



G H Raisoni College of Engineering

(An Autonomous Institute affiliated to RTM Nagpur University Nagpur)

Department of Information

Technology

B. Tech. in Information technology

Scheme - 2020-2021



Scheme and Curriculum of B. Tech. Information technology

Scheme Summary

Semester	Credits	Hours	Marks	No. of Theory Heads	No. of Practical Heads	Total Heads
I	18	26	575	5	7	12
II	19	26	550	5	6	11
III	22	25	525	6	3	9
IV	23	26	650	7	4	11
V	21	28	625	6	6	12
VI	22	29	600	6	6	12
VII	20	25	500	5	2	7
VIII	15	27	475	1	1	2
Total	160	212	4500	41	35	76

Course Category Credits Summary

Semester	No. of Credits for Course Category						TOTAL
	Core (C)	Basic Science and Humanities (BS &H)	Skills (A)	Electives (EL)	Open Electives (OE)	PROJECT/ INTRNSHIP (P)	
I	3	2	3				8
II	2	4	2				8
III	5	1					6
IV	4	1	3		1		9
V	5	1	1				7
VI	2	2	4	1	1		10
VII				5		1	6
VIII					1	1	2
TOTAL	21	11	13	6	3	2	56



Scheme of B. Tech. in Information Technology

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
			L	T	P	Total Hrs		Theory			Practical			Total Marks
								TAE	CAE	ESE	IN	EX	TI	
SEMESTER-I														
UBSL151	Matrices and Differential Calculus	BS1	2	1		3	3	10	15	50			75	
UBSL101/ UBSP101	Engineering Physics	BS2	1	1	2	4	3	10	15	50	25		100	
UCSL101/ UCSP101	Computer Programming	C1	2		4	6	4	10	15	50	50		125	
UCSL102/ UCSP102	Foundations of Data Analytics	C2	1		2	3	2	10	15	50	25		100	
UECL103/ UECP103	Introduction to Discrete Devices and Circuits	C3	2		2	4	3	10	15	50	25		100	
UITP101	Problem Identification and Design Thinking	A1			2	2	1				25		25	
UIISP102	Introduction to Drones	A2			2	2	1				25		25	
UIISP101	Biomedical Engineering	A3			2	2	1				25		25	
TOTAL			8	2	16	26	18	50	75	250	200	--	575	

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
			L	T	P	Total Hrs		Theory			Practical			Total Marks
								TAE	CAE	ESE	IN	EX	TI	
SEMESTER-II														
UBSL152	Integral Calculus and Differential Equations	BS3	2	1		3	3	10	15	50			75	
UBSL153	Linear Algebra and Statistics	BS4	2	1		3	3	10	15	50			75	
UBSL131/ UBSL131	Environmental Chemistry	BS5	1		2	3	2	10	15	50	25		100	
UITP102	Programming for Problem Solving	C4			4	4	2				50		50	
UECL104/ UECP104	Modeling of Digital Circuits	C5	3		2	5	4	10	15	50	25		100	
UHUL101/ UHUP101	Communication Skills	H1	2		2	4	3	10	15	50	25		100	
UECP105	Internet of Things	A4			2	2	1				25		25	
UHUP102	Foreign Language	A5			2	2	1				25		25	
TOTAL			10	2	14	26	19	50	75	250	175	--	550	



Scheme of B. Tech. in Information Technology

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
			L	T	P	Total Hrs		Theory			Practical			Total Marks
								TAE	CAE	ESE	IN	TEXT	IM	
SEMESTER-III														
UBSL255	Discrete Mathematics & Graph Theory	BS	3	1		4	4	10	15	50			75	
UCSL201 UCSP201	Data Structures and Algorithms	C	3		2	5	4	10	15	50	25		100	
UCSL202	Computer Architecture and Organisation	C	3			3	3	10	15	50			75	
UECL208 UECP208	Applications of Microprocessors and Microcontrollers	C	3		2	5	4	10	15	50	25		100	
UITL201 UITP201	Object Oriented Programming	C	3		2	5	4	10	15	50	25		100	
UECL204	Signals and Systems	C	3			3	3	10	15	50			75	
TOTAL			18	1	6	25	22	60	90	300	75		525	

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
			L	T	P	Total Hrs		Theory			Practical			Total Marks
								TAE	CAE	ESE	IN	TEXT	IM	
SEMESTER-IV														
UBSL256	Transforms & Numerical Methods	BS	3	1		4	4	10	15	50			75	
UCSL203	Formal Languages and Automata	C	3			3	3	10	15	50			75	
UCSL205 UCSP205	Design and Analysis of Algorithms	C	3		2	5	4	10	15	50	25	25	125	
UITL204 UITP204	Computer Network	C	2		2	4	3	10	15	50	25		100	
UCSL206 UCSP206	Operating System	C	3		2	5	4	10	15	50	25		100	
UISL2XX	Open Elective - I	OE	2			2	2	10	15	50			75	
UAIL206 UAIP206	Machine Learning Algorithm	A	2		2	4	3	10	15	50	25		100	
TOTAL			18	1	8	27	23	70	105	350	100	25	650	



Scheme of B. Tech. in Information Technology

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					Total Marks
			L	T	P	Total Hrs		Theory			Practical		
								TAE	CA	ESE	IN	TEXT	
SEMESTER-V													
UCSL301 UCSP301	Database Management System	C	2	1	2	5	4	10	15	50	25	25	125
UITL419 UITP419	Computer System Security	C	3		2	5	4	10	15	50	25		100
UITL302 UITP302	Web Development	C	2		4	6	4	10	15	50	25		100
UITL306 UITP306	JAVA Programming	C	2		2	4	3	10	15	50	25		100
UITL308 UITP308	Software Engineering for Project Management	C	2		2	4	3	10	15	50	25		100
UHUL303	Engineering Economics and Industrial Management	H	2			2	2	10	15	50			75
UHUP305	Aptitude	A			2	2	1				25		25
TOTAL			13	1	14	28	21	60	90	300	150	25	625

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					Total Marks
			L	T	P	Total Hrs		Theory			Practical		
								TAE	CA	ESE	IN	TEXT	
SEMESTER-VI													
UITL307 UITP307	Real Time Operating Systems	C	2		2	4	3	10	15	50	25		100
UECL310 UECP310	Digital Signal Processing	C	3		2	5	4	10	15	50	25		100
UXXLXXX UXXPXXX	Elective - I	EL	3		2	5	4	10	15	50	25		100
UISL3XX	Open Elective - II	OE	2			2	2	10	15	50			75
UHUL3XX	Humanities Elective	H	2			2	2	10	15	50			75
UHUL304	Universal Human Values 2: Understanding Harmony	H	3			3	3	10	15	50			75
UHUP302	Employability Skills	A			2	2	1				25		25
UHUP301	Campus Recruitment Training	A			2	2	1				25		25
UAIP_203	Data Preprocessing	A			4	4	2				25		25
TOTAL			15		14	29	22	60	90	300	150		600



Scheme of B. Tech. in Information Technology

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
			L	T	P	Total Hrs		Theory			Practical			Total Marks
								T	A	E	E	S	E	
SEMESTER-VII														
UXXLXXX UXXPXXX	Elective-II	EL	3		2	5	4	10	15	50	25		100	
UXXLXXX	Elective - III	EL	3			3	3	10	15	50			75	
UXXLXXX	Elective - IV	EL	3			3	3	10	15	50			75	
UXXLXXX	Elective - V	EL	3			3	3	10	15	50			75	
UXXLXXX	Elective - VI	EL	3			3	3	10	15	50			75	
UITP412	Project	P			8	8	4				50	50	100	
TOTAL			15	10	25	20	50	75	250	75	50	500		

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
			L	T	P	Total Hrs		Theory			Practical			Total Marks
								T	A	E	E	S	E	
SEMESTER-VIII														
UISL4XX	MOOCS based Open Elective	OE	3			3	3	10	15	50			75	
UITP413	Internship	P			24	24	12				200	200	400	
TOTAL			3	24	27	15	10	15	50	200	200	475		



Pool of Track wise Electives

Elective	Language & Software Development	Course Code	Networks and Security	Course Code	Signal Processing	Course Code	Data Base Management & Analysis	Course Code	Artificial Intelligence & Machine Learning	Course Code	Soft Computing	Course Code
Track	Track-I		Track-II		Track-III		Track-IV		Track -V		Track-IV	
Electives with Laboratory												
Elective-I (Credits :4) (Semester- VI)	Mobile Application Development	UITL303 UITP303	Information Security and Cryptography	UITL 304 UITP 304	Digital Image Processing	UECL 420 UECP 420	Big Data Computing	UITL 305 UITP 305	Artificial Neural Network	UAIL 317 UAIP 317	Soft Computing	UAIL 301 UAIP 301
Elective-II (Credits :4) (Semester-VII)	Scripting Language	UITL401 UITP401	Wireless Adhoc Network	UITL 409 UITP 409	Audio and Speech Signal Processing	UECL 413 UECP 413	Unstructured Database Management System	UITL 418 UITP 418	Deep Learning	UAIL 411 UAIP 411	Cloud Computing	UITL 414 UITP 414
Electives without Laboratory												
Elective-III (Credits :3) (Semester- VII)	Natural Language Processing	UAIL302	Digital Marketing	UCSL 413	Bio-Informatics: Algorithms and Applications	UISL 402	Blockchain Technology	UCSL 412	Brain Machine Interface	UECL 418	Reconfigurable Computing	UISL 410
Elective-IV (Credits :3) (Semester- VII)	Business Intelligence	UAIL210	Digital Forensics	UDIL 418	Digital Video Processing	UITL 410	Distributed Database & Object Oriented Database	UITL 411	Artificial Intelligence and Expert Systems	UAIL 421	Neuromorphic Computing	UISL 405
Elective-V (Credits :3) (Semester- VII)	Embedded System Design and RTOS	UECL303	Wireless Sensor Network	UECL412	Biomedical Imaging	UISL 411	AWS: Cloud Computing Services	UITL 402	Pattern Recognition	UAIL 211	Mobile Computing	UITL 406
Elective-VI (Credits :3) (Semester-VII)	Mobile Game Development	UITL407	DevOps : Software Development & IT Operations	UITL 403	Multirate Signal Processing	UITL 408	Agile Scrum Master	UCSL 428	Virtual & Augmented Reality	UAIL 414	Git: Control System for Tracking Changes	UITL 404



Skill Category Courses

Semester	Details	Name	Credits
I	A1	Problem Identification and Design Thinking	1
	A2	Introduction to Drones	1
	A3	Biomedical Engineering	1
II	A4	Internet of Things	1
	A5	Foreign Language	1
IV	A6	Machine learning Algorithm	1
	A7		1
	A8		1
V	A9	Aptitude	1
VI	A10	Data Preprocessing	1
	A11		1
	A12	Employability Skills	1
	A13	Campus Recruitment Training	1

Open Electives

Open Elective –I		Open Elective –II	
Course Code	Course Name	Course Code	Course Name
To be offered based on courses available on NPTEL/SWAYAM			

Information Technology				
Scheme-2020-2021				
Elective	Course Code	Semester	Course Name	Offered in AY
Open Elective-I	UISL201	IV	ENGLISH FOR INTERNATIONAL ASPIRANTS	2021-22
	UISL202	IV	APPLIED ENGLISH COMMUNICATION SKILLS	2021-22
	UISL203	IV	CAREER (SOFT) SKILLS FOR ENGINEERS	2022-23
	UISL204	IV	ENGLISH FOR COMPETITIVE EXAMINATIONS	2021-22
	UISL205	IV	ADVANCED COMMUNICATION SKILLS	2021-22
	UISL206	IV	SANSKRIT FOR TECHNICAL KNOWLEDGE	2022-23
Open Elective-II	UISL308	VI	E-BUSINESS	2022-23
	UISL309	VI	FINANCIAL MANAGEMENT FOR MANAGERS	2022-23
	UISL310	VI	BUSINESS DEVELOPMENT: FROM START TO SCALE	2022-23
Humanities Elective	UHUL312	VI	CONTENT DESIGNING AND MEDIA FUNDAMENTALS	2022-23
	UHUL313	VI	CYBER ETHICS AND MORAL RESPONSIBILITY	2022-23



Semester I

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
			L	T	P	Total Hrs		Theory			Practical			Total Marks
								TA	CA	EE	EE	IN	TE	
SEMESTER-I														
UBSL151	Matrices and Differential Calculus	BS1	2	1		3	3	10	15	50				75
UBSL101/ UBSP101	Engineering Physics	BS2	1	1	2	4	3	10	15	50	25			100
UCSL101/ UCSP101	Computer Programming	C1	2		4	6	4	10	15	50	50			125
UCSL102/ UCSP102	Foundations of Data Analytics	C2	1		2	3	2	10	15	50	25			100
UECL103/ UECP103	Introduction to Discrete Devices and Circuits	C3	2		2	4	3	10	15	50	25			100
UITP101	Problem Identification and Design Thinking	A1			2	2	1				25			25
UISP102	Introduction to Drones	A2			2	2	1				25			25
UISP101	Biomedical Engineering	A3			2	2	1				25			25
TOTAL			8	2	16	26	18	50	75	250	200	--	575	



Course Title: Matrices & Differential Calculus										
Semester	I	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	BS	2 Hrs.	1 Hr.	--	3	10	15	50	NA	NA
Course Code	UBSL151									
Teaching Mode	Offline	3 Hrs			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	To introduce concepts of matrices in the field of Engineering.
	To develop skills in student to solve engineering problems based on Matrices.
	To introduce concepts of Differential Calculus & Vector Calculus in the field of Engineering.
	To develop skills in students to solve applications-based problems on Differential Calculus.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand and use the theory of Matrices to solve the system of linear equations and engineering problems in respective disciplines.
	CO2: Determine the Eigen values and Eigen vectors of a matrix and apply to various engineering problems in respective disciplines.
	CO3: Apply concepts of differentiation in solving engineering problems.
	CO4: Use applications of partial differentiation to solve various problems in engineering.
	CO5: Apply the Knowledge of vector differentiation to solve various problems in engineering.

Mapping of Course Outcomes with Program Outcomes:

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



Course Contents:

Unit	Contents	Hours
I	Matrices: Adjoint of Matrix, Inverse of matrix by adjoint method, Solution of simultaneous equations by adjoint method. Inverse of matrix by Partitioning method. Rank of matrix, Consistency for system of linear equations, Linear dependence.	8
II	Characteristics equation, Eigen values and its properties. Eigen vectors. Reduction to diagonal form, Cayley Hamilton theorem (statement & verification). Sylvester's theorem, Association of matrices with linear differential equations of second order with constant coefficient.	10
III	Differential Calculus of single variable function: Review of limits, continuity, differentiability and Mean value theorem. Successive differentiation, Leibnitz's Theorem, Taylor's series and Maclaurin series for single variable function.	7
IV	Differential Calculus of function of several variables: Functions of several variables, First and higher order partial derivatives, Euler's theorem, Chain rules. Jacobian, Properties of Jacobian, Maxima and minima of function of two variables, Lagrange's method of undetermined multipliers.	9
V	Vector Calculus: Differentiation of vectors, Gradient of a scalar point function, Directional derivatives. Divergence and Curl of vector point function. Solenoidal & Irrotational vector field.	8

Text Books	1.	Higher Engineering Mathematics, B S Grewal, Khanna Publishers, 2013, Forty Third Edition
	2.	Advanced Engineering Mathematics: Erwin Kreyszig John Wiley and Sons, 2013, Tenth Edition
Reference Books	1.	Advanced Engineering Mathematics, Jain, R K and Iyengar S.R.K, Narosa Publishers, Alpha Science International, Ltd, 2007, Third Edition
	2.	Advanced Mathematics for Engineers and Scientists, Spiegel, M. R, McGraw-Hill, 2010, Second Edition



Course Title: Engineering Physics										
Semester	I /II	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Odd/ Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	BS	1 Hr.	1 Hr.	2 Hrs.	3	10	15	50	25	--
Course Code	UBSL101 UBSP101									
Teaching Mode	Offline	4 Hrs			Total	75			25	
Duration of ESE	2Hrs					100				

Course Objectives	Demonstration of the fundamentals of uniform and non-uniform electric and magnetic fields and working of related devices.
	Familiarization and demonstration of the concepts of interference, laser and their applications.
	Explanation of working of various optoelectronic devices.
	Demonstration of the fundamentals of Quantum Mechanics and its related applications.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Identify the trajectories of electron in uniform Electric and Magnetic fields and operate related devices.
	CO2: Describe the phenomenon of interference & implement it for finding related parameters.
	CO3: Explain the working of Laser & use it for different applications.
	CO4: Identify various optoelectronic devices and use them for various applications.
	CO5: Apply the knowledge of Quantum Mechanics to solve related problems.

Mapping of Course Outcomes with Program Outcomes:

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



Course Contents:

Unit	Contents	Hours
I	Electron Ballistics and Optics: Trajectories of electron in uniform Electric and Magnetic field (Qualitative), Bethe's law, Electron Lens, Devices-Electron microscope (Theoretical), CRO	4
II	Optics: Interference-Interference in uniform & non-uniform thin films, AR Coatings, Surface Testing, Branch specific applications.	4
III	LASER: Characteristics, Spatial and Temporal Coherence, Einstein Coefficient & its significance, Basic requirements of Laser, Components of laser, He-Ne, Semiconductor laser and Branch Specific applications.	6
IV	Semiconductor Physics: Review of basic Semiconductor physics, Hall Effect, Review of working of PN junction diode with reference to energy level diagrams. Optoelectronic Devices:-Types of optoelectronic devices, LED-Types & working principle, OLED, properties & comparisons, OLED applications, PIN Photodiode, Solar Cell, Branch specific applications as sensors and detectors	6
V	Quantum Physics: Blackbody Radiation, Compton Effect, Wave particle duality: De Broglie wavelength, Group and Phase velocity, Heisenberg's Uncertainty principle & its applications, Schrödinger's Mechanics: Physical interpretation of Wave Function, Elementary Idea of Operators, Solution of Schrodinger equation for simple boundary value problems, Tunneling, Applications-TEM, SEM, Effect of Quantum constriction on properties of nanomaterials	6

Text Books	1.	Fundamentals of Physics by David Halliday, Robert Resnick and Jerle Walker; John- Wiley and Sons, 2018, Eleventh Edition
	2.	Concepts of Modern Physics by Baiser et. al, Tata McGraw-Hill Education Pvt. Ltd, 2015, Twenty Ninth edition
	3.	Physics for Engineering, Dr. Bhavana P Butey, Oxford University Press, 2017, First Edition
E-Books	1.	https://www.phindia.com/Books/EBooks
Reference Books	1.	Quantum Mechanics by Leonard I Schiff, Tata McGraw-Hill Education Pvt. Ltd, 2014, Fourth Edition
	2.	Nanotechnology, Dr. Sulbha K Kulkarni, Capital Publishing Co., 2011
	3.	Electronic Engineering Material and Devices by: John Allison (TMH),1971
Online TL Material	1.	https://nptel.ac.in/courses/104/104/104104085/

Sr. No.	Name of Experiments
1	Application of CRO: To measure amplitude of AC voltage and determine unknown frequency using CRO
2	Determination of diameter of thin wire using interference by using Air Wedge
3	Determination of Wavelength of Laser source by Newton's ring.
4	Determination of Hall Coefficient of an Extrinsic Semiconductor by arranging it in a Hall Effect. Experiment.
5	Determination of Band gap of an Intrinsic semiconductor by using PN junction



	diode
6	PN junction diode as a rectifier-Find efficiency & ripple factor by using CRO
7	Application of diode: Voltage regulation by Zener diode.
8	Study of various Photo detectors as sensors
9	Application of interference: Determination of radius of curvature of plano-convex lens using Newton's ring set up.
10	Application of interference: Determination of refractive index using Newton's ring set up.
11	Laser: Determination of Birefringence of double image prism.
12	Determination of Band gap by four probe method.
13	Application of Diode: Determination of Planks Constant by using LEDs.
14	Comparison of V-I characteristics of various diodes.
15	Application of CRO: Determination of phase difference between two AC signals.



