias Hollerer, “Augmented Reality: Principles and Practice (Usability)
   Addison-Wesley Educational Publishers, 1st Edition, 2016.
3. Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality applications: Foundations of Effective Design’, Morgan Kaufmann publishers, 2009.

Reference Books

1. N. Honcharova, “Technology of augmented reality in textbooks of new generation”, Boeing Corporation, 2019.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces: Theory and Practice”, Addison Wesley, 2nd Edition, 2017.
3. Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2016.
4. Borko Furht, “Handbook of Augmented Reality”, Springer, 2011.
5. Michael Haller, “Emerging Technologies of Augmented Reality: Interfaces and Design”, Idea Group Publishing, 2007.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	2	2	2	2	1	1	1	2	2	3	3	3
2	2	3	3	2	2	2	2	1	1	1	2	2	3	3	3
3	2	2	3	2	2	2	2	1	1	1	2	2	3	3	3
4	2	2	3	2	2	2	2	1	1	1	2	2	3	3	3
5	2	2	3	2	2	2	2	1	1	1	2	2	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

U20CBS201	SKILL DEVELOPMENT COURSE 1	L	T	P	C	Hrs
		0	0	2	0	30

Python Programming

Course Content:

Python Concepts, Data Structures, Classes:

- Interpreter
- Program Execution
- Statements
- Expressions
- Flow Controls
- Functions
- Numeric Types
- Sequences and Class Definition
- Constructors
- I/O and Error Handling In Python

Visualization in Python:

- Matplotlib package
- Plotting Graphs
- Controlling Graph
- Adding Text
- More Graph Types
- Getting and setting values
- Patches

U20CBS302	SKILL DEVELOPMENT COURSE 2	L	T	P	C	Hrs
		0	0	2	0	30

R Programming

Course Content:

- **Introduction**
  R and features, Evolution of R?,Big data Hadoop and R
- **Data Types**
  R & R Studio Installation, Scalar, Vectors, Matrix, List, Data frames, Factors, Handling date in R, Conversion of data types, Operators in R
- **Importing Data**
  CSV files, Database data (Oracle 11g), XML files, JSON files, Reading & Writing PDF file, Reading & Writing JPEG files, Saving Data in R,
- **Manipulating Data**
  Cbind, Rbind, Sorting, Aggregating, dplyr
- **Conditional Statements and Functions**
  If …else, For loop, While loop, Repeat loop, Apply ()
- **Statistical Concepts**
  Descriptive Statistics, Inferential Statistics, Central Tendency (Mean,Mode,Median), Hypothesis Testing, Probability, tTest, ,Chi Square test, Correlation
- **Predictive Modelling**
  Linear Regression, Normal distribution, Density
- **Data Visualisation in R using GGPlot**
  Box Plot, Histograms, Scatter Plotter, Line chart, Bar Chart, Heat maps, Misc. functions and Data Visualization using Plotly

U20CBS403	SKILL DEVELOPMENT COURSE 3	L	T	P	C	Hrs
		0	0	2	0	30

1. Graphic Design

Course Content:

1. Introduction to Blender Interface
2. Working with viewports
3. Creating & Editing objects
4. Materials & Textures
5. Setting up a world
6. Lighting & Cameras
7. Rendering Movies & Images
8. Ray-Tracing
9. Animation Basics
10. Adding 3D Texts

2.Exploring GITHUB Platform

Course Content:

1. Introduction to Version Control - Keeping Historical Copies - Diffing Files - Applying Changes.
2. Practical Application of diff and patch.
3. Version control - Version Control and Automation.
4. Git - Installing Git - Installing Git on Windows (Optional) - First Steps with Git - Tracking Files - The Basic Git Workflow - Anatomy of a Commit Message.
5. Introduction to Git Locally - Using Git Locally.
6. Skipping the Staging Area - Getting More Information About Our Changes - Deleting and Renaming Files.
7. Undoing Changes Before Committing - Amending Commits – Rollbacks - Identifying a Commit
8. Introduction to branch - Creating New Branches - Working with Branches.
9. Merging - Merge Conflicts. Working with Remotes.
10. Introduction to GitHub - Basic Interaction with GitHub – Introduction to remote - Working with Remotes - Fetching New Changes - Updating the Local Repository.
11. The Pull-Merge-Push Workflow - Pushing Remote Branches - Rebasing the Changes - Rebasing Example.
12. Collaboration Introduction to Collaboration - Simple Pull Request on GitHub - The Typical Pull Request Workflow on GitHub - Updating an Existing Pull Request - Squashing Changes.
13. Code reviews - Code Review Workflow - Uses of Code Reviews in GitHub. Managing Collaboration.
14. Tracking Issues.
15. Continuous Integration.
16. Collaboration.

3. AptitudeBasics

Course Content:

1. Number System - Basics, Properties & Type of Numbers - Divisibility Rules
2. LCM & HCF - Unit Digit Concept [Cyclicity Method]
3. Decimals, Simplification. Ratio & Proportion - Compounded & Duplicate Ratio - Inverse Ratio - Shortcut to Find Ratio - Continuous Proportion - Mean & Divisibility Proportion.
4. Ages - Both Data is in Ratio or Time Format - One Data in Ratio or Time Format & Other Data in Sum, Difference or Product
5. Logical [Puzzles] Method.
6. Average - Basics & Finding Average in Complex - Replacement & Alteration Method - Average Speed Finding Problems.
7. Allegation & Mixtures
8. Ratio of Mixture - Finding the Kilogram through Ratio
9. Mean Value Method
10. Ratio Mixture [Fraction Method] - Iteration Method.

U20CBS504	SKILL DEVELOPMENT COURSE 4 ForeignLanguage/IELTS –I	L	T	P	C	Hrs
		0	0	2	0	30

Student should choose the Foreign Language/IELTS course like Japanese/French/Germany/IELTS,etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisorand language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

U20CBS605	SKILL DEVELOPMENT COURSE 5 NPTEL/MOOC -I	L	T	P	C	Hrs
		0	0	0	0	30

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved byAcademic Council on the recommendation of HoD at the beginning of the semester if necessary, subject toratification in the next Academic council meeting.

The Committee will monitor the progress of the student and recommend the grade (100%Continuous Assessment pattern) based on the completion of course/marks secured in online examinations. The marks attained forth is course is not considered for CGPA calculation

Employability Enhancement Course

		L	T	P	C	Hrs
U20CBS806	**Skill Development Course 6: NPTEL/ MOOC-II**	**0**	**0**	**0**	**0**	**30**

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

U20CBM101 **INDUCTION PROGRAM**

Induction program for students to be offered right at the start of the first year

Duration of the Program	3 Weeks
Induction program	• Physical Activity • Creative Arts and Culture • Mentoring and Universal Human Values • Familiarization with College, Dept./Branch • Literary Activity • Proficiency Modules • Lectures and Workshops by Eminent People • Visits in Local Area • Extra-Curricular Activities in College

1. Physical Activity

This would involve a daily routine of physical activity with games and sports. There would be games in the evening or at other suitable times according to the local climate. These would help develop team work besides health. Each student could pick one game and learn it for the duration of the induction program and hopefully, continue with it later.

2. Creative Arts

Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, music, dance, pottery, sculpture etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

3. Mentoring and Universal Human Values

Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring takes place in the context and setting of Universal Human Values. It gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

4. Other Activity

Activities that are not there on a daily basis, but are conducted for 3-4 days (typically in the afternoons) and change thereafter.

4.1. Familiarization with College, Department/Branch

The incoming students should be told about the credit and grading system, and about the examinations. They should be informed about how study in college differs from study in school. They should also be taken on a tour of the college and shown important points such as library, canteen, and other facilities. They should be shown their department, and told what it means to get into the branch or department. Describe what role the technology related to their department plays in society and after graduation what role the student would play in society as an engineer in that branch. A lecture by an alumnus of the Dept. would be very helpful in this regard. They should also be shown the laboratories, workshops and other facilities. The above should be done right in the first two days, and then over the afternoons thereafter, as appropriate.

4.2. Literary Activity

Literary activity would encompass reading a book, writing a summary, debating, enacting a play etc.

4.3. Proficiency Modules

The induction program period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

4.4. Lectures and Workshops by Eminent People

Lectures by eminent people should be organized, say, once a week. It would give the students exposure to people who are eminent, in industry or engineering, in social service, or in public life. Alumni could be invited as well. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, VivekanandKendras, S-VYASA, etc. may be organized. Workshops which rejuvenate or bring relief to students would also be welcome, such as, Art of Living workshops (3 sessions, 9 hours).