Course Title: COMPUTER PROGRAMMING										
Semester	I	Teaching Scheme				Evaluation Scheme				
		Theory		Practical						
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	2 Hrs.		4 Hrs.	4	10	15	50	50	--
Course Code	UCSL101/ UCSP101									
Teaching Mode	Offline	6 Hrs			Total	75			50	
Duration of ESE	2Hrs					125				

Course Objectives	To introduce the basics of components of programming language and also develop logical thinking
	To implement concepts of mathematics into programming.
	To help students understand how to model real-world problems into the software and develop practical programming skills
Course Outcomes	CO1: Design algorithms and flowcharts for solving Mathematical and Engineering Problems
	CO2: Apply the suitable Control structures to solve the given problem
	CO3: Investigate the problems and identify the use of Pointers and Functions in it.
	CO4: Assess the programming structure and recommend the type of array to be useful to find a solution for applications.
	CO5: Synthesize various problems to develop logical thinking

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		3											2	
CO2			3										1	
CO3				3									2	
CO4			3										2	
CO5			3										2	

Course Contents:

Unit	Contents	Hours
I	Introduction to Programming: Evolution, Programming Paradigms, Features, Algorithm, Flow charts, Data types and storage classes, Strings, Scope of variables, Tokens, Type Casting, Operators	8
II	Control Statements: Decision Making Statements: if, if-else, nested if, nested if-else, switch, go-to. Loop Control Statements: Entry control, Exit Control, while, do-while, for, break, continue	7



III	Arrays: Definition, Declarations, Initialization, Accessing, Types of Arrays: 2D,3D	7
IV	Pointers: Definitions, Declarations, Applications Functions: Definitions, Declarations, Types, Calling, Function arguments: Call by Value, Call by Reference, Recursion	6
V	Structure: Definition, Accessing Structure Members, Structures as Function Arguments, Pointers to Structures Union: Definition, Accessing Union Members Advance Topic: (As per the instructor)	7

Text Books	1.	Kernighan and Ritchie, C programming language Prentice Hall of India,
	2.	Balguruswamy, "Programming in ANSIC", Tata Mcgraw Hill Publishing
	3.	Kakde and Deshpande, "C and Data Structure", Charles River Media Publisher
	4.	Yashwant Kanetkar, Let's C, BPB Publishers
Reference Books	1.	Herbert Schildt, C: The Complete Reference, Mcgraw Hill Publishing
	2.	Expert C Programming, Deep C Secrets by Peter van der Linden.
On-line TL Material	1.	https://spoken-tutorial.org/tutorial-search/?search_foss=C+and+C++

Sr. No.	Name of Experiments
1	Implement syntax of C with algorithm and flowchart
2	Implement Data Types and Type casting
3	Implement the Branch control statements in C
4	Implement the Loop control statements in C
5	Implement the concept of Pointers using C
6	Implement the Functions in C
7	Implement recursive functions in C
8	Implement the Linear Array Operations.
9	Implement the Matrix Array Operations Array for addition and multiplication
10	Implement Structures in C
Open Ended Experiments	
1	Student Record Management System
2	Simple CPP
Details of on line Laboratory Resource Material Instruction / Operating Manuals	
1.	https://spoken-tutorial.org/tutorial-search/?search_foss=C+and+C++
2	https://cse02-iiith.vlabs.ac.in/



Course Title: Foundation of Data Analytics										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD/EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	Int	Ext
Course Code	UCSL102/ UCSP102	1		2	2	10	15	50	25	--
Teaching Mode	Offline	3 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	To perform descriptive statistics on the given dataset
	To perform inferential statistics on the given dataset
	Apply linear regression and logistic regression and perform data visualization on the given dataset with Tableau.
Course Outcomes	CO1: Analyze the dataset and perform Descriptive Statistics
	CO2: Analyze the dataset and perform an Inferential Statistics
	CO3: Apply linear regression on the given dataset
	CO4: Apply the logistic regression on the given dataset
	CO5: Create an interactive data visualization

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3										2	
CO2	3										2	
CO3			3								3	
CO4			3								3	
CO5					3							3

Course Contents:

Unit	Contents	Hours
I	Buzzwords of Data Science, Info-graphic representation of terminologies, Difference between Analysis and Analytics, Applications	3
II	Descriptive Statistics: Population and Sample, Types of Data, Measurement Levels, Representation of categorical variables, Measures of Central Tendency (Mean, Median, Mode), Skewness, Variance, Standard Deviation, Coefficient of Variation, Covariance, Correlation. Histogram Analysis.	3
III	Inferential Statistics: Distribution, Normal Distribution, Standard Normal Distribution, Central Limit Theorem, Standard Error, Estimators and Estimates, Confidence Interval, Students T Distribution, Margin of Error	3



IV	Linear Regression: Introduction to Regression, Simple and Multiple Linear Regression, Correlation vs. Regression, SST (Sum of Squares Total), SSR (Sum of Squares Regression), SSE (Sum of Squares Error) R-Square, Adjusted R-Squared. Multiple Linear Regression, Significance of p-value	3
V	Logistic Regression: Logistic regression, Logit vs logistic, Applications of logistic regression Introduction to data visualization and various graphical ways of data representation	3

Text Books	1.	The Art of Statistics: Learning from Data (Pelican Books), by
	2.	Principles of Statistics by M. G. Bulmer, Dover Publications Inc.
	3.	Statistics 101: From Data Analysis and Predictive Modeling to Measuring Distribution and Determining Probability, Your Essential Guide to Statistics By David Borman, Adams Media
EBooks	1.	An Introduction to the Science of Statistics: From Theory to Implementation, by Joseph C. Watkins https://www.math.arizona.edu/~jwatkins/statbook.pdf
	2.	Introduction to Statistics, by David M. Lane http://onlinestatbook.com/Online_Statistics_Education.pdf
Reference Books	1.	Information Dashboard Design: Displaying Data for At-a-glance Monitoring by Stephen Few, Analytics Press
	2.	Beautiful Visualization, by Noah Iliinsky, Julie Steele Publisher(s): O'Reilly Media, Inc. ISBN: 9781449379865
On-line TL Material	1.	The Business Intelligence Analyst Course 2020 https://www.udemy.com/course/the-business-intelligence-analyst-course-2018/
	2.	The Data Science Course 2020: Complete Data Science Bootcamp https://www.udemy.com/course/the-data-science-course-complete-data-science-bootcamp/

Sr. No.	Name of Experiments
1	Apply pivot table of Excel to perform data analysis
2	Perform Descriptive statistics of given dataset using Data Analysis Toolbox of Excel
3	Perform the Histogram Analysis of given dataset using Data Analysis Toolbox of Excel
4	Perform Simple Linear Regression using Data Analysis Toolbox of Excel or with Python and Interpret the regression table
5	Perform Multiple Linear Regression using Data Analysis Toolbox of Excel or with Python and Interpret the regression table
6	Perform the Logistic Regression and given dataset and Interpret the regression table
7	Install Tableau, Understand User Interface, Dimensions, Measures, Pages, Filters, Marks and Show Me, Dataset Connections and Create a visualization
8	Various graphs in Tableau, Integration of Map and geo-locations, Creating Interactive Dashboard and Publishing your Dashboard to Tableau Public Site
9	Scatter Plots, Data Highlighter, Pages and Cards, Annotations Creating Story and



	publishing on Tableau Public
10	Given a case study: Perform Interactive Data Visualization with Tableau
Open Ended Experiments	
1	Perform Data Visualization with Microsoft Power BI
2	Perform Data Visualization with R
Details of on line Laboratory Resource Material Instruction / Operating Manuals	
1.	Google classroom on 'Business Intelligence Analyst' – Code: udsf4px



Course Title: Introduction To Discrete Devices And Circuits										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
		Theory		Practical						
Term	Odd/Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	2 Hrs.	--	2 Hrs.	3	10	15	50	25	--
Course Code	UECL103 UECP103									
Teaching Mode	Offline	4 Hrs.			Total	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	To give understanding on how current flows through the p-n junction and relating this phenomenon to the characteristics and operation of the diodes, bipolar and field-effect transistors.
	To expose students to the function and application of the diodes, bipolar junction and field effect transistors in electronic circuits.
	To use appropriate experimentation techniques to evaluate circuit performance.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Relate operation of diodes, types of diodes and their role in design of simple electronic applications.
	CO2: Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points for various biasing methods.
	CO3: Classify Power amplifiers, Oscillators & Display Devices
	CO4: Interpret the operation of the Field Effect Transistor (FET), Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and design FET circuits
	CO5: Demonstrate familiarity with basic electronic components and use them to design simple electronic circuits

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	3	3	3	2	1	1	1	1	2	3
CO2	3	3	3	3	3	2	1	1	1	1	2	3
CO3	3	3	3	3	3	2	1	1	1	1	2	3
CO4	3	3	3	3	3	1	1	1	1	1	2	3
CO5	3	3	3	3	3	1	1	1	1	1	2	3

Course Contents:

Unit	Contents	Hours
I	Semiconductor Devices: PN junction diode review, Half and full wave rectifiers, Zener Diode, Varactor Diode, Tunnel Diodes, Clippers and Clampers circuits	6



II	BJT Transistors- structure, Operations & characteristics, voltages and currents equations, CE, CB, CC configurations, Early Effect	6
III	BJT Circuits DC load line, Biasing circuits, Stability factor, thermal runaway, Compensation methods, h-parameters, Feedback Amplifiers,	6
IV	Field Effect Transistor: FETs – Drain and Transfer characteristics, - Current equations-Pinch off voltage and its significance, MOSFETs,	6
V	Active and Passive sensors: Temperature, humidity, light sensors, Piezo electrical Transducers, Relay	6

Text Books	1.	Electronics Devices and Circuits, S. Salivahanan, N Suresh Kumar, Tata McGraw-Hill, 2008, Third Edition
	2.	Integrated Electronics, Jacob Millman, Tata McGraw-Hill, 2009, Second Edition
	3.	Electronics devices and Circuits and Theory Robert L. Boylestad, Louis Nashelsky, Pearson India, 2009, Tenth Edition
E--Books	1.	Electronics Devices and Circuits, S. Salivahanan
	2.	Solid State Electronic Devices, Ben G Streetman & Sanjiv Kumar Banerjee, Sixth Edition
Reference Books	1.	Electronic Devices & Circuits, Sanjiv Gupta,
	2.	Microelectronics Circuits, A S Sedra & K C Smith, Oxford University Press, 2013, Seventh Edition
	3.	Electronics Devices and Circuits, Nagrath I J, PHI, Learning Pvt Ltd, 2009, Third Edition
On-line TL Material	1.	Virtual Lab, Electronic Devices & Circuits, IIT Bombay http://vlabs.iitb.ac.in/vlab/electrical/index.html

*: Every practical will be performed on Bread Board

Sr. No.	Name of Experiments / Mini Projects
0	Study of different electronic components
1	Observe and draw V-I Characteristics of PN Diode & LED Diode.
2	Observe and draw the V-I characteristics and Regulation characteristics of a Zener diode.
3	Design Clipper circuit using Diode.
4	Design Clamper circuit using Diode.
5	Obtain ripple factor of Half Wave/Full wave Rectifier circuit with & without filter
6	Draw the input and output characteristics of transistor connected in CE/CB/CC any one Configuration
7	Design bipolar junction transistor as a switch
8	Design Audio oscillator using BJT
9	Design Radio Oscillator using BJT
10	Design Oscillator for Laptop.
11	Draw the Drain and Transfer characteristics of a given FET in CS Configuration.
12	Draw the Drain and Transfer characteristics of a given MOSFET in CS



	Configuration.
Open Ended Experiments	
1	Design of Class B push pull power amplifier and observe cross over distortion.
2	Design Zener regulator circuits for Processor Motherboard.
3	Design of Simple analog application circuits.



Course Title: Problem Identification and Design Thinking										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	Odd/Even					TAE	CAE	ESE	INT	EXT
Course Category	A	--	--	2 Hrs.	2	--	--	--	25	--
Course Code	UITP101									
Teaching Mode	Offline	2Hrs			Total	--			25	
Duration of ESE	NA					25				

Course Objectives	Learn to illustrate the problem definition, significance of stakeholders and information gathering
	Conduct the brainstorming to generate ideas and refining of ideas
	Select the potential ideas and design potential solution
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Identify the problem definition and stakeholders
	CO2: Analyze the gathered information and identify potential ideas
	CO3: Design a suitable prototype and evolve it.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	--	3	--	--	--	--	--	--	--	--	--	--
CO2	--	--	--	3	--	--	--	--	--	--	--	--
CO3	--	--	3	--	--	--	--	--	--	--	--	--

Sr. No.	Name of Experiments
1	Define: Identify the problem definition and define it and identify the stakeholders. Enlist the constraints associated with Problem Definition and formulate the objectives.
2	Research: Conduct primary and secondary research in identified problem definition. Identify GAP and scope for improvement.
3	Information Gathering: Gather the information in the form of qualitative, quantitative and through surveys
4	Ideate: Perform brainstorming which can leads to generation of potential ideas
5	Refinement: Refine the ideas and increase the effectiveness
6	Prototype: Design a suitable prototype for ideas generated in Ideate Phase.
7	Selection: Identify the proposed design solution for implementation or development phase
8	Implementation: Implement the solution or deliver the solution to stakeholders



9	Evolve: Identify what worked well and where in the scope for improvement.
10	Report Writing: Write a detailed report for all the phases of design thinking.
Open Ended Experiments	
1	Define the Industry based problem and conduct the primary and secondary research and information gathering
2	Ideate the potentials ideas and design a prototype for industry based problem.

Text Books	1.	Basics Design 08: Design Thinking, By: Gavin Ambrose, Paul Harris, AVA Publishing
	2.	Jeanne Liedtka and Tim Ogilvie Designing for Growth: A Design Thinking Tool Kit for Managers (Columbia University Press, 2011)
EBooks	1.	The Design Thinking: Guidebook by Mr. Lee Chong Hwa (Lead Facilitator)
Reference Books	1.	Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation (Harper Business, 2009)



Course Title: Introduction to Drones										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
		Theory		Practical						
Term	Odd/ Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	A	--	--	2 Hrs.	1	--	--	--	25	--
Course Code	UISP102									
Teaching Mode	Offline	2 Hrs			Total	--			25	
Duration of ESE	NA					25				

Course Objectives	Be able to describe common components of drone
	Be able to define concepts related to drone
	Be able to design the application-oriented drone
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Recognize and describe the role of drone in present, past and future society
	CO2: Comprehend basic components of drone.
	CO3: Explain the impact of various payloads of drone.
	CO4: Interpret the aspects of legal issues
	CO5: Implement and design application-oriented drone.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	1	2	2	3	--	3	3	2	3	1
CO2	3	3	1	2	2	3	--	3	3	2	3	1
CO3	3	3	1	2	2	3	--	3	3	2	3	1
CO4	3	3	1	2	2	3	--	3	3	2	3	1
CO5	3	3	1	2	2	3	--	3	3	2	3	1

Course Contents:

Unit	Contents	Hours
I	Introduction to Drone Technology Types of Drones and Their Technical Characteristics, Main Existing Drone Types, Level of Autonomy, Size and Weight, Differences in Energy Source, Widely Used Drone models,	4
II	Assembly of Drone Parts of a Drone, Motor, Propellers, Flight Controllers, Electronic Speed Controllers, Safe Assembly of Drone and Drone air Flight for aerial Photos. Battery management systems	4
III	Impact of Payloads Types of Payloads and their application sensors, other payloads and	4



	frequency spectrum issues.	
IV	Legal Aspects Legal issues on the use of frequency spectrum and electronic equipment, surveillance and compliance. Flight zones	4
V	Case studies Future Developments in Drone Technology. Advance topic	4

Text Books	1.	The future of Drone Use Opportunities and Threats from Ethical & Legal Perspectives -Prof Bart Custer's, Center for Law and Digital Technologies, Leiden Law School, Leiden University, The Netherlands, October 2016, T.M.C. ASSER PRESS, ISBN: 978-94-6265-131-9
	2.	Drones (The Ultimate Guide): How they work, learning to fly, how to fly, building your own drone, buying a drone, how to shoot photos -Publisher: Create Space Independent Publishing Platform; Large Print edition (May 30, 2017) Ben Rupert (Author)
E--Books	1.	Quad copters and Drones: A Beginner's Guide to Successfully Flying and Choosing the Right Drone -Create space Independent Pub (25 June 2015) Mark Smith (Author)
Reference Books	1.	Build a Drone: A Step-by-Step Guide to Designing, Constructing, and Flying Your Very Own Drone Barry Davies
	2.	Drones: An Illustrated Guide to the Unmanned Aircraft that are Filling our Skies



Sr. No.	Name of Experiments / Mini Project
1	Experimental study of customized drone components interfacing
2	Study of mAh battery capacity with flight time calculation and battery connection
3	Study of type of motors and ESC with connection in adopter
4	Experimental study of propeller blade rotation CC & CCL & it's role in control
5	Installation of Pluto X controller App & it's setting
6	Study of throttle control in quad copter and its controlling
7	Experimental study of role of yaw control in quad copter
8	Experimental study of role of roll control in balancing
9	Experimental study of role of pitch control in quad copter balance and its control
10	Study of sensor board X breakout and sensor interfacing to quad copter
Open Ended Experiments / New Experiments	
1	Chuck to ARM
2	Open Sesame: Drone take-off due to change in ambient pressure
3	Turn the Drone upright from its flipped position
Details of Online Laboratory Resource Material Instruction / Operating Manuals	
1.	Cygnus software
2.	Pluto X operating manuals
3.	Transmitter & Receiver console



Course Title: Biomedical Engineering										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	Odd/Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	IN T	EXT
Course Category	A	--	--	2 Hrs.	1	--	--	--	25	--
Course Code	UISP101									
Teaching Mode	Offline	2 Hrs.			Total	--			25	
Duration of ESE	NA					25				

Course Objectives	It helps students to understand importance of biological concepts in engineering fields.
	To understand application of engineering concepts in medical instrumentation.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand Human anatomy
	CO2: Relate various applications of sensors for Biomedical applications with safety standards.
	CO3: Analyses and apply various biomedical diagnostic methods.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	2	2	1	2	3	2	2	2
CO2	2	2	2	2	3	2	1	2	3	2	2	3
CO3	3	2	2	2	3	2	1	2	3	2	2	3

Course Contents:

Unit	Contents	Hours
I	Human Physiology and Anatomy: Introduction to Human Physiology, Nervous system, Cardiovascular system,	4
II	Biomedical Instrumentation: Bio-electric Signals, Types of Electrodes, Electrodes for ECG, EMG, EEG, Transducers and sensors related to biomedical measurements, ECG Machine, B. P, Heart Rate, Heart Sound, Blood Flow Measurements. Electrocardiography, Pacemakers, Defibrillators, Biomedical Standards.	8



III	Diagnostic Medical instruments: X-ray, CT scan, MRI, Ultrasonic Doppler Machine, Diathermy, Lasers in medical application, Robotics in medical application, Case studies, Advance topics in biomedical Engineering. Introduction to BCI. Application of AI in Biomedical.	8
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Text Books	1.	Biomedical Instrumentation and Measurement, Cromwell, PHI.
	2.	Biomedical Instrumentation, R. S. Khandpur,
Reference Books	1.	Carr and Brown, "Biomedical Instrumentation".
	2.	Webster, "Application and Design of Medical Instruments".

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Study of Human Physiology by Skeleton model
2	Design and perform Heart Rate Detection System using Arduino
3	To study and measure the EEG signals
4	To study and measure the ECG signals
5	To study and measure the EMG signals
6	Mini project
7	Open Ended Experiments



Semester II

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme						
			L	T	P	Total Hrs		Theory			Practical			Total Marks
								TAE	CAE	ESE	INT	EXT		
SEMESTER-II														
UBSL152	Integral Calculus and Differential Equations	BS3	2	1		3	3	10	15	50			75	
UBSL153	Linear Algebra and Statistics	BS4	2	1		3	3	10	15	50			75	
UBSL131/ UBSL131	Environmental Chemistry	BS5	1		2	3	2	10	15	50	25		100	
UITP102	Programming for Problem Solving	C4			4	4	2				50		50	
UECL104/ UECP104	Modeling of Digital Circuits	C5	3		2	5	4	10	15	50	25		100	
UHUL101/ UHUP101	Communication Skills	H1	2		2	4	3	10	15	50	25		100	
UECP105	Internet of Things	A4			2	2	1				25		25	
UHUP102	Foreign Language	A5			2	2	1				25		25	
TOTAL			10	2	14	26	19	50	75	250	175	--	550	

Course Title: Integral Calculus and Differential Equations										
Semester	II	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	Even					TAE	CAE	ESE	INT	EXT
Course Category	BS	2 Hrs.	1 Hr.	NA	3	10	15	50	NA	NA
Course Code	UBSL152									
Teaching Mode	Offline	3 Hrs			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	To introduce the concepts of Integral calculus & Vector integration in the field of Engineering.
	To develop skills in student to apply the concepts of integrals in various engineering problems.
	To develop skills in student to solve problems of Ordinary Differential Equations and its applications in field of engineering.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand and use concept of definite integral & solve engineering problems.
	CO2: Evaluate the multiple integrals using different techniques and apply it to solve engineering problems.



	CO3: Understand vector integration and its applications related to real life problems.
	CO4: Solve first order, first degree & higher order differential equations.
	CO5: Form differential equations for simple engineering systems and find its solution.

Mapping of Course Outcomes with Program Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Integral Calculus: Curve tracing (Cartesian Form), Gamma function, Beta function, Relation between beta and gamma function, Differentiation under integral sign. (Self-study: Area, Volume, Length, Surface area using simple integration.)	8
II	Multiple Integral: Double integral, Change of variables, Change of order of integration, Triple integral, Applications of multiple integral: Area, mass, volume.	10
III	Vector Integration: Line integral, Surface integral, Volume integral, Statement of Gauss theorem, Greens theorem and Stokes theorem and its applications.	8
IV	Differential Equations: Linear, Reducible to linear and exact differential equations of first order. Higher order linear differential equations with constant coefficients (Cases of CF & PI).	8
V	Method of variation of parameters, Cauchy's and Legendre homogeneous differential equations. Applications of Differential equations.	8

Text Books	1.	Higher Engineering Mathematics: B. S. Grewal, Khanna Publishers, 2013, Forty Third
	2.	Advanced Engineering Mathematics: Erwin Kreyszig John Wiley & Sons, 2013, Tenth Edition
Reference Books	1.	Advanced Engineering Mathematics: Jain, R.K. and Iyengar, S.R.K, Narosa Publishers; Alpha Science International, Ltd, 2007, Third Edition
	2.	Advanced Mathematics for Engineers and Scientists: Spiegel, M. R, McGraw-Hill, 2010, Second Edition



Course Title: Linear Algebra and Statistics										
Semester	II	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	BS	2 Hrs.	1 Hrs.	NA	3	10	15	50	NA	NA
Course Code	UBSL153									
Teaching Mode	Offline	2Hrs			Total	75			-	
Duration of ESE	2 Hrs.					75				

Course Objectives	Introduce the basic concept of matrices and vectors.
	Introduce the basic concept of statistical probability to solve engineering problems.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Apply simple operations like adding, multiplying, inverting, transposing, etc. in matrices and vectors.
	CO2: Apply the concepts of Linear Algebra in programming languages.
	CO3: Apply the concepts of least squares methods and basic problems in probability.
	CO4: Apply the knowledge of Random variables.
CO5: Apply the knowledge of Probability distributions to solve engineering problems.	

Mapping of Course Outcomes with Program Outcomes:

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



Course Contents:

Unit	Contents	Hours
I	Elimination with matrices, Inverse matrices, Factorization, Vector space, Column space and null space, Pivot variables, Row reduced form, Independence, Subspaces, Bases and dimensions, Four fundamental subspaces, Graphs, Networks, Incidence matrix.	10
II	Eigen values and eigenvectors, Diagonalization of a matrix, Symmetric matrices, Linear transformations, Singular Value Decomposition	08
III	Statistics: Introduction to measures of central tendency, Least Square method, Correlation and Regression, Introduction to probability, conditional probability, Baye's theorem.	09
IV	Random Variables, Distribution functions of continuous & discrete random variables, Mathematical expectations.	08
V	Special probability distributions: Binomial, Poisson's and Normal distributions.	07

Text Books	1.	Linear Algebra and Matrix Analysis for Statistics, Chapman & Hall, CRC Texts in Statistical Science
	2.	Linear Algebra and Its Applications, Gilbert Strang, Cengage Learning, 2006, Fourth
EBooks	1.	https://faculty.atu.edu/mfinan/algebra2.pdf
	2.	https://sites.math.northwestern.edu/~len/LinAlg/
	3.	https://faculty.atu.edu/mfinan/LINENG.pdf



Course Title: Environmental Chemistry										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Odd/Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	BS	1 Hrs.	NA.	2 Hrs.	2	10	15	50	25	--
Course Code	UBSL131 UBSP131									
Teaching Mode	Offline	3 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	Demonstrate various methods of water treatment for domestic and industrial purpose.
	Explanation of different types of batteries and its commercial applications
	Demonstration and familiarization of impact of waste on environmental degradation.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Explain various methods of water treatment for domestic and industrial use
	CO2: Differentiate various categories of waste and its disposal techniques
	CO3: Identify various batteries and recognize its commercial applications
	CO4: Classify the different types of Energy and its future scope
CO5: Apply the knowledge of environmental pollution and degradation to solve related problems	

Mapping of Course Outcomes with Program Outcomes:

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



Course Contents:

Unit	Contents	Hours
I	Water Technology: Purification of Domestic water, Boiler troubles, softening methods of industrial water	6
II	Solid Waste Management and treatment Technology: Introduction to E-Waste, Biomedical waste and Solid waste. Treatment: Collection, segregation, transportation and its disposal techniques	4
III	Battery Technology: Introduction to Battery, reversible and irreversible batteries. Examples: Lead-acid battery, Lithium-ion battery and fuel cell	4
IV	Energy Management: Fuel- Characteristics, composition and determination of Solid, Liquid and gaseous fuel. Alternative forms of energy-Conventional and Non-Conventional sources – Hydroelectricity, Nuclear, Solar, Biomass and Geothermal energy and Bio-gas	4
V	Upcoming Technology for pollution control: Air pollution- Urban air quality standards as per WHO, its sources and controlling methods. Water pollution- water quality index as per WHO, its sources and controlling methods	4

Text Books	1.	Text Book of Engineering Chemistry, S S Dara, S Chand & company,2013, Eleventh Edition
	2.	Engineering Chemistry, Jain & Jain, Dhanpatrai&Dhanpatrai,2015, Sixteenth Edition
	3.	A Test Book of Environmental Chemistry & Pollution Control, S S Dara, S Chand & Co.,2006, Eleventh Edition
E books	1	Water purification, Alexandru Grumezescu, First edition
	2	Solid waste management by Stephen Burnley, Willey publication, 2014
	3	Air Pollution, S K Agarwal, APH Publishing, 2005
Reference Books	1.	Environmental Chemistry, B K Sharma and H. Kaur, Goel Publishing House, 2014, Fourteen Edition
	2.	Environmental Studies, R. Rajgopalan, Oxford Publication, 2016, Third Edition
On-line TL Material	1	Introduction to Household Water Treatment and Safe Storage, https://www.coursera.org/learn/water-treatment/home/welcome
	2.	Electronic waste Management-Issues and challenges by Dr. Brajesh Kumar Dubey, http://nptel.ac.in/courses/120108005/
	3	Integrated Waste Management for a Smart City, https://onlinecourses.nptel.ac.in/noc19_ce31/course
	4	Air pollution-Global threat to our Health https://www.coursera.org/learn/air-pollution-health-threat/home/welcome



Sr. No.	Name of Experiments / Case Studies
1	Physical parameters of water- Determination of PH, turbidity and conductivity of given water sample.
2	Chemical parameters of water- Determination of Hardness by Complexometric method and Alkalinity by Warders Method.
3	Demonstration on different types of cells and batteries.
4	Determination of Moisture present in given Solid waste
5	Case study on current scenario of region-specific waste generation.
6	Determination of Proximate analysis of Solid fuel as Coal.
7	Determination of Acid value of Liquid fuel.
8	Demonstration on measuring air quality by using Air Quality Tester.
9	Determination of chloride ions from given water sample by Argentometric Method
10	Determination of DO of given water sample by Iodometric titration
11	Preparation of Biodiesel from edible oil
12	Determination of saponification value of liquid fuel



Course Title: Programming for Problem Solving										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	Odd/Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	--	--	4 Hrs.	2	--	--	--	50	--
Course Code	UITP102									
Teaching Mode	Online	4 Hrs			Total	--			50	
Duration of ESE	NA					50				

Course Objectives	This Course introduces basic idea of how to solve given problem.
	Focuses of paradigms of programming language.
	Aims at learning python as programming language.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Analyze and understand the behavior of fundamental programming constructs.
	CO2: Develop & Analyze Algorithms for solving problems.
	CO3: Demonstrate the knowledge of various concepts of Python Language.
	CO4: Demonstrate knowledge of advanced concepts of Python Programming
	CO5: Develop solutions using functions & recursion

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	--	3	--	--	--	--	--	--	--	--	--	--
CO2	--	--	3	--	--	--	--	--	--	--	--	--
CO3	--	3	--	--	--	--	--	--	--	--	--	--
CO4	--	--	--	3	--	--	--	--	--	--	--	--
CO5	--	--	3	--	3	--	--	--	--	--	--	--

Course Contents:

Unit	Contents	Hours
I	ALGORITHMIC PROBLEM SOLVING: Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).	8
II	DATA, EXPRESSIONS, STATEMENTS Python interpreter and interactive mode; values and types: int, float, Boolean, string, and list; variables, expressions, statements, Tuple	8



	assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments;	
III	CONTROL FLOW, FUNCTIONS Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices,	8
IV	DICTIONARIES Dictionaries: operations and methods; advanced list processing – list comprehension; Object Oriented Programming: Classes and objects-inheritance-polymorphism	8
V	FILE HANDLING & EXCEPTION HANDLING Overview of exception classes and Types: try, except, finally: File processing: reading and Writing files, Recent Trends in Python	8

Sr. No.	List of Experiment
1	Implementing if else in Python
2	Implementing loop in Python
3	Implementing Functions in Python
4	Implementing Set, Tuple & Dictionary in Python
5	Project Using Python Module 1: Algorithms, Expression, Variables & I/O
6	Module 2: Control Structures
7	Module 3: List, Strings, Tuples & Dictionary
8	Module 4: Functions
9	Module 5: Object Oriented Programming
10	Module 6: Expression Handling & File Handling

Text Books	1.	Python Programming using problem solving Approach, Reema Theraja, 2017, First Edition
	2.	A Byte of Python, C. H. Swaroop, Edition 2.1



Course Title: Modeling of Digital Circuits										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	Odd/Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs.	--	2 Hrs.	4	10	15	50	25	--
Course Code	UECL104 UECP104									
Teaching Mode	Offline	5 Hrs.			Total	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	To understand number system and optimization laws
	To apply knowledge on VHDL program in Combinational & Sequential
	To interpret complex problem in the field of digital system design
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Solve the problems on Number system codes and their conversions.
	CO2: Create and design canonical logic forms
	CO3: To demonstrate basic knowledge VHDL fundamentals
	CO4: Design VHDL Programs
	CO5: Design real time digital applications

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	3	2	--	--	--	--	--	--	1	3
CO2	3	3	3	2	--	--	--	--	--	--	1	3
CO3	3	3	3	2	--	--	--	--	--	--	1	3
CO4	3	3	3	2	--	--	--	--	--	--	1	3
CO5	3	3	3	2	--	--	--	--	--	--	1	3

Course Contents:

Unit	Contents	Hs
I	D.C. Circuits: Circuits Elements (R, L, C), Kirchhoffs Laws, Voltage source, Current Source (definition, characteristics of practical source, equivalent)	05
II	Number Systems & Boolean Algebra: Number system, Decimal, binary, octal, hexadecimal number system, 1s and 2s complement codes, Boolean algebra, De-Morgan's theorems, Logic Gates, canonical logic forms, sum of product & product of sums, Karnaugh maps.	08



III	Combinational & Sequential circuits: Introduction to combinational circuits, code conversions, decoder, encoder, multiplexers & De-multiplexer, binary adder, Subtractor, BCD adder, Latches, Flip-flops, counters, Shift Registers, Finite state Machine.	11
IV	Introduction to VHDL: Introduction to VHDL, Methodologies, design units, data objects, VHDL data types, Attributes, Concurrent and sequential, Structural statements, inertial and transport delays, delta delay, signal drivers.	08
V	Combination Logic design: Gates, decoder, encoder, multiplexer, De-mux, adder, Subtractor, Latches, SR latch, Flip-Flops, Shift Registers, counters Subprograms – Functions, Procedures, generic, generate, package, IEEE standard logic library.	08

Text Books	1.	Digital Electronics, R P Jain, McGraw Hill, 2017, Second Edition
	2.	Digital Logic and Computer Design Morris Mano, PHI, 2017 , Review Second Edition
	3.	VHDL Primer, J Bhasker, Pearson Education
EBooks	1.	Free Range VHDL-Bryan Mealy, Fabrizio Tappero
Reference Books	1.	Digital Electronic Principles, Malvino, PHI, 2011-13, Seventh Edition
	2.	Digital System Design – John Wakerley
On-line Material	TL	1. IIT's NPTEL lectures

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Design 4:1 multiplexer and write a VHDL code for same using data flow style of modeling.
2	Design Arithmetic and Logic Unit for 16 bit operation (Addition, Subtraction, Multiplication, Division, ORing, ANDing, XORing, XNORing)
3	Design BCD to seven segment decoder & display “GHRCE”.
4	Design half adder and full adder and write a VHDL code for same using dataflow style of modeling.
5	Design & write Test bench for an 8-bit adder having range 0 to 255 decimal.
6	Design 4-to-16 decoder by combining two 3-to-8 decoders and write a VHDL code for Same using structural style of modeling.
7	Write a VHDL code for to design Flip-Flop (D, T, and SR) using behavioral style of modeling.
8	Write a VHDL code for 3-bit up-down counter using sequential style of modeling.
9	Write a VHDL code for high speed two-pole switch for power controlling on FPGA using sensitivity list.
10	Design of Finite state machine to detect a sequence “1011” using Mealy model and write VHDL code for the same.
Open Ended Experiments	
1	Write a VHDL code for to divide clock frequency of 50 Mhz.
2	Write a code for 8 Bit RAM Module
Details of Online Laboratory Resource Material Instruction / Operating Manuals	
1.	Virtual Lab



Course Contents:

Unit	Contents	Hours
I	Course Foundation: Ice-Breaker- Activity on Group Introduction (Circle Activity) Self- Realization – Review on SWOC Analysis and self- Introspection SMART Goals- Preparation and presentation of Individual goal charts Pre-Training Module: Assessment on prior knowledge of the students	4
II	Communication for Engineering: Introduction, process, barriers, Types of Communication--Talk on Emerging trends and importance of communication skills in Engineering- Overview of Listening, Speaking, Reading and Writing skills (LSRW)- The techniques and usage of the interrelated LSRW skills- The practical execution of LSRW Skills in Classroom and Lab	4
III	Formal Correspondence and Content Framing: Introduction to formal Writing techniques- Difference between Formal and Informal Writing- Formats of Letter and Email Writing- Practice of letter and email writing with real time situations- The Art of framing communication with effective content- Implementation of High order thinking skills with Critical thinking to explore Creativity. Review Activity with Moral Case studies/Case Letters (Stereo Type/ Gender Bias)/ Abstract Writing/Newspaper article/Extempore	4
IV	Presentation skills: Structure of Presentations-Use of aids like Power point- Do's and Don'ts of presentation-Types of presentation- Body Language during presentation- The practical execution of Presentation skills (Individual and Technical) along with review and feedback	4
V	Non-verbal Communication Difference between Verbal and Non-verbal Communication-Physical Appearance-“Do Looks really Matter?”- Body Language Practice with Storytelling activity- Tips for improving Nonverbal communication (Gesture/Posture/Facial Expression/Personal Appearance/ Eye contact)	4

Text Books	1.	Communication Book, Global Education Ltd,2020 (In Progress)
E--Books	1.	Bridging the Soft Skills Gap, Bruce Tulgan
Reference Books	1.	Soft Skills for enhancing Employability (Connecting Campus to Corporate), M S Rao
	2.	Communication Skills for Technical Students, Mr. Farahatulla
On-line Material	TL 1.	Online Lectures/Exercises/Assessment/Evaluation/Quizzes shall be made available with extended learning

Sr. No.	Name of Activities
1	Reading Skills: Read Aloud
2	Writing Skills: Abstract Writing
3	Read- Write Activity: Activity on Comprehension
4	Read-Speak Activity: Case Letters
5	Speak- Speak Activity: Turn Court
6	Write- Write: Triggering Mind
7	Presentation Skills: Practical of Creating PPTs



Course Title: Internet of Things										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	Odd/ Even	Th	Tu	Pr		TAE	CAE	ESE	INT	EXT
Course Category	A	--	--	2 Hrs.	1	--	--	--	25	--
Course Code	UECP105									
Teaching Mode	Offline	2 Hrs.			Total	--			25	
Duration of ESE	NA					25				

Course Objectives	To enable students to understand scope of Internet of things in Industry
	To introduce the concept of Internet of things
	To develop & apply Advance method for Implementation of Internet of Things
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Analyze various IoT devices and its technology.
	CO2: Select and use of appropriate IoT technologies & Gateways protocols for application development.
	CO3: Design and development of IoT application with the use of different cloud technology.