4.5. Visits in Local Area

A couple of visits to the local landmarks including historical monuments should be organized. This would familiarize the students with the area together with bonding with each other, like in a picnic. Visits should also be organized to a hospital, orphanage or a village. These would expose them to people in suffering or to different lifestyles. This might also sensitize them to engineering needs in these areas.

4.6. Extra-Curricular Activities in College

The new students should be introduced to the extra-curricular activities at the college/university. They should be shown the facilities and informed about activities related to different clubs etc. This is when selected senior students involved in or leading these activities can give presentations, under faculty supervision.

U20CBM202	ENVIRONMENTAL SCIENCE	L	T	P	C	Hrs
		2	0	0	0	30

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

i. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii. Slogan making event
iii. Poster making event
iv. Cycle rally
v. Lectures from experts

(b) Actual Activities:

i) Plantation
ii) Gifting a tree to see its full growth
iii) Cleanliness drive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so

		L	T	P	C	Hrs
U20CBM203	UNIVERSAL HUMAN VALUES II	2	0	0	0	30

Course Objectives

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Outcomes

CO1 - Aware of themselves, and their surroundings (family, society, nature)
CO2 - Responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO3 - Better critical ability. become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4 - Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.
CO5 - Know the contribution of scientists of different eras.

UNIT - I Introduction to Need, Basic Guidelines, Content and Process for Value Education

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

UNIT - II Understanding Harmony in the Human Being - Harmony in Myself!

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

UNIT - III Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

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

UNIT – IV Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

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

Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

UNIT – V Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems - Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.

Text Book

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

Reference Books

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

U20CBM303	PHYSICAL EDUCATION	L	T	P	C	Hrs
		0	0	2	-	30

Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 30 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

U20CBM404 **NSS**

NSS training is compulsory for all the Undergraduate students

1. The above activities will include Practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 30 hours.
4. The above activities will be monitored by the respective faculty in-charge.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree

U20CBM505	INDIAN CONSTITUTION	L	T	P	C	Hrs
		2	0	0	-	30

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

U20CBM606	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- To get a knowledge in Indian Culture
- To Know Indian Languages and Literature and the fine arts in India
- To explore the Science and Scientists of Medieval and Modern India

Course Outcomes

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

CO1 - Understand philosophy of Indian culture.

CO2 - Distinguish the Indian languages and literature.

CO3 - Learn the philosophy of ancient, medieval and modern India.

CO4 - Acquire the information about the fine arts in India.

CO5 - Know the contribution of scientists of different eras.

UNIT - I Introduction to Culture:

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT - II Indian Languages, Culture and Literature:

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature

UNIT - III Religion and Philosophy:

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT – IV Fine Arts in India (Art, Technology& Engineering):

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT – V Education System in India:

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

Reference Books

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. S. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal BanarsidassPublishers, ISBN 13: 978-8120810990, 2014.

U20CBM707	PROFESSIONAL ETHICS	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- To enable the students to create an awareness of Engineering Ethics and Human Values,
- To instill Moral and Social Values and Loyalty and to appreciate the rights of others.
- To develop a firm ethical base.
- To make the students realize the significance of ethics in a professional environment.
- To acquaint students with the latest intellectual property rights

Course Outcomes

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

CO1- Apply ethics in society. **(K3)**

CO2- Discuss the ethical issues related to engineering. **(K2)**

CO3- Act as a responsible Experimenter and follow the codes of ethics. **(K3)**

CO4- Realize the responsibilities and rights in society. **(K2)**

CO5- Familiarize with the Multinational Corporations and their Social Responsibility. **(K3)**

UNIT I HUMAN VALUES (6 Hrs)

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self- confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS (6 Hrs)

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION (6 Hrs)

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS SAFETY (6 Hrs)

Safety and Risk – Assessment of Safety and Risk – Risk-Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES (6 Hrs)

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility

Reference Books

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
3. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics –Concepts and Cases", Cengage Learning, 2009.
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
6. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
7. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" McGraw Hill education, India Pvt. Ltd., New Delhi, 2013.
8. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011

Web Resources

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org