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	3	2	3	--	--	--	--	--	--	3
CO2	2	1	3	2	3	--	--	--	--	--	--	3
CO3	2	2	3	2	3	--	--	--	--	--	2	3

Course Contents:

Unit	Contents	Hours
I	Architecture of IoT Introduction of IoT, Introduction Industry 4.0, Need of IoT for Industry 4.0, Block Diagrams of IoT System, Virtual Private server and IoT Cloud, Application Programming Interface (API)	6
II	Development of Things using Arduino Platform: Introduction of IoT Node with Sensor and Actuator, Interface sensors & devices, NodeMCU and ESP 32 wifi Microcontroller, Network: LORA, NRF, Xbee, IoT Gateway.	6



	Communication protocol: Introduction of Internet Protocol, Internet Layer: IP Transport layer-TCP, UDP, Application Layer- HTTP, MQTT, FTP, CoAP, SPDY.	
III	IoT Platform and Application: Customized IoT Platform using Virtual Private Server, Amazon Alexa, Google API, Blynk, Cayenne, Thingsboard, Thigspeak. Case Study of applications.	8

Text Books	1.	Samuel Greengard, The Internet of Things by Samuel Greengard
	2.	Klaus Schwab, “The Fourth Industrial Revolution” by Klaus Schwab Author:
	3.	Cuno P Fister, Getting started with Internet of Things
EBooks	1.	IoT and Smart Building Data – by Senseware.
	2.	Sky Hook, Everything You Need to Know About LPWAN Location
Reference Books	1.	CunoPfister, Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 2018
	2.	Adrian McEwen , Designing the Internet of Things Kindle Edition

Sr. No.	Name of Experiments
1	To perform programming for Interfacing NodeMCU to Cloud Thingsboard
2	To perform programming for sending DHT Temperature sensor data to cloud.
3	To perform programming for control home appliance using NodeMCU controller and cloud.
4	Design and interface Water level indicator using NodeMCU controller
5	Perform Raspberry PI program to interface of network device [wifi, GSM, GPRS] for device communication
6	Design and Perform digital Notice Board Application Using Raspberry pi3 Mega Board using NodeMCU.
7	Design and Perform smart Garbage indication system using NodeMCU controller and GLCD.
8	Design and Perform IOT Based Agriculture monitoring system using Wifi ESP8266 [Thinkspeak Cloud]
9	Project Module 6: Perform Automatic Plant Irrigation controlling System using NodeMCU and Cloud
10	Open Ended Experiment:



Course Title: Foreign Language (German)										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	Odd/ Even	Th	Tu	Pr		TAE	CAE	ESE	INT	EXT
Course Category	A	--	--	2 Hrs.	1	--	--	--	25	--
Course Code	UHUP102									
Teaching Mode	Offline	2 Hrs.			Total	--			25	
Duration of ESE	--					25				

Course Objectives	Written communication: student can create basic-level Spanish written communications that correctly employ and incorporate the grammar, vocabulary, and cultural material presented in class.
	Oral communication: student can create basic-level Spanish oral communications using correct Spanish grammar, vocabulary, cultural material, and pronunciation presented in class.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Use basic greetings in the social context and express basic needs in day-to-day life.
	CO2: Use and respond to classroom directions and basic commands.
	CO3: Execute and acquire basic personal and social information.
	CO4: Explain reading and writing of all characters, compound characters, Count and understand basic numbers.
	CO5: Understand sentences consisting of basic grammar patterns and particles.

Mapping of Course Outcomes with Program Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Introduction to Germany – its culture and people Pronunciation – BASIC and ADVANCED Basic Greetings and Self-Introduction. Grammar- Nouns-genders, article Grammar- Nouns - Plural forms Vocabulary- Months, weekdays and daytimes and number system Vocabulary-Time and date	6



	Grammar – Personal Pronouns.	
II	Basic numbers- Count and understand basic numbers. Vocabulary-Family, professions Vocabulary- Directions, Common words Vocabulary –Job-Related and Modes of Transport Grammar – Possessive Pronouns Vocabulary- House.	6
III	Furniture and Draperies Vocabulary- Food and Drinks Grammar-Regular verbs Vocabulary- Vegetables and fruits Grammar-Irregular verbs.	4
IV	Grammar-Modal verbs and Imperative Verbs WH – Questions Vocabulary- Body parts and Clothes Grammar – Sentences- types and Framing.	4
V	Grammar-Imperative sentences and Framing questions Vocabulary- Common Places, Hobbies Grammar- Adjectives and Opposites. Test –Viva and Written.	4

Text Books	1.	Tangram Aktuell 1, Rosa-Maria Dallapiazza, TilSchönherr, Eduard von Jan, Hueber Publication, Neu Edition.
E-Books	1.	Tangram Aktuell 1, Rosa-Maria Dallapiazza, TilSchönherr, Eduard von Jan, Hueber Publication, with Audio CD.
On-line TL Material	1.	https://alison.com/courses/basic-german-language-skills-revised/content?event=login



III	Vocabulary-colors, Vocabulary-Family, profession Vocabulary- Directions, Common words Test (30 min), Listening to CD.	6
IV	Vocabulary- House and Furniture and Draperies Vocabulary- Food and Drink and Cutlery Grammar-Regular, verbs Vocabulary- Vegetables and fruits. Modes of transport, Random vocabulary Grammar- cases in French Test (30 min). Listening to CD Translation passage Writing emails, Listening and speaking sessions Test. Count and understand basic numbers.	6
V	Body parts and Clothes Translation passage and spoken Test (30 min) and School and college cases in French Vocabulary	4

Text Books	1.	SAISON 1A: MÉTHOD DE FRANCAIS, Marie- Noëlle Cocton, ÉlodieHeu, Nowela - Portal Romanisty, Nouvelle Version, 2015.
E-Books	1.	SAISON11.DIDER.PDF with Audio CD
On-line TL Material	1.	https://alison.com/courses/french-language-studies-introduction/content?event=login



Course Title: Foreign Language (Spanish)										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	Odd/ Even	Th	Tu	Pr		TAE	CAE	ESE	INT	EXT
Course Category	A	--	--	2 Hrs.	1	--	--	--	25	--
Course Code	UHUP102									
Teaching Mode	Offline	2 Hrs.			Total	--			25	
Duration of ESE	NA					25				
Course Objectives	Written communication: student can create basic-level Spanish written communications that correctly employ and incorporate the grammar, vocabulary, and cultural material presented in class.									
	Oral communication: student can create basic-level Spanish oral communications using correct Spanish grammar, vocabulary, cultural material, and pronunciation presented in class.									
Course Outcomes	Upon successful completion of this course, student will be able to:									
	CO1: Use basic greetings in the social context and express basic needs in day-to-day life.									
	CO2: Use and respond to classroom directions and basic commands.									
	CO3: Execute and acquire basic personal and social information.									
	CO4: Explain reading and writing of all characters, compound characters, Count and understand basic numbers.									
CO5: Understand sentences consisting of basic grammar patterns and particles.										

Mapping of Course Outcomes with Program Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Introduction to Spain – its culture and people Pronunciation – BASIC and ADVANCED Basic Greetings and Self-Introduction	4
II	Grammar- Nouns- genders, article Grammar- Nouns - Plural forms Vocabulary- Months, weekdays and day times, Vocabulary- Grammar – Personal Pronouns, Basic numbers- Count and understand basic numbers	4



III	Vocabulary-Family, professions Vocabulary- Directions, Common words Vocabulary –Job-Related and Modes Of Transport Grammar – Possessive Pronouns Vocabulary- House	6
IV	Furniture and Draperies Vocabulary- Food and Drinks Grammar-Regular verbs Vocabulary- Vegetables and fruits, Body parts and Clothes	6
V	Framing questions, WH – Questions Vocabulary Vocabulary-Common Places, Hobbies Test –Viva and Written.	4

Text Books	1.	Aula Internacional 1 &2, Difusion, Difusion Centro De Investigacion Y Publicaciones De Domas S.L, Nueva Edition (May 2,2016)
E-Books	1.	AULA INTERNACIONAL Nueva edición with audio CD
On-line TL Material	1.	https://alison.com/courses/introduction-to-spanish-revised/content?event=login



Course Title: Foreign Language (Japanese)										
Semester	I/II	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	Odd/ Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	A	--	--	2 Hrs.	1	--	--	--	25	--
Course Code	UHUP102									
Teaching Mode	Offline	2 Hrs.			Total	--			25	
Duration of ESE	NA					25				

Course Objectives	Written communication: student can create basic-level Spanish written communications that correctly employ and incorporate the grammar, vocabulary, and cultural material presented in class.
	Oral communication: student can create basic-level Spanish oral communications using correct Spanish grammar, vocabulary, cultural material, and pronunciation presented in class.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Use basic greetings in the social context and express basic needs in day-to-day life.
	CO2: Use and respond to classroom directions and basic commands.
	CO3: Execute and acquire basic personal and social information.
	CO4: Explain reading and writing of all characters, compound characters, Count and understand basic numbers.
CO5: Understand sentences consisting of basic grammar patterns and particles.	

Mapping of Course Outcomes with Program Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Introduction of Japanese Language: Origin, history. Aspects of Japanese language: written, spoken, communicative Introduction of Japan as country. General class discussion about Japan and its cultural aspects. E.g., Japanese Language, Society, History, Geography, Dressing, Food.	4



II	Education, Family relations, Work culture and daily life, Travel and tourism, Mass media, Law and order, Literature, Performing arts, Drama, Popular music, Movies and entertainment, Games and Sports.	4
III	<p>Introduction of Japanese Language: Written structure: Scripts- Hiragana, Katakana, Kanji Spoken structure: Valid sound patterns, Consonants and vowels Introducing oneself in Japanese: (Hello, How do you do, I am , Nice to meet you etc.) Hiragana Script Characters (10) from Aa to Ko: Stroke order writing, practice with flash cards General words based on completed hiragana characters (10) Hiragana Script Characters (15) from Ga to Zo: Stroke order writing, practice with flash cards General words based on completed hiragana characters (10) Hiragana Script Characters (15) from Ta to No: Stroke order writing, practice with flash cards General words based on completed hiragana characters (15) Introduction of Basic greetings1 (Good Morning, Good Day, Good Evening, Thank you, Good Bye etc.) Hiragana Script Characters (15) from Ha to Po: Stroke order writing, practice with flash cards General words based on completed hiragana characters (15) Hiragana Script Characters (16) from Ma to N: Stroke order writing, practice with flash cards General words based on completed hiragana characters (20) Counting in Japanese Basic numbers (1 to 10), 2-, 3- and 4-digit numbers. Reading and writing from digits to Japanese and vice versa.</p>	6
IV	<p>Hiragana Script: Rules for sound prolongation and its expression using hiragana. Prolongation using ‘u’ and B. Prolongation using vowels. General words based on hiragana prolonged characters (10) Grammar Basic sentence pattern ‘A wa B desu’, ‘A wa B desuka’. Introduction of particles ‘wa’ and ‘ka’, copula ‘desu/dewaarimasen’.</p>	6
V	<p>Hiragana Script: Rules for writing compound characters and its expression using hiragana. Small characters ‘Ya’, ‘Yu’, ‘Yo’ and B. Small character ‘Tsu’ General words based on hiragana compound characters, Grammar.</p>	4

Text Books	1.	Minna no Nihongo, 3A Corporation (Indian Edition Goyal Publication), Elementary Edition- 2018.
E-Books	1.	Minna no Nihongo part 1-1 elementary main text book.
On-line TL Material	1.	https://alison.com/courses/japanese/revised/content?event=login



Semester III

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
			L	T	P	Total Hrs		Theory			Practical		Total Marks
								TA	CA	ES	IN	EXT	
SEMESTER-III													
UBSL255	Discrete Mathematics & Graph Theory	BS	3	1		4	4	10	15	50			75
UCSL201 UCSP201	Data Structures and Algorithms	C	3		2	5	4	10	15	50	25		100
UCSL202	Computer Architecture and Organisation	C	3			3	3	10	15	50			75
UECL208 UECP208	Applications of Microprocessors and Microcontrollers	C	3		2	5	4	10	15	50	25		100
UITL201 UITP201	Object Oriented Programming	C	3		2	5	4	10	15	50	25		100
UECL204	Signals and Systems	C	3			3	3	10	15	50			75
TOTAL			18	1	6	25	22	60	90	300	75		525



Course Title: Discrete Mathematics and Graph Theory										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	BS	3 Hrs.	1 Hr.	--	4	10	15	50	--	--
Course Code	UBSL255									
Teaching Mode	Offline	4 Hrs.			Total	75			--	
Duration of ESE	2 Hrs.									

Course Objectives	This course introduces size and kind of objects.
	It also skills to analyze objects meeting the criteria, finding "largest", "smallest", or "optimal" objects.
	It also introduces combinatorial structures and apply algebraic techniques to combinatorial problems
Course Outcomes	CO1: Know grouping of objects and operation, Relation, ordering of objects.
	CO2: Understand and use concepts of Groups.
	CO3: Apply the concept of Boolean algebra in computer science engineering.
	CO4: Solve problems using basic graph theory.
	CO5: Understand combinatorial structure and develop algebraic technique to solve combinatorial problems.
	CO6: Solve applications problems on number theory.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Set Theory Operations on sets, Laws of algebra of sets, Representation of sets on computer in terms of 0's & 1's. Partition & covering of a set, ordered pair, Product set, Relation–Different types of relations, Graph of relation, Matrix of relation, Transitive closure of relation, Properties of relations, Compatible relation. Functions, Partial ordering & partially ordered set, Hasse diagram of Poset, totally ordered set, Peano axioms & Mathematical Induction.	8



II	<p>Group Algebra or Algebraic systems like semigroup, monoid and examples. Homomorphism, Isomorphism of semigroup & monoid. Groups, properties of algebraic groups. Permutations groups, Subgroups, Cosets, Lagrange's theorem, properties of cyclic groups, generator of group, kernel of Homorphism, quotient group, Rings, types of rings, Fields, subring, Integral domain.</p>	8
III	<p>Lattices and Boolean algebra Lattice as Poset & as algebraic system, Types of lattices, Hasse diagrams, Sublattice, direct product of Lattices, Lattice Homomorphism, complement of elements of lattices, Various lattices, composition tables, Lattice, Boolean algebra; Boolean Expressions, Equivalence of Boolean Expression by tables, Simplification of circuit & equivalent circuit by truth tables.</p>	8
IV	<p>Graph Theory Graphs and its types, Sub graph, Quotient graph, Euler path, complete path, indegree, outdegree, reachability, cycle, matrix representation of graph. Transitive closure of graph, Adjacency matrix, Trees, Venn diagram, Representation of trees, binary trees, spanning trees, Prim's algorithm.</p>	8
V	<p>Combinatorics Definition of generating functions and examples, proof of simple combinatorial identities. Recursive relations: definitions & examples, explicitly formula for sequence, back tracking to find explicit formula of sequence, solving recurrence relations. Counting Theorem and application, multiplication principle of counting. Permutation & Combination with examples. The pigeon hole principle & extended pigeon hole principle and application of pigeon hole principle in solving simple problems.</p>	8
VI	<p>Number Theory Continued fractions, The study of continued fractions. Alpha has Infinite continued fraction if alpha is irrational. Alpha has periodic continued fractions if alpha is quadratic irrational. Application to approximation of irrationals by rationals. Hurwitz's theorem, Advanced topic on Combinatorial Theory.</p>	8

Text Books	1.	Discrete Mathematical structure with application to computer science by Trembley & Manohar (Mc. Graw Hill)
	2.	Discrete Mathematical Structure by Kolmann , Busby & Ross (PHI)
	3.	Discrete mathematics by Lipschutz & Lipson, Schaum's outline, TMH
Reference Books	1.	Discrete Mathematics by Liu
	2.	Discrete Mathematics by John Truss (Addison Wesley, 2000)
	3.	Foundations of Discrete Mathematical by K. D. Joshi (Willey Eastern).



Course Title: Data Structure and Algorithms										
Semester	III	Teaching Scheme				Evaluation Scheme				
		Theory		Practical						
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3Hrs		2Hrs	4	10	15	50	25	25
Course Code	UCSL201 UCSP201									
Teaching Mode	Online	5 Hrs			Total	75			50	
Duration of ESE	2 Hrs					125				

Course Objectives	This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.
	It's also aimed at developing skill to implement methods to solve specific problems using basic data structures.
	The course also provides career opportunities in design of data, implementation of data, technique to sort and searching the data.
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Illustrate various technique to for searching, Sorting and hashing
	CO2: Explain the significance of dynamic memory management Techniques
	CO3: Design and analyze different linear data structure techniques to solve real world problem.
	CO4: Implement non-linear data structure to find solution for given engineering applications.
CO5: Summarize different categories of data Structures	

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	1	3	2	3	--	--	--	--	--	--	--	--	2	--
CO2	--	2	3	3	--	--	--	--	--	--	1	--	2	--
CO3	--	3	3	3	1	--	--	--	--	--	--	--	3	--
CO4	--	3	3	3	--	--	--	--	--	--	1	--	3	--
CO5	--	3	3	2	--	--	--	--	--	--	--	1	--	1

Course Contents:

Unit	Contents	Hours
I	Introduction –Algorithms, Common operations on data structures, Types of data structures, Data structures & Programming, Program Design, Complexities, Time Complexity, Step Count Method, order of Growth,	7



	Asymptotic Notation. Sorting and Searching Introduction, Sorting, Insertion Sort, Selection Sort, Merging, Merge-Sort, Shell Sort, Radix Sort, Searching and Data Modification, Hashing	
II	Arrays: Introduction, Linear Arrays, Arrays as ADT, Representation of Linear array in Memory, Traversing Linear Arrays, Inserting and deleting, Sorting; Bubble Sort, Searching; Linear Search, Binary Search Stacks, Queue and Recursion- Introduction, Stacks, Array Representation of Stacks, Linked Representation of Stacks, Stack as ADT, Arithmetic Expression; Polish Notation, Application of Stacks, Recursion, Towers of Hanoi, Implementation of Recursive Procedures by Stacks, Queue, Linked Representation of Queues, Queues as ADT, Circular Queues, Deques, Priority Queues, Applications of Queues	8
III	Introduction: Linked List- Representation of Linked Lists in Memory, Traversing a Linked List, Searching a Linked List, Memory Allocation; Garbage Collection, Insertion into a Linked List, Deletion from a Linked List, Header Linked List, Circularly Linked Lists, Two-Way Lists (or Doubly Linked Lists).	7
IV	.Trees and Binary Trees -Binary Trees • Representation, Operations: Insert, Delete, Traversal: Preorder, Inorder, Postorder, Traversal Algorithms Using Stacks, Header Nodes; Threads, Threaded Binary Trees, Binary Search Trees ,Searching and Inserting in Binary Search Trees,Deleting in a Binary Search Tree, Balanced Binary Trees,AVL Search Trees, Insertion in an AVL Search Tree, Deletion in an AVL Search Tree, m-way Search Trees ,Searching, Insertion and Deletion in an m-way Search tree, B-Trees ,Searching, Insertion and Deletion in a B-tree,B+-Trees Graph Algorithms	7
V	Graphs and their Applications- Introduction, Graph Theory Terminology, Sequential Representation of Graphs, Adjacency Matrix; Path Matrix, Linked Representation of a Graph, Operations on Graphs, Traversing a Graph,Posets; Topological Sorting, Spanning Trees	6

Text Books	1.	AVAho, J Hopcroft, JD Ullman, Data Structures and Algorithms, Addison-Wesley, 1983.
	2.	THCormen, CF Leiserson, RL Rivest, C Stein, Introduction to Algorithms, 3rd Ed., MIT Press, 2009.
	3.	Sahni, S., “Data Structures, Algorithms, and Applications in C++”, WCB/McGraw-Hill.
E--Books	1.	https://apps2.mdp.ac.id/perpustakaan/ebook/Karya%20Umum/Dsa.pdf
Reference Books	1.	Data Structures & Algorithms, 1e, Alfred V.Aho, Jeffery D. Ullman , Person.
	2.	MT Goodrich, R Tamassia, DM Mount, Data Structures and Algorithms in Java, 5th Ed., Wiley, 2010. (Equivalent book in C also exists.)
	3.	Wirth, N., “Algorithms and Data Structures”, Prentice-Hall of India.
online TL Material	1.	https://nptel.ac.in/courses/106/102/106102064/
	2.	http://cse01-iiith.vlabs.ac.in/
	3.	https://ds2-iiith.vlabs.ac.in/data-structures-2/



Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Implement Searching Algorithms
2	Implement Sorting Algorithms
3	Implement the concept Stack
4	Implement the concept of Queues
5	Implement the concept of Linked List
6	Implement the concept of Doubly Linked List
7	Implement the concept of B Trees
8	Create a Binary Search Tree & perform tree traversals
9	Implement the concept of DFS and BFS in Graph
10	Design, Develop and Implement a Program in C for operations on AVL Trees and Splay Trees
Open Ended Experiments / New Experiments	
1	https://www.cs.usfca.edu/~galles/visualization/OpenHash.html
2	https://www.cs.usfca.edu/~galles/visualization/ClosedHash.html
Details of online Laboratory Resource Material Instruction / Operating Manuals	
1.	https://ds1-iiith.vlabs.ac.in/data-structures-1/
2.	https://ds2-iiith.vlabs.ac.in/data-structures-2/



Course Title: Computer Architecture and Organization										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3	--	--	3	10	15	50	--	--
Course Code	UCSL202	Hrs.								
Teaching Mode	Online	3 Hrs.			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	To understand the design principles of digital computing systems
	To provide essential understanding of different subsystems of modern computer system and design aspects these subsystems
	To provide overview on performance enhancement methods in instruction execution
Course Outcomes	CO1: To describe the basic components and design of a computer system
	CO2: To examine the issues involved in the instruction execution and various stages of instruction life stage
	CO3: To apply the concept of various memories and interfacing technologies
	CO4: To analyze the different parallel processing technique
	CO5: To design different high performance computing architecture

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	--	--	--	--	--	--	--	--	--	--	--	3	--	--
CO2	--	3	--	--	--	--	--	--	--	--	--	--	2	--	--
CO3	--	3	--	--	--	--	--	--	--	--	--	--	2	--	--
CO4	--	--	3	--	--	--	--	--	--	--	--	--	3	--	--
CO5	--	--	3	--	--	--	--	--	--	--	--	--	--	3	--

Course Contents:

Unit	Contents	Hours
I	Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU –registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set, Instruction set architecture CISC, RISC, Case study –instruction sets of common CPUs	8
II	Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Booth’s algorithm, integer division Data representation method Booths multiplication, division algorithm and example IEEE standard single and double precision format and examples	8



III	Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices, Segmentation, TLB, Page replacement algorithms	8
IV	Pipelining: Basic concepts of pipelining, Arithmetic and Instruction Pipeline, throughput and speedup, pipeline hazards, Introduction, Logic Design Conventions, Building a Datapath – A Simple Implementation scheme – An Overview of Pipelining – Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions.	8
V	CPU control unit design: hardwired and micro-programmed design approaches, Case study - design of a simple hypothetical CPU. Multicore processors architecture , Advanced topics & its Application.	8

Text Books	1.	Computer Organization and Architecture by Carl Hamacher 4 th Edition
	2.	Advance computer Architecture by Kai Hwang under Tata McGraw Hill publications
	3.	Introduction to Parallel Processing: Algorithms & Architectures, Behrooz Parhami in Springer Shop
EBooks	1.	Computer Architecture and Organization by William Stallings http://home.ustc.edu.cn/~leedsong/reference_books_tools/Computer%20Organization%20and%20Architecture%2010th%20-%20William%20Stallings.pdf
Reference Books	1.	Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare By PHI Publications
	2.	Fundamentals of Parallel Processing by Jordan Harry, Alaghband Gita, PHI Publication
	3	Parallel Computers – Architecture and Programming by V. Rajaraman And C. Siva Ram Murthy.
	4.	Introduction to Parallel Programming by Steven Brawer
On-line TL Material	1.	NPTL https://nptel.ac.in/courses/106/105/106105163/



Course Title: Applications of Microprocessor and Microcontroller										
Semester	III	Teaching Scheme				Evaluation Scheme				
		Theory		Practical						
Term	III	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs.	-	2 Hrs.	4	10	15	50	25	-
Course Code	UECL 208 UECP208									
Teaching Mode	Offline	5 Hrs.			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	1. To study and understand various microcontrollers and embedded systems
	2. To understand the design parameters of embedded systems applications.
	3. To study and impart different tools for embedded system and IoT application design.
Course Outcomes	CO1 Demonstrate the principle of embedded systems and Microcontroller
	CO2 Design the interfacing of devices and peripherals
	CO3 Develop programming for applications develop real time applications
	CO4 Make Use of Arduino Controller for Designing of Embedded Applications.
	CO5 Design and Develop different embedded system and IoT applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	2	2	3	2	3	--	--	--	--	--	2	1	3	2	3
CO2	2	2	3	2	3	--	--	--	--	--	2	1	3	2	3
CO3	3	2	3	2	3	--	--	--	--	--	2	1	3	2	3
CO4	3	2	3	2	3	--	--	--	--	--	2	1	3	2	3
CO5	3	2	3	3	3	--	--	--	--	--	2	1	3	2	3

Course Contents:

Unit	Contents	Hours
I	Microprocessors: Microprocessor Technology: 8085/8086- architectural overview & Programming model.	9
II	Microcontrollers: Introduction to microcontrollers, 8051 architecture, data types and directives, flag bits and PSW register, register bank and stack.	9
III	Assembly Language Programming: Jump, Loop and Call Instructions, I/O Port Programming, Addressing modes, Arithmetic, Logic instructions and programs, data types and time delay. Interfacing to External Memory.	9



IV	Programming: Timer/counter, Interrupts and serial communications, Serial I/O, Programming Tools, Program using C Interfacing with 8051: ADC and DAC interfaces for microcontrollers, Real time interfacing with LED, Keypad, LCD display, Sensors interfacing	9
V	Arduino: Introduction to Arduino, Pin configuration and architecture, coding of Arduino using IDE. Interfacings	9

Text Books	1.	Muhammad Ali Mazidi, the 8051 Micro-controller & Embedded System using assembly & C, Pearson Education, 2008, Second
	2.	Muhammad Ali Mazidi, ARM Assembly language programming and Architecture, Second
	3.	Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education India, 2009, Second
Reference Books	1.	Shibu K. V. Introduction to Embedded System, The McGraw Hill, 2011
	2.	Ajay V. Deshmukh, Micro-controllers - Theory and Applications, Tata McGraw Hill,
	3.	Kenneth J. Ayala, The 8051 Micro-controller – Architecture, Programming & Applications, Penram International & Thomson Asia, 1996, Second

Sr. No.	Name of Experiments	Mapped Course Outcomes
1	Write a program to perform Arithmetic operations using 8051 microcontroller	CO1
2	Write a program to perform data transfer between two memory blocks using 8051 microcontroller	CO2
3	Write a program to find smallest number from memory blocks using 8051 microcontroller	CO2
4	Interface LED / 7Segment display with 8051 Microcontroller (Proteous based)	CO3
5	Interface different sensor like LDR, IR with 8051 Microcontroller (Proteous based)	CO4
6	Interface LCD display with Arduino (Hands on)	CO6
7	Design and perform different embedded system and IoT Applications	CO5
8	Project Module-1	CO3, CO5, CO6
9	Project Module-2	CO3, CO5, CO6
10	Project Module-3	CO3, CO5, CO6



Course Title: Object Oriented Programming										
Semester	III	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	ODD					TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs.	-	2 Hrs.	4	10	15	50	25	-
Course Code	UITL201/ UITP201									
Teaching Mode	Online	5 Hrs.			TOTAL	75			25	
Duration of ESE	2 Hrs.						100			

Course Objectives	1. This course introduces student's general idea and concepts of object-oriented programming.
	2. It is also aimed at developing skills to implement these concepts.
	3. The course provide carrier opportunities in design of some applications as object-oriented concepts plays dominant role in software development
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Articulate the principles of object-oriented programming using C++
	CO2: Apply function overloading, constructor overloading, operator overloading & its uses in programming
	CO3: Implement inheritance and polymorphism concepts and its use for application development
	CO4: Implement static and dynamic memory allocation for software development
	CO5: Develop generic programming applications using templates

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	--	3	--	--	--	--	--	--	--	--	--	--	2	--	--
CO2	--	--	3	--	--	--	--	--	--	--	--	--	3	--	--
CO3	--	--	2	2	--	--	--	--	--	--	--	--	3	--	--
CO4	--	--		2	--	--	--	--	--	--	--	--	2	--	--
CO5	--	--		2	--	--	--	--	--	--	--	--	2	--	--

Course Contents:

Unit	Contents	Hours
I	Principles Of Object-Oriented Programming: Differences between C and C++.A look at procedure Oriented programming, object-oriented programming paradigm, basic concepts of OOP, Benefits of OOP, OO languages, A sample program, structure of C++ program. Introduction to OOPS: The origins of C++, what is Object	8



	Oriented Programming? Some C++ fundamentals, Headers & Name Spaces, Introducing C++ Classes, Function overloading, Operator overloading, Inheritance, Constructors & Destructors, Function & Operator Overloading:	
II	Overloading constructor functions, Localizing variables, Function overloading & Ambiguity, Finding the address of an overloaded function, this Pointer, Operator overloading, References, Using reference to overload a unary operator, Overloading [], overloading (), Applying operator overloading.	8
III	Inheritance, Virtual Functions and polymorphism Inheritance and the access specifier, Constructors and Destructors in derived classes, Multiple Inheritance, Passing parameters to a basic class, Pointers and references to derived types, Virtual Functions, Why virtual functions?, Pure virtual functions and abstract types, Early Vs Late binding.	8
IV	Static & Dynamic allocation Static & Dynamic allocation using new and delete, static class members, Virtual base classes, const member functions and mutable, volatile member functions, Using the asm keyword, linkage specification, The. * And ->* operators, creating conversion functions, copy constructors, Granting access, namespaces, Explicit constructors, type name and export.	8
V	Templates & Exception Handling Class templates, class templates with multiple parameters, function templates, function templates with multiple parameters, File Handling, Exception Handling, fundamentals, options the uncaught exception (), Applying exception Handling, and RTTI, casting operators, Recent trends in Object Oriented Programming in C++ , Advanced topics & its Application	8

Text Books	1.	Object Oriented Programming in C++ -Robert Lafore, edition, Galgotia publications
	2.	The Complete Reference C++, Herbert Schildt, 4th Edition, TMH
E--Books	1.	Cryptography & network security by atul kahate https://www.pdfdrive.com/cryptography-network-security-by-atul-kahate-e124796757.html
Reference Books	1.	Let's C++ by Y. Kanetkar, BPB publications
	2.	Object oriented programming with C++, E Balagurusamy, 4th edition, TMH

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Write a program to compute the area of triangle and circle by overloading the area () function.
2	Define a class to represent a bank account. Include the following members: Data members: - Name of depositor, Account number, Type of account, Balance amount in the account Member functions: - To assign initial values, To deposit an amount, To withdraw an amount after checking the balance, To display name & balance Write a main program to test program using class and object.
3	Create two classes DM and DB which stores values of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another



	object of DB. Use a friend function to carry out addition operation
4	Create a class MAT of size $m * n$. Define all possible matrix operations for MAT type objects
5	Create Stud class to display student information using constructor and destructor. (Default constructor, Multiple constructors, Copy constructor, Overloaded constructor)
6	Consider class network of given figure. The class master derives information from both account and admin classes which in turn derive information from the class person. Define all the four classes and write a program to create, update and display the information contained in master objects.
7	A book shop sells both books and video tapes. Create a class media that stores the title and price of the publication. Create two derived classes, one for storing number of pages in the book and another for storing playing time of tape. A function display () must be defined in all classes to display class contents. Write a program using polymorphism and virtual function.
8	Write a program to show use of this pointer, new and delete.
9	Write a function template for finding the minimum value contained in an array
10	Write a program containing a possible exception. Use a try block to throw it and catch block to handle it properly.
Open Ended Experiments / New Experiments	
1	Write a class template to represent a generic vector. Include member functions to perform following tasks -To create a vector -To modify the value of given element -To multiply by scalar value. -To display vector.
2	Write a C++ program to design a simple calculator



Course Title: Signals and Systems										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs.			3	10	15	50	-	-
Course Code	UECL204									
Teaching Mode	Offline	3 Hrs.			TOTAL	75			-	
Duration of ESE	2 Hrs.									

Course Objectives	1. To introduce the fundamentals, characteristics, concept techniques of signals & systems.
	2. Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
	3. To characterize LTI systems in the Time domain and various Transform domains
Course Outcomes	CO1. To represent & classify signals, Systems & identify LTI systems.
	CO2. To understand LTI systems and its analysis.
	CO3. To analyze the Continuous Time systems by performing Convolution
	CO4. To understand Discrete time systems and LTI systems.
	CO5. To understand sampling of signals and quantization process

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	3	3	3	2	--	--	--	--	--	--	1	--	3	--	--
CO2	3	3	3	2	--	--	--	--	--	--	1	--	3	--	--
CO3	3	3	3	2	--	--	--	--	--	--	1	--	3	--	--
CO4	3	3	3	2	--	--	--	--	--	--	1	--	3	--	--
CO5	3	3	3	2	--	--	--	--	--	--	1	--	3	--	--

Course Contents:

Unit	Contents	Hours
I	Introduction to Signals and Systems: Signals and systems as seen in everyday life, and in various branches of engineering and science electrical, mechanical, hydraulic, thermal, biomedical signals and systems as examples. Basic definitions, Classification of signals and systems. Signal operations and properties. Basic continuous time signals, discretization of continuous	10



	time signals, discrete time signals. Basic system properties, Some special signals of importance: the unit step, the unit impulse, the sinusoidal, the complex exponential, Representation of digital signals. Case study of different signals form communication and biomedical field	
II	Continuous time and discrete time Linear shift invariant (LSI) systems: Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations.	10
III	Continuous Time Fourier Transform: Representation of Aperiodic Signal, Fourier Transform for Periodic Signals, Properties of CTFT, Convolution and multiplication property of continuous FT, Systems characterized by Linear Constant Coefficient Differential equations. Convolution Property. Introduction to Z Transform	10
IV	Discrete Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT): Properties of DTFT and DFT, convolution property, multiplication property, Duality, Systems characterized by Linear Constant Coefficient Difference Equations	8
V	Sampling: Sampling theorem – Graphical and analytical proof for Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, Introduction to Band Pass sampling.	7

Text Books	1.	Signals and Systems: Alan V Oppenheim, Alan S Willsky, S Hamid Nawab, Prentice Hall India 2009
	2.	Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.
	3.	Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
EBooks	1.	https://drive.google.com/file/d/0B7SUGT-4AMaJZGFvTi0tMHpmRjQ/view
Reference Books	1.	Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.
	2.	Signals, Systems and Transforms - C. L. Philips, J.M.Parr and Eve A.Riskin, Pearson education.3rd Edition, 2004.
	3	Fundamentals of Signals and Systems Michel J. Robert, MGH International Edition, 2008.
on line TL Material	1.	IIT's NPTEL lectures



Semester-IV

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
			L	T	P	Total Hrs		Theory			Practical		Total Marks
								TAE	CAE	ESE	IN	EXT	
SEMESTER-IV													
UBSL256	Transforms & Numerical Methods	BS	3	1		4	4	10	15	50			75
UCSL203	Formal Languages and Automata	C	3			3	3	10	15	50			75
UCSL205 UCSP205	Design and Analysis of Algorithms	C	3		2	5	4	10	15	50	25	25	125
UITL204 UITP204	Computer Network	C	2		2	4	3	10	15	50	25		100
UCSL206 UCSP206	Operating System	C	3		2	5	4	10	15	50	25		100
UISL2XX	Open Elective - I	OE	2			2	2	10	15	50			75
UAIL206 UAIP206	Machine Learning Algorithm	A	2		2	4	3	10	15	50	25		100
TOTAL			18	1	8	27	23	70	105	350	100	25	650



Course Title: Transforms and Numerical Methods										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	BS	3 Hrs.	1 Hr.	--	4	10	15	50	--	--
Course Code	UBSL256									
Teaching Mode	Offline	4 Hrs.			Total	75			--	
Duration of ESE	2 Hrs.									

Course Objectives	The objective of this course is to teach students to comprehend the transform method to solve differential and difference equations.
	Learn Numerical methods to solve algebraic, transcendental, simultaneous and ordinary differential equations.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the mathematical descriptions in Laplace Transform
	CO2: Understand the mathematical descriptions in Z- transform.
	CO3: Understand numerical techniques to solve various algebraic and transcendental equations
	CO4: Apply the knowledge of numerical techniques to solve ordinary differential equations

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	2	--	1	--	--	--	--	--	--	3
CO2	3	3	2	--	1	--	--	--	--	--	--	3
CO3	3	3	2	--	1	--	--	--	--	--	--	3
CO4	3	3	2	--	1	--	--	--	--	--	--	3

Course Contents:

Unit	Contents	Hours
I	Laplace Transforms: Laplace transform: definition and their simple properties, Transform of derivatives and integrals, Evaluation of integrals by Laplace transform, Inverse Laplace transform and its properties, Convolution theorem, Laplace transforms of periodic function and unit step function. Solutions of mathematical models (ODE & PDE) using Laplace Transform. Solution of simultaneous ordinary differential equations by Laplace Transform	12



	method.	
II	Z-Transforms: Definition, properties of Z- Transforms, Inverse Z- Transform and Relation between Z transform and Laplace Transform. Convolution Theorem, Application of Z-Transform to solve difference equations with constant coefficients.	12
III	Numerical Methods-I: Error analysis, Solutions of algebraic and transcendental equations. Bisection method, False position method, Newton-Raphson method and their convergences. Solution of system of linear equations by Gauss Seidel method, Crout's method, Gauss Jordan method, Jacobi's Method	12
IV	Numerical Methods-II: Solution of ordinary differential equation by Taylor series method, Runge-Kutta fourth order method, Euler modified method, Picard's Method, Milne's Predictor corrector method. Solution of Simultaneous and higher order differential equations.	12

Text Books	1.	Higher Engineering Mathematics, Grewal B.S.: Khanna Publishers; 2013 Forty Third
E-Books	1.	http://www.math.ust.hk/~machas/numerical-methods.pdf
Reference Books	1.	Advanced Engineering Mathematics, Kreyszig, E. John Wiley & Sons; 2000, Eight
	2.	Advanced Engineering Mathematics, Jain, R.K. and Iyengar, S.R.K,2007, Third
	3.	Numerical Methods, Dr. P Kandasamy, S.Chand Publishers Edition forty third.
	4.	Introduction to Numerical Analysis, S. Baskar and S. Sivaji Ganesh, 2013



Course Title: Formal Languages and Automata										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs.	--	--	3	10	15	50	--	--
Course Code	UCSL203									
Teaching Mode	Offline	3 Hrs.			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	To provide introduction to some of the central ideas of theoretical computer science from the perspective of formal languages.
	To introduce the fundamental concepts of formal languages, grammars and automata theory.
	Classify machines by their power to recognize languages and use finite state machines to solve problems in computing.
	To understand deterministic and non-deterministic machines.
	Use of Turing Machine and Pushdown Automata in Formal Language.
Course Outcomes	CO1: Understand the abstract machines and their power to recognize the valid Languages.
	CO2: Modeling of finite state machines for solving computing problems.
	CO3: Design context free grammars for formal languages.
	CO4: Apply Formal language to solve problems based on push down automata.
	CO5: Solve problems based on linear bounded automata and Turing

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	3		--	--	--	--	--	--	--	--	--	--	3	--	--
CO2	--	3	--	--	--	--	--	--	--	--	--	--	2	--	--
CO3	--	3	--	--	--	--	--	--	--	--	--	--	2	--	--
CO4	--	--	3	--	--	--	--	--	--	--	--	--	3	--	--
CO5	--	--	3	--	--	--	--	--	--	--	--	--	--	3	--



Course Contents:

Unit	Contents	Hours
I	Introduction- Basic Mathematical Notation and techniques- Finite State systems – Basic Definitions – Finite Automaton – DFA & NFA – Finite Automaton with ϵ - moves – Regular Languages- Regular Expression – Equivalence of NFA and DFA – Equivalence of NFA's with and without ϵ -moves – Equivalence of finite Automaton.	08
II	Regular Expressions- Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Properties of Regular Languages Pumping Lemma for Regular Languages, Applications of the Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages.	08
III	Context-Free Grammars: Chomsky hierarchy of languages. Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Forms, Parse Tree, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages.	08
IV	Push Down Automata- Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.	08
V	Definitions of Turing machines – Models – Computable languages and functions – Techniques for Turing machine construction – Multi head and Multi tape Turing Machines – The Halting problem.	08

Text Books	1	Introduction to Automata Theory, Languages, and Computation, 3rd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
	2	Introduction to the Theory of Computation, Michael Sipser, 3 rd edition, Cengage Learning.
Reference Books	1	Introduction to Languages and The Theory of Computation, John C Martin, TMH.
	2	Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
	3	A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
	4	Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.



Course Title: Design and Analysis of Algorithms										
Semester	IV	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs.	-	2 Hrs.	4	10	15	50	25	25
Course Code	UCSL205 UCSP205									
Teaching Mode	Offline	5 Hrs.			Total	75			50	
Duration of ESE	2 Hrs.					100				

Course Objectives	This course introduces students the general idea of analysis and design of algorithms while making them aware of basic methods of algorithm analysis and design.
	It is also aimed at developing skills to solve real life applications which involve algorithm development
	The course also provides career opportunities in analysis, design and optimization technique in algorithms
Course Outcomes	CO1: Recall basic concepts of algorithm in analysis and Design of algorithms.
	CO2: Examine Recurrence relations, solutions of recurrence of searching sorting methods
	CO3: Apply Greedy methods used for analysis and Design of Algorithm
	CO4: Analyze Dynamic Programming concepts in designing algorithm
	CO5: Evaluate advanced techniques and tools available for algorithm analysis and development

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		3											2	
CO2			3										1	
CO3				3									2	
CO4			3										2	
CO5			3										2	



Course Contents:

Unit	Contents	Hours
I	Unit – I: Mathematical foundations & Asymptotic notations summation of arithmetic and geometric series, n , n^2 , Complexity calculation of various standard functions, Principles of designing algorithms, Asymptotic notations of analysis of algorithms, analyzing control structures, worst case and average case analysis, Iterative Algorithm analysis.	9
II	Unit – II: Advanced data structures Recurrence relations, solutions of recurrence relations using technique of characteristic equation and generating functions Divide and conquer basic strategy, matrix operation, Strassen's matrix multiplication, binary search, quick sort, merge sort.	9
III	Unit – III: Greedy Method Greedy method – basic strategy, application to job sequencing with deadlines problem, minimum cost spanning trees, single source shortest path etc.	9
IV	Unit IV: Dynamic Programming Dynamic Programming basic strategy, multistage graphs, all pairs shortest path, single source shortest paths, optimal binary search trees, traveling salesman, Knapsack, sum of subset problems	9
V	Unit V: Traversal and Search Techniques Basic Traversal and Search Techniques, breadth first search and depth first search, Backtracking basic strategy, 8-Queen's problem, graph coloring, Hamiltonian cycles etc Advance Topic: (As per the instructor)	9

Text Books	1.	Thomas H. Cormen et. al. "Introduction to Algorithms", Prentice Hall of India.
	2.	Design & Analysis of Computer Algorithms by Aho, Horowitz, Sahani, Rajsekharan, Pearson education
Reference Books	1.	"Computer Algorithms", Galgotia Publications Pvt. Ltd. Brassard, Bratley, "Fundamentals of Algorithms", Prentice Hall
	2.	Computer Algorithms: Introduction to Design and analysis, 3 rd Edition, By Sara Baase & A. V. Gelder Pearson Education.
On-line TL Material	1.	NPTEL course on Design and Analysis of Algorithms: https://www.class-central.com/course/nptel-design-and-analysis-of-algorithms-3984

Sr. No.	Title of Practical	Hrs. Allotted	Relevance to CO
1.	To Implement and analyze time complexity of Searching Algorithm.	2	CO1
2.	To Implement and analyze time complexity of Sorting Algorithm.	2	CO1
3.	To Implement and analyze time complexity of algorithm using Divide and Conquer Technique.	2	CO2



4.	To Implement and analyze time complexity of Greedy Algorithm.	2	CO2
5.	To Implement and analyze time complexity of Algorithm of Dynamic Programming Technique.	2	CO3
6.	To implement and analyze time complexity of Minimum Cost spanning Tree Algorithm.	2	CO3
7.	To implement and analyze time complexity of Single source shortest path Algorithm.	2	CO4
8.	To implement and analyze time complexity of All pair shortest path Algorithm.	2	CO4
9.	To implement and analyze time complexity of Graph Traversing Algorithm.	2	CO5
10.	Open-Source Practical	2	CO5



Course Title: Computer Network										
Semester	IV	Teaching Scheme				Evaluation Scheme				
		Theory		Practical						
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	2 Hrs.	--	2 Hrs	3	10	15	50	25	--
Course Code	UITL204 UITP204									
Teaching Mode	Offline	4 Hrs.			Total	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	To understand the computer network architectures.
	To make aware of design and performance perspective of network architectures.
	To discuss current trends in communication
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Analyze the need for OSI reference model in computer networking
	CO2: Studying the various transmission medium used in physical layer
	CO3: Analyzing different Elementary protocols for communication and Identify IEEE standards employed in computer networking
	CO4: Solve and apply various Routing Algorithm and Protocols
	CO5: Use techniques involved in developing transport and application layer of computer networking.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Contents:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	--	3	--	--	--	--	--	--	--	--	--	--	3	2	--
CO2	--	--	3	--	--	--	--	--	--	--	--	--	3	--	--
CO3	--	--	--	--	3	--	--	--	--	--	--	--	2	3	--
CO4	--	--	3	--	--	--	--	--	--	--	--	--	3	2	--
CO5	--	--		3	--	--	--	--	--	--	--	--	2	3	--

Unit	Contents	Hours
I	Introduction The use of computer networks. Network hardware. LAN's, Man's, WAN's, internet works, Network software, protocol hierarchies, design issues for layers, interfaces and services, Connectionless oriented and connectionless services, service primitives, relationship of Services to protocols, the OSI reference model, TCP/IP reference model, comparison of OSI and TCP/IP reference	8



	model.	
II	<p>Physical Layer The theoretical basis for data communication-Fourier analysis, bandwidth-limited signals, Maximum data rate of a channel, transmission media-magnetic media, and twisted pair coaxial Cable, fiber optics. Wireless transmission, microwave transmission. Multiplexing, switching, Narrow and ISDN - services, architecture, interface, perspective on N-ISDN, broadband ISDN & ATM-virtual circuits versus circuit switching, transmission in ATM networks, ATM Switches.</p>	8
III	<p>Data Link Layer Design issues - services provided to the network Layer, framing, error control, flow control, Error correcting & detecting codes, elementary data link protocols, simplex stop and wait Simplex protocols for noisy channel, sliding window protocols-one bit protocol, go back Protocol, selective repeat protocol. The medium access sub layer - static and dynamic channel Allocation in LANs and MANs, Multiple access protocols - ALOHA. CSMA, collision free Protocols, limited contention protocols, IEEE 802.11 wireless LAN protocols, IEEE Standards 802 for LAN and MANs-802.3 & Ethernet, token bus. Token ring,</p>	8
IV	<p>The Network Layer Design issues, services provided to the transport layer, internal organization, comparison of Virtual circuit and datagram subnets, routing algorithms. Optimality principle, shortest path Routing, flooding, flow-based routing, distance vector routing, link state routing, hierarchical Routing, broadcast & multicast routing, congestion control algorithms, general principles Prevention policies, traffic shaping. flow specifications, congestion control in virtual circuit Subnets. choke packets, load shedding, jitter control. IP protocol, IP address. Subnets, internet Control protocols, OSPF. BGP.</p>	8
V	<p>Transport and Application Layer Transport and Application Layer - services provided to the upper layer, Quality of Service, Transport service primitives, elements of transport protocols, addressing, establishing a Connection, releasing a connection, flow control & buffering, multiplexing, crash recovery,</p>	8

Text Books	1.	Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Fifth Edition, Pearson
	2.	Data Communication And Networking, Behrouz A. Forouzan, Fourth Edition, McGraw Hil
E-Books	1.	Fayez Gebali, Analysis of Computer and Communication Networks, First Edition, Springer
Reference Books	1.	Jean Walrand , Pravin Varaiya, High-Performance Communication Networks (The Morgan Kaufmann Series in Networking), Second Edition, Morgan Kaufmann Publishers
	2.	V.S.Bagad, I.A.Dhotre, Computer Communication Networks, Third Edition, Technical Publications, Illustrated
	3.	Norman Abramson, Franklin F. Kuo, Computer-communication networks, Fourth Edition, Prentice-Hall, 1973, Illustrated



List of Experiments:

Experiment No.	Title of Experiments	CO
1	Study of Networks and layered communications, understanding of Network equipment, wiring in details	CO1
2	Study of basic network command and Network configuration commands	CO1, CO2
3	Install and configure Network Devices: HUB, Switch and Routers.	CO2
4	Introduction to Packet Tracer, creating of a LAN and connectivity test in the LAN	CO3
5	Configure a Network topology using packet tracer software	CO3
6	Overview of IP Addressing and sub-net masking.	CO4
7	Study of Basic Router Configuration, Static Routing Implementation.	CO4
8	Observing Static and Dynamic Routing	CO4
9	Packet capture and header analysis by wire-shark (TCP,UDP,IP)	CO5
10	Configuring a Cisco Router as a DHCP Server	CO5
11	Configuring RIP	CO5



Course Title: OPERATING SYSTEM										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs.	--	2 Hrs.	4	10	15	50	25	--
Course Code	UCSL206 UCSP206									
Teaching Mode	Offline	5 Hrs.			Total	75			25	
Duration of ESE	2 Hrs.						100			

Course Objectives	Introduces general idea, structure and functions of operating system
	Making students aware of basic mechanisms used to handle processes, memory, storage devices and files.
	Recent trends in the operating system
Course Outcomes	CO1. Identify basic structure and purpose of operating system.
	CO2. Interpret the concepts of process and illustrate various CPU scheduling algorithms.
	CO3. Interpret the concepts of inter process communication.
	CO4. Schematize Deadlock & security mechanisms in operating systems.
	CO5. Analyze different memory management techniques with advantages and disadvantages.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, system design and implementation.	6
II	Process & Its Scheduling Process concept, process control block, Types of schedulers, context switch, threads, multi-threading model, goals of scheduling and different scheduling algorithms,	4



III	Process management and synchronization: Concurrency conditions, Critical section problem, software and hardware solution, semaphores, conditional critical regions and monitors, classical inter process communication problems	4
IV	Deadlock definitions, Prevention, Avoidance, detection and Recovery, Goals of Protection, access matrix, Deadlock implementation	8
V	Memory Management & File systems: Contiguous allocation, Relocation, Paging, Segmentation, Segmentation with paging, demand paging, Virtual Memory Concepts, page faults and instruction restart, page replacement algorithms, working sets, Locality of reference, Thrashing, Garbage Collection. File concept, Access methods space allocation strategies, disk arm scheduling strategies.	8

Text Books	1.	Operating System concepts – Silberchatz; Galvin, Addison Wesley, 6th Edn.
	2.	Modern Operating Systems – Tanenbaum, Pearson Edn. 2 ndedn
	3.	Operating Systems: Internals and Design Principles -- William Stallings
Reference Books	1.	Operating Systems – S R Sathe, Macmillan Publishers, India, 2008
	2.	Operating System –Milan Milenkovic, McGraw-Hill, 1987
	3.	Operating Systems - 3 rd Edition by Gary Nutt, Pearson Education.
On line TL Material	1.	https://nptel.ac.in/courses/106/108/106108101/



Course Title: Open Elective - I										
Semester	IV	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	EVEN	Th	Tu	Pr		TAE	CAE	ESE	INT	EXT
Course Category	OE	2 Hrs.	--	--	2	10	15	50	--	---
Course Code	UISL2XX		2 Hrs.			Total	75			--
Teaching Mode	NPTEL BASED					75			--	
Duration of ESE	2 Hrs.					75				
To be offered based on courses available on NPTEL/SWAYAM										

Information Technology				
Scheme-2020-2021				
Elective	Course Code	Semester	Course Name	Offered in AY
Open Elective-I	UISL201	IV	ENGLISH FOR INTERNATIONAL ASPIRANTS	2021-22
	UISL202	IV	APPLIED ENGLISH COMMUNICATION SKILLS	2021-22
	UISL203	IV	CAREER (SOFT) SKILLS FOR ENGINEERS	2022-23
	UISL204	IV	ENGLISH FOR COMPETITIVE EXAMINATIONS	2021-22
	UISL205	IV	ADVANCED COMMUNICATION SKILLS	2021-22
	UISL206	IV	SANSKRIT FOR TECHNICAL KNOWLEDGE	2022-23
Open Elective-II	UISL308	VI	E-BUSINESS	2022-23
	UISL309	VI	FINANCIAL MANAGEMENT FOR MANAGERS	2022-23
	UISL310	VI	BUSINESS DEVELOPMENT: FROM START TO SCALE	2022-23
Humanities Elective	UHUL312	VI	CONTENT DESIGNING AND MEDIA FUNDAMENTALS	2022-23
	UHUL313	VI	CYBER ETHICS AND MORAL RESPONSIBILITY	2022-23



Course Title: Machine Learning Algorithm										
Semester	IV	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	EVEN	Th	Tu	Pr		TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs.	-	2 Hrs.	4	10	15	50	25	-
Course Code	UAIL206 UAIP206									
Teaching Mode	Offline	5 Hrs.			Total	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	The objectives of the course is to introduce students to the basic machine learning algorithms.
	To understand nature of the problem and apply suitable machine learning algorithm
Course Outcomes	CO1: Understand complexity of Machine Learning algorithms and their limitations;
	CO2: Understand modern notions in machine learning and computing;
	CO3: Be capable of confidently applying common Machine Learning algorithms in practice and implementing their own;
	CO4: Be capable of performing experiments in Machine Learning using real-world data.
	CO5: Implement different Machine Learning Models

Course Contents:

Unit	Contents	Hours
I	Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation	6
II	Linear regression, Decision trees, over fitting Instance based learning, Feature reduction, Collaborative filtering-based recommendation	8
III	Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM	8
IV	Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning	6
V	Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model	6

Text Books	1.	Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
	2.	Introduction to Machine Learning Edition 2, by Ethem Alpaydin



Sr. No.	List of Practical
1	Calculating Evaluation using Sklearn library (Regression Metrix): 1. Mean Absolute Error 2. Mean Squared Error 3. R squared Error
2	Write a python program to evaluate a Confusion Matrix from given Dataset
3	Write a python program to evaluate a Linear Regression on Diabetic Dataset
4	Write a python program to evaluate a Decision tree on iris Dataset
5	Write a python program to evaluate a Over fitting and Underfitting on custom dataset
6	Write a python program to evaluate a Applying Logistic Regression on iris Dataset
7	Write a python program to evaluate an Applying gaussian Naïve Bayes learning on iris Dataset
8	Write a python program to predict numbers in image
9	Write a python program to evaluate a Apply PCA Algorithm on Iris Dataset
10	Introduction to Fundamental of Fuzzy Logic and Basic Operations (Through Virtual Lab)
11	Color Image Processing (Through Virtual Lab)
12	Mean and Covariance (Through Virtual Lab)



SEMESTER-V

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
			L	T	P	Total Hrs		Theory			Practical		Total Marks
								TAE	CAE	ESE	INT	EXT	
SEMESTER-V													
UCSL301 UCSP301	Database Management System	C	2	1	2	5	4	10	15	50	25	25	125
UITL419 UITP419	Computer System Security	C	3		2	5	4	10	15	50	25		100
UITL302 UITP302	Web Development	C	2		4	6	4	10	15	50	25		100
UITL306 UITP306	JAVA Programming	C	2		2	4	3	10	15	50	25		100
UITL308 UITP308	Software Engineering for Project Management	C	2		2	4	3	10	15	50	25		100
UHUL303	Engineering Economics and Industrial Management	H	2			2	2	10	15	50			75
UHUP305	Aptitude	A			2	2	1				25		25
TOTAL			13	1	14	28	21	60	90	300	150	25	625



Course Title: DATABASE MANAGEMENT SYSTEM										
Semester	V	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	ODD					TAE	CAE	ESE	INT	EXT
Course Category	C14	2 Hrs	1 Hr	2 Hrs	4	10	15	50	25	25
Course Code	UCSL301/ UCSP301									
Teaching Mode	Offline	5 Hrs			Total	75			50	
Duration of ESE	2 Hrs					125				

Course Objectives	This course introduces general idea of database management system, also gives idea to design databases using data modeling and design techniques.
	It is also aimed to developing skills to implement real life applications which involve database handling.
	This course also provide carrier opportunities in subject areas of designing, storage techniques and data handling and managing techniques
Course Outcomes	CO1: Analyze an information storage problem and derived an information model expression in the form of Entity relation diagram and design appropriate data model for it.
	CO2: Demonstrate SQL queries to perform CRUD (Create, Retrieve, Update, Delete) operations on database and perform inferential analysis of data model
	CO3: Identify features of database management systems and Relational database and Understand functional dependencies and various normalization forms
	CO4: Perform basic transaction processing and management and ensure database security, integrity and concurrency control
	CO5: Analyze the management of structured and unstructured data management with recent tools and technologies

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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



Course Contents:

Unit	Contents	Hours
I	Introduction to DBMS - DBMS Architecture, Data Models, E-R Diagram, Relational Database design:	6
II	SQL Concepts - Basics of SQL, DDL, DML, DCL, structure – creation, alteration, defining constraints, Functions - aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types.	8
III	Functional Dependency (FD) – Basic concepts, closure of set of FD, closure of attribute set, Decomposition, Normalization – 1NF, 2NF, 3NF, BCNF, 4NF, Query Optimization	5
IV	Transaction control commands – Commit, Rollback, Save point. Transaction Management: Transaction concepts, properties of transactions, serializability of transactions, Two- Phase Commit protocol, Deadlock, two-phase locking protocol. Cursors, Stored Procedures, Stored Function, Database Triggers.	7
V	NoSQL Databases - Introduction, CRUD Operations, Data Mining, Advances in databases	4

Text Books	1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2002.
	2.	Jeff Ullman, and Jennifer Widom, A First Course in Database systems, 2nd Ed.
E-Books	1.	https://ebooks.lpude.in/computer_application/mca/term_1/DCAP204_MANAGING_DATABASE_DCAP402_DATABASE_MANAGEMENT_SYSTEMS.pdf
Reference Books	1.	G. K. Gupta :”Database Management Systems”, McGraw – Hill.
	2.	Regina Obe, Leo Hsu, PostgreSQL: Up and Running, 3rd Ed, O’Reilly Media 2017.
	3.	Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, O’Reilly Media 2018.
	4.	RamezElmasri and ShamkantNavathe, Fundamentals of Database Systems 2nd Ed, Benjamin Cummings, 1994.
online TL Material	1.	https://nptel.ac.in/courses/106/105/106105175/

Sr. No	Name of Experiments / Mini Projects/ Case Studies
1	Draw E-R diagram and convert entities and relationships to relation table for a given scenario. a. Two assignments shall be carried out i.e. consider two different scenarios (eg. bank, college, Employee, Hotel etc)
2	To perform following SQL activity: a) Creating a database b) Creating Tables (With and Without Constraints) c) Inserting Record in table



3	To Perform the following: a. Viewing all databases, Viewing all Tables in a Database, Updating/Deleting Records in a Table
4	To Perform the following SQL query on database: a. Altering a Table, Dropping/Truncating/Renaming Tables, Backing up / Restoring a Database
5	For a given set of relation schemes, create tables and perform the following Simple Queries: Simple Queries with Aggregate functions, Queries with Aggregate functions (group by and having clause), Queries involving- Date Functions, String Functions , Math Functions
6	To perform SQL query that demonstrate Join Queries- Inner Join, Outer Join, Left join, Right Join
7	To perform SQL query that demonstrate following: Search conditions, Summary queries, Sub- queries, Subqueries- With IN clause, With EXISTS clause
8	To perform SQL query for extracting data from more than one table using SQL concept
9	To perform SQL query to understand the concepts: Transaction, ROLL BACK, COMMIT & CHECK POINTS.
10	Open ended practical on NOSQL
Open Ended Experiments / New Experiments	
1	Name of case based practical: Develop two menu driven project for management of database system: 1. Library information system a. Engineering b. MBA 2. Inventory control system a. Computer Lab b. College Store 3. Student information system a. Academic b. Finance 4. Time table development system a. CSE, IT & MCA Departments b. Electrical & Mechanical Departments
Details of online Laboratory Resource Material Instruction / Operating Manuals	
1	http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/exp5/index.php
2	http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/exp3/index.php



Course Title: Computer System Security										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C22	3 Hrs	NA	2 Hrs	4	10	15	50	25	-
Course Code	UITL419/ UITP419									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	1. This course covers the fundamentals of computer systems security.
	2. It introduces many different areas of security such as encryption, malicious code, Authentication and access control, trusted computer systems, operating system and network security.
	3. The objective of this course is to provide students with a comprehensive overview of the threats to computer security, technologies for security assurance, and engineering approaches to security solutions.
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Understand the basic concepts and goals of Information security such as Confidentiality, Integrity, Authentication, Non - Repudiation, Authorization, and Availability and their relevance in various Contexts.
	CO2: Identify and design the various cryptographic algorithms for the appropriate protection measures against malicious code.
	CO3: Apply the modern principles of network security threats and determine efforts to counter them.
	CO4: Analyze, implement and maintain security requirements and mechanisms in various computer systems and networks.
CO5: Design and apply the principles of trusted system to achieve the degree of assurance.	



Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Introduction: attacks, services, mechanisms, security attacks, security services, a model for internet work security, encryption model, steganography, classical encryption techniques, modern techniques - simplified DES, block cipher principles, data encryption standard, strength of DES, differential & linear cryptanalysis, block cipher design principles, block, cipher modes of operation.	7
II	Confidentiality using conventional encryption: placement of encryption function, traffic confidentiality, key distribution, random number generation. Public key cryptography: principles, RSA algorithm, key management, diffie-hellman key exchange, elliptic curve remainder theorem, discrete logarithms.	7
III	Message Authentication & hash functions: Authentication requirements, functions, codes, hash functions, security of hash function & MACs. Hash & Mac algorithms: MD5 message digest algorithm, secure hash algorithm (SHA-1), digital signatures & authentication protocols: digital signatures, authentication protocols, digital signature standard.	7
IV	Computer System security: IP security: overview, architecture, authentication header, encapsulating security payload, combining security associations, key management. Computer Security testing: Penetration Testing, Security Penetration Tools like Netsparker, Wireshark, Metasploit, Burp Suite Pen Tester etc.	7
V	Web security: requirements, secure sockets layer & transport layer security, secure electronic transaction, networks management security. System Security: Intruders, viruses and worms, Firewalls: design principles, trusted systems. Privacy rules: Access, data backup, test security systems and processes. Mobile security issues, Security Issues in Cloud. Issues and Challenges of Mobile Cloud Computing.	7



Text Books	1.	Cryptography and networks security principles & practice 2/c by William Stallings (Pearson Education prentice Hall).
	2.	Networks security Essentials Applications & standards by William Stallings (Pearson Education, LPF).
	3.	Cryptography in C and C++ by Michael Welschenbach (A press IDG Books India).
E--Books	1.	https://freecomputerbooks.com/compscspcialSecurityBooks.html
	2.	http://www.cs.unibo.it/~babaoglu/courses/security/resources/documents/Computer_Security_Principles_and_Practice_(3rd_Edition).pdf
	3.	http://www.uoitc.edu.iq/images/documents/informatics-institute/exam_materials/Introduction%20to%20Computer%20Security%20pdf%20DONE.pdf
Referenc e Books	1.	Introduction to Data Compression by Khalid Sayood (Morgan kaufmann/Harcourt India).
	2.	Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press.
	3.	Michael T. Goodrich and Roberto Tamassia, Introduction to Computer Security, Addison Wesley, 2011.
On line TL Material	1.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-858-computer-systems-security-fall-2014/download-course-materials/
	2.	http://nptel.ac.in/courses/106105031/
	3.	http://freevideolectures.com/Course/3027/Cryptography-and-Network-Security

List of Practical:

Sr. No.	Name of Experiments (Programming Language: C++, Python)
1	Perform encryption and decryption using Caesar cipher Algorithm.
2	Perform encryption and decryption using Play Fair Cipher.
3	Perform encryption and decryption using Rail Fence Technique. (Row Transposition Techniques)
4	Perform encryption and decryption using (Columnar Transposition Techniques)
5	Perform encryption and decryption using One Time Pad Algorithm.
6	Write a program to implement extended Euclidean Algorithm.
7	Write a program to Develop a Secure System by Applying RSA Cryptography Algorithms.
8	Write a C program to implement Digital signature algorithm
9	Write a Program to Implement Elliptic curve based Arithmetic.
10	Write a program to implement Diffie–Hellman Key Exchange.
11	Open source Tools



Course Title: Web Development										
Semester	V	Teaching Scheme				Evaluation Scheme				
		Theory		Practical						
Term		Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	2Hrs.	--	4Hrs.	4	10	15	50	25	-
Course Code	UITL302/ UITP302									
Teaching Mode	Offline	6 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	1. To understand the basic principles of web designing
	2. To learn web page creation using HTML
	3. To learn dynamic website design using CSS & JAVA Script
	4. To learn content management system
	5. To learn web hosting
Course Outcomes	Upon successful completion of the course, students will be able to
	CO1: Explain the basic principles of web designing
	CO2: Implement all basic tags in HTML
	CO3: Design web page using HTML, CSS & JAVA Script
	CO4: Design & Understand content management system
	CO5: Publish & Host the website

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1:	-	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO2:	-	1	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3:	-	1	2	2	-	-	-	-	-	-	-	-	3	-	-
CO4:	-	1	2	2	-	-	-	-	-	-	-	-	2	-	-
CO5:	-	1	1	2	-	-	-	-	-	-	-	-	2	-	-



Unit	Contents	Hours
I	Web Design Principles: Basic principles involved in developing a web site, Planning process, Designing navigation bar, Page design, Home Page Layout Design Concept., Brief History of Internet, What is World Wide Web, Why create a web site, Web Standards	8
II	Introduction to HTML: What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags. Elements of HTML: Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls	8
III	Introduction to Cascading Style Sheets & JAVA Script: Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model, Advanced CSS, JAVA Script Introduction, Application, Advantages, Popup Boxes, Programming details, Class & object.	8
IV	Content Management System: The differences between content, content management, and a content management system. Types of content management systems. Why we use CMS, what a CMS does, and what CMS doesn't do	8
V	Introduction to Web Publishing or Hosting: Creating the Web Site, Saving the site, Working on the web site, Creating web site structure, Creating Titles for web pages, Themes-Publishing web sites.	8

Text Books	1.	HTML 5 in simple steps by Kogent Learning Solutions Inc. Dreamtech Press
	2.	HTML, XHTML, and CSS Bible, 5ed Steven M. Schafer , Wiley India
E--Books	1.	HTML 5 in simple steps by Kogent Learning Solutions Inc. Dreamtech Press
	2.	HTML, XHTML, and CSS Bible, 5ed Steven M. Schafer , Wiley India
Reference Books	1.	Web Technologies: HTML, Javascript, Kogent Learning, Wiley India
online TL Material	1.	NPTEL course: https://nptel.ac.in/courses/106/106/106106156/
	2.	Udemy course: Web Design for Beginners: Real World Coding in HTML & CSS



Experiment Number	Title of the Experiments	COs	Duration
Experiment No. 1	Implementing Basic tags in HTML	CO1	2 Hrs
Experiment No. 2	Design a web page using table tag exploring all attributes	CO1	2 Hrs
Experiment No. 3	Design a form in html considering all input types	CO2	2 Hrs
Experiment No. 4	Design a web page using inline & embedded CSS	CO2	2 Hrs
Experiment No. 5	Design webpage using external CSS	CO3	2 Hrs
Experiment No. 6	Design & implement all types of popup boxes using JAVA Script	CO3	2 Hrs
Experiment No. 7	Design a calculator in html using JAVA Script taking inputs from user	CO4	2 Hrs
Experiment No. 8	Design a dynamic website using combinations of HTML, CSS & JAVA Script	CO4	2 Hrs
Experiment No. 9	Web hosting	CO5	2 Hrs
Experiment No. 10	Explore the different open source web designing tools	CO5	2 Hrs



Course Title: Java Programming										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	V	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C									
Course Code	UITL306 / UITP306	02	-	02	03	10	15	50	25	-
Teaching Mode	Offline	4 Hrs			Total	75			25	
Duration of ESE	2 Hrs						100			

Course Objectives	Understand basic concepts of Java Programming
	Develop skills to build real life applications
	Explore carrier opportunities as java application developer
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Articulate the principles of object-oriented programming using Java
	CO2: Apply the concept of Packages, Interface and Exception Handling in programming
	CO3: Implement multithreaded programming concepts and its use for application development
	CO4: Implement I/O, String Handling, AWT & Swing for software development
	CO5: Develop the applications in Java based on Networking and Generics

Course Objectives	Understand basic concepts of Java Programming
	Develop skills to build real life applications
	Explore carrier opportunities as java application developer
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Articulate the principles of object-oriented programming using Java
	CO2: Apply the concept of Packages, Interface and Exception Handling in programming
	CO3: Implement multithreaded programming concepts and its use for application development
	CO4: Implement I/O, String Handling, AWT & Swing for software development
	CO5: Develop the applications in Java based on Networking and Generics



Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	3	--	--	--	--	--	--	--	--	--	--	2	--	--
CO2	--	--	3	--	--	--	--	--	--	--	--	--	3	--	--
CO3	--	--	2	2	--	--	--	--	--	--	--	--	3	--	--
CO4	--	--	--	2	--	--	--	--	--	--	--	--	2	--	--
CO5	--	--	--	2	--	--	--	--	--	--	--	--	2	--	--

Course Contents:

Unit	Contents	Hours
I	<p>Introduction to JAVA, Class and Object Introduction to data types, operators and control statements, Classes: fundamentals of classes, declaring objects, assigning objects, reference variables, methods, constructor, variable handling and garbage collection. Methods and classes: Overloading methods, using objects as parameters, arguments passing, returning objects, recursion, access control, understanding static, introducing final, nested inner classes, storage classes, command line arguments.</p>	5
II	<p>JAVA Packages, Interface and Exception Handling Packages and interface: Packages, access protection, importing packages, interfaces. Exception handling: fundamentals, exception types, uncaught exception, try-catch, displaying description of an exception, multiple catch clauses, nested try statements. throw, throws, finally, built in exceptions, creating own exception subclasses.</p>	5
III	<p>Multithreaded Programming JAVA thread model, thread priorities, synchronization, messaging, the thread class, runnable interface, creating thread, creating multiple thread. using isAlive(), join(), thread priority, synchronization, interthread communication, suspending, resuming, stopping threads using multithreading.</p>	5
IV	<p>I/O, String Handling, GUI Programming I/O stream, bytes stream, character stream, pre-defined streams, reading console input reading character, reading string, writing console output, the PrintWriter class, reading and writing files, transient and volatile modifiers, using instance of strictfp, native method. String Handling: string constructor, special string operator, character extraction, string comparison, searching string, modifying a string, data conversion using valueOf(), changing case of Characters within a string, string buffer. GUI Programming</p>	6



V	<p>Networking, Generics &Advanced Topics Networking: networking basics & socket overview, client/server, reserved socket, proxy server, internet addressing, networking classes and interfaces, factory methods and instance method TCP/IP client socket, URL, URL connections, TCP/IP server socket, datagram. Generics: General form of generic class and examples, creating generic method, generic interfaces, class hierarchies, erasure, generic restrictions Advanced Topics: Servlets and JSPs, API, Web services & Micro Services</p>	8
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Text Books	1.	The Complete Reference by Herbert Schild, TMH Publication
	2.	Programming with Java- A Primer by E. Balagurusamy, 3rd Edition, TMH Publication
Reference Books	1.	The Complete Reference- JAVA 2- 3rd Edition By Patrick Naughton, TMH Publ.
	2.	J. Nino, F. A. Hosch (2002), An Introduction to programming and OO design using Java, John Wiley & sons, New Jersey
	3.	Y. Daniel Liang (2010), Introduction to Java programming, 7th edition, Pearson education
On line TL Material	1.	https://www.udacity.com/course/java-programming-basics--ud282
	2.	https://www.udemy.com/share/101s4i/
	3.	https://www.coursera.org/specializations/java-programming

Sr. No.	Name of Experiment
1.	<p>Design a java class to perform following operations</p> <ul style="list-style-type: none"> (i) To print Fibonacci Series using recursion in java (ii) To check prime number (iii) To take input as number from command-line and to reverse that number. (iv) To check Palindrome number (v) To calculate Factorial of entered number (vi) To check Armstrong number (vii) To sort an array element using bubble sort algorithm (viii) Binary to hexadecimal conversion (ix) To generate random number <p>Binary to decimal number conversion</p>
2.	Develop student result processing system using CLI in Java



3.	<p>Object serialization Design classes for Currency, Rupee, and Dollar. Write a program that randomly generates Rupee and Dollar objects and write them into a file using object serialization. Write another program to read that file, convert to Rupee if it reads a Dollar, and while leave the value as it is if it reads a Rupee.</p>
4.	<p>Event-driven programming Design a scientific calculator using event-driven programming paradigm</p>
5.	<p>Multithreading Write a multi-threaded Java program to print all numbers below 100,000 that are both prime and fibonacci number (some examples are 2, 3, 5, 13, etc.). Design a thread that generates prime numbers below 100,000 and writes them into a pipe. Design another thread that generates fibonacci numbers and writes them to another pipe. The main thread should read both the pipes to identify numbers common to both.</p>
Mini Projects	
6.	<p>Event-driven and Concurrent Programming Develop a simple OPAC system for library using even-driven and concurrent programming paradigms of Java. Use JDBC to connect to a back-end database.</p>
7.	Develop an intranet based multi-threaded chatting and file shearing application in Java for employees in particular company
8.	Develop a AWT based bank customer management system application in Java
9.	Open Ended: Develop a Swing based college student management MVC pattern-based application for college to manage student record.



Course Title: SOFTWARE ENGINEERING FOR PROJECT MANAGEMENT										
Semester	V	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	V	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	2Hrs	--	2Hrs	3	10	15	50	25	--
Course Code	UITL308 UITP308									
Teaching Mode	Offline	4 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	The student should be made to:
	1. Understand the phases in a software project
	2. Understand fundamental concepts of requirements engineering and Analysis Modeling.
	3. Understand the major considerations for enterprise integration and deployment.
Course Outcomes	4. Learn various testing and maintenance measures
	Up on successful completion of this course, student will be able to:
	CO1: Identify the key activities in managing a software project
	CO2: Compare different process models.
	CO3: Concepts of requirements engineering and Analysis Modeling.
CO4: Apply systematic procedure for software design and deployment.	
CO5: Compare and contrast the various testing and maintenance	

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	-	-	-	-	-	-	-	3	-	-	-	-
CO2	3	2	3	-	-	-	-	-	-	-	3	-	-	-	-
CO3	2	3	3	2	1	-	-	-	-	-	3	-	3	2	-
CO4	2	3	3	-	-	-	-	-	-	-	3	-	3	3	-
CO5	3	-	3	1	-	-	-	-	-	-	3	-	-	3	-



Course Contents:

Unit	Contents	Hours
I	SOFTWARE PROCESS Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation – LOC and FP Based Estimation, COCOMO Model – Project Scheduling – Scheduling, Earned Value Analysis – Risk Management.	7
II	REQUIREMENTS ANALYSIS AND SPECIFICATION Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary	7
III	SOFTWARE DESIGN Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design – Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.	7
IV	PROJECT MANAGEMENT Estimation – FP Based, LOC Based, Make/Buy Decision, COCOMO II – Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection, RMMM – Scheduling and Tracking –	7
V	TESTING Software testing fundamentals-Internal and external views of Testing-white box testing – basis path testing-control structure testing-black box testing Debugging	7

Text Books	1.	Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Seventh Edition, McGraw-Hill International Edition, 2010.
	2.	Ian Sommerville, “Software Engineering”, 9th Edition, Pearson Education Asia, 2011.
E--Books	1.	Foundations of Software Engineering by Kevin Amaratunga
	2.	The New Software Engineering by Sue Conger
Reference Books	1.	Rajib Mall, “Fundamentals of Software Engineering”, Third Edition, PHI Learning Private Limited, 2009.
	2.	Pankaj Jalote, “Software Engineering, A Precise Approach”, Wiley India, 2010.
on line TL Material	1.	Certification Courses available: https://nptel.ac.in/downloads/106105087/
	2.	Free Courses available: https://swayam.gov.in/course/236-software-engineering

**Practical List**

Sr. No.	Title of Practical	Relevance to Course Outcome
1	Design software requirement specification for the same for assigned Project	CO1
2	Identify Functional and Non-functional requirements for assigned Project	CO1
3	Design a Use case diagram for assigned Project	CO2, CO3
4	Design a Class diagrams for assigned Project	CO3,CO5
5	Design a Sequence diagrams for assigned Project	CO3,CO5
6	Design a Collaboration diagrams for assigned Project	CO3,CO5
7	Design a State chart diagrams for assigned Project	CO3,CO5
8	Design an Activity diagrams for assigned Project	CO3,CO5
9	Design a Component diagrams	CO3,CO5
10	Design a Deployment diagrams	CO3,CO5



Course Title: Engineering Economics and Industrial Management										
Semester	V	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	ODD	Th	Tu	Pr		TAE	CAE	ESE	INT	EXT
Course Category	H	2	--	-	2	10	15	50	--	--
Course Code	UHUL303									
Teaching Mode	Offline	2			Total	75			--	
Duration of ESE	2 Hrs.						75			

Course Objectives	1. Understanding of basic knowledge of Economics and its application.
	2. Understanding of Management as discipline and its practices.
	3. Strengthening knowledge of management in the functional area of Marketing and Finance.
Course Outcomes	1. The students should be able to understand the basic concepts of Micro-Economics, which shall be helpful in their Engineering career.
	2. The students should be able to understand the basics concepts of Macro-Economics and its applications.
	3. The student should be able to understand different functions of Management and its importance in managing an organization.
	4. The student should be able to understand the relevance of Marketing of Product or Services and its applicability in profit maximization.
	5. The student should be able to understand the importance of Financial Management and its applicability in Industrial scenario.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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



Course Contents:

Unit	Contents	Hours
I	Demand, Utility and Indifference curves, approach to Analysis of demand, Elasticity of demand, Measure of demand elasticity, Factors of Production, Advertising elasticity. Market and Market Structures: Price and output determination under perfect competition, monopolistic competition, oligopoly & monopoly, Depreciation and methods for its determination.	7
II	Functions of central and commercial banks, Inflation, Deflation, Stagflation, Direct and Indirect Taxes, New economic policy, Liberalization, Globalization, Privatization, Monetary & Fiscal policies of the government, Meaning and phases of business cycles.	6
III	Definition, nature and scope of Management, Functions of management - Planning, Organizing, Directing, Controlling, Principles of management, Communication.	5
IV	Meaning of Marketing management, concepts of marketing, Marketing Mix, Service Marketing, Product Life Cycle, New Product Development, Pricing strategies, Channels of distribution, Promotion Mix	7
V	Meaning, nature and scope of Financial Management, Sources of Financing, Ratio Analysis. Time value of money.	5

Text Books	1.	Modern Economics Theory, by K.K. Dewett, S. Chand & company ltd., 3rd Edition, 2006
	2.	Essentials of Management by Harold Koontz & Hein & Wehrich Tata McGraw Hill Publishing, 7th Edition, 2008.
	3.	Marketing Management by Philip Kotler, Kevin Keller, 14th Edition, 2016.
	4.	Financial Management by M.Y. Khan & P.K. Jain, Tata McGraw Hill Publishing, 5th Edition, 2008.
E--Books	1.	http://164.100.133.129:81/econtent/Uploads/Managerial_Economics%20(1).pdf [Economics]
	2.	http://164.100.133.129:81/econtent/Uploads/Financial_Management.pdf [Financial Management]
Reference Books	1.	Management by Stephen P. Robbins Mary A. Coulter, 14th Edition.
	2.	Marketing Management by Ramaswamy V S and Namakumari, Macmillan India Ltd.
	3.	Financial Management by I M Pandey, Vikas Publishing House, New Delhi.



Course Title: Aptitude										
Semester	V	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	EVEN					TAE	CAE	ESE	INT	EXT
Course Category	A	--	--	2	1				25	--
Course Code	UHUP305									
Teaching Mode		2			Total	--			25	
Duration of ESE						25				

Course Objectives	The Curriculum aims to equip students in order to apply quantitative reasoning and Mathematical analysis methodologies to understand and solve problems.
	The students shall attain conceptual clarity to comprehend reasoning questions in a simple way and arrive at decisions at a logical manner.
	The program intends to enhance student's Critical Thinking, Analytical, Evaluative and Creative skills that make them best fit and sustain in the corporate/competitive world.
Course Outcomes	CO1: Students shall draw conclusions or make decisions based on analysis and critique of quantitative information. This leads them to effectively justify the conclusion and execute their plans.
	CO2: Students shall solve real life problems requiring interpretation and comparison of various probabilities to ascertain the best outcomes expected.
	CO3: Students shall identify logical relation to analyze, comprehend and apply mathematical techniques instead of assumptions to different real time situations.
	CO4: Shall solve the campus placements aptitude papers that qualifies them to get employed.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		1				1				3					
CO2			1					1			2				
CO3		1				2			1						
CO4										3	1	1			



Course Contents:

Unit	Contents	Hours
I	Aptitude Introduction, Orientation on syllabus, Emerging aptitude requirement, Pre-assessment on existing knowledge	
II	Number System, Problem on Numbers, Ratio and Proportion, Averages, Percentage, Profit/ Loss and Discount, Simple Interest and Compound Interest, Partnership, Mixtures and Alligations, Speed, Time & Distance, Time & Work, Boats and Stream, Pipes and Cistern, Permutation & Combination, Probability, Progression, Mensuration	
III	Blood Relation, Direction, Analogy, Puzzles, Seating Arrangement, Syllogism, Clocks, Calendar, Cubes & Dices, Coding and Decoding, Spatial and 2-D Ability, Data Sufficiency, Number Series	
IV	Table chart, pie chart, bar graph and line graph, problems based on the various data , such as combination of gender, city, profession, salary, sports, vehicle, problems based on Pie chart, degree of fraction occupied by the commodity, line chart and bar chart	

Text Books	1.	Book on Aptitude and Verbal Ability- Global Education Ltd(Under Review)
Reference Books	1.	Quantitative Aptitude- R S Aggarwal - 2017 Edition- S. Chand
	2.	Campus Recruitment- Paxis Group
E-Learning	1.	Wifi study, indiabix.com, freshers world, sawal.com, unacademy



VI SEMESTER

Course Code	Name of Course	Course Category	Teaching Scheme				Credit	Evaluation Scheme					Total Marks
			L	T	P	Total Hrs		Theory		Practical			
								TAE	CA	ESE	IN	EXT	
SEMESTER-VI													
UITL307 UITP307	Real Time Operating Systems	C	2		2	4	3	10	15	50	25		100
UECL310 UECP310	Digital Signal Processing	C	3		2	5	4	10	15	50	25		100
UXXLXXX UXXPXXX	Elective - I	EL	3		2	5	4	10	15	50	25		100
UISL3XX	Open Elective - II	OE	2			2	2	10	15	50			75
UHUL3XX	Humanities Elective	H	2			2	2	10	15	50			75
UHUL304	Universal Human Values 2: Understanding Harmony	H	3			3	3	10	15	50			75
UHUP302	Employability Skills	A			2	2	1				25		25
UHUP301	Campus Recruitment Training	A			2	2	1				25		25
UAIP_203	Data Preprocessing	A			4	4	2				25		25
TOTAL			15	14	29	22	60	90	300	150			600



Course Title: Real Time Operating Systems										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	VI	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	2		2	3	10	15	50	25	--
Course Code	UITL307 UITP307									
Teaching Mode	Offline	4 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	1. To study Real-Time System concepts, Characteristics, features and types.
	2. To Study RTOS Kernel
	3. To study Real-Time scheduling
	4. To Study different RTOS
	5. To study Real-Time Applications
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Apply the knowledge Real Time Operating Systems and its applications in real scenarios
	CO2: Apply different used approaches for real-time systems
	CO3: Gain knowledge Working and implementation of real time applications.
	CO4 : Design scheduling algorithms related to real time applications
CO5: Identify and use recent trends in RTOS of development	

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		2											3	2	-
CO2		2		2										2	-
CO3		3	3	3									3	3	-
CO4		3	3	3									2		-
CO5		3	2										3	3	-



Unit	Contents	Hours
I	Introduction : Real-time Systems, Non-Real Time Systems, Real-Time Applications, Types of Real-Time Systems, Characteristics of Real Time Systems, features of Real time Systems, Hard versus Soft Real-Time Systems	05
II	Reference Model of Real-Time Systems : Timing Constraints, Hard and Soft Timing Constraints, Deterministic and Probabilistic Model, Temporal Parameters of Real-Time Workload, Periodic, Aperiodic And Sporadic Job model	07
III	Concept and Fundamentals of RTOS : RTOS Kernel, Threads, Time Services and Scheduling, Internal and External Interrupts	07
IV	Scheduling Mechanisms for Real-Time systems : Commonly Used Approaches to Real-Time Scheduling, Periodic, Aperiodic And Sporadic Jobs Scheduling, Priority-Driven Scheduling, Fixed-Priority Scheduling, Preemptive and non-Preemptive scheduling, Clock Driven Scheduling, EDF Scheduling.	07
V	RTOS Case Studies : Real Time UNIX, POSIX, RTLinux, VxWorks	04

Text Books	1.	Real-Time Systems : Jane W.S. Liu, Pearson Education
	2.	Real-Time Systems: Theory and Practice by <i>Mall</i> , Rajib, Pearson Education India
	3.	Real Time Systems : C.M. Krishna & Kang G. Shin, McGraw-Hill
E--Books	1.	Real-time Operating Systems: Book 1 - The Theory, by Jim Cooling (Kindle Edition)
	2.	VxWorks – Redefining the Role of the <i>RTOS</i>
Reference Books	1.	Simple Real-time Operating System: A Kernel Inside View for a Beginner, Chowdary Venkateswara Penumuchu, Wonder Book
	2.	The POSIX.1 standard: a programmer's guide, Fred Zlotnick, Benjamin-Cummings Publishing Co., Inc. United States
	3.	Tornado and Vxworks, what's not in manual, Christof Wehner, Publisher : Ciando
on line TL Material	1.	FreeRTOS Documentation https://www.freertos.org/Documentation/RTOS_book.html
	2.	NPTEL : Real Time Systems by Prof. Rajib Mall, Professor, IIT Kharagpur
	3.	Mastering the FreeRTOS™ Real Time Kernel : A Hands-On Tutorial Guide Richard Barry



Experiment Number	Title of the Experiments	COs	Duration
Experiment No. 1	Study of RTOS Simulator	5	2 Hrs
Experiment No. 2	Study of RTLinux Features	5	2 Hrs
Experiment No. 3	Study of VxWorks Features	5	2 Hrs
Experiment No. 4	Implementation of Task Creation	1	2 Hrs
Experiment No. 5	Implementation of Priority-Driven Scheduling	2,3,4	2 Hrs
Experiment No. 6	Implementation of Fixed-Priority Scheduling	2,3,4	2 Hrs
Experiment No. 7	Implementation of Preemptive scheduling	2,3,4	2 Hrs
Experiment No. 8	Implementation of non-Preemptive scheduling	2,3,4	2 Hrs
Experiment No. 9	Implementation of Clock Driven Scheduling	2,3,4	2 Hrs
Experiment No. 10	Implementation of EDF Scheduling	2,3,4	2 Hrs



Course Title: DIGITAL SIGNAL PROCESSING										
Semester	VI	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	Even	3	-	2	4	TAE	CAE	ESE	INT	EXT
Course Category	Core	3	-	2	4	10	15	50	25	
Course Code	UECL310, UECP310									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	To study different types of signals and systems
	To understand transformation tools for analysis of signals & systems
	To learn design of various digital filters and use of DSP processor for real time applications
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand fundamentals and applications of discrete-time signals and systems
	CO2: Apply Z transform to discrete-time signals and systems
	CO3: Apply Fourier transform to discrete-time signals and systems
	CO4: Design digital filters for discrete time signals for applications
	CO5: Understand architecture and functioning of DSP processor for real time applications

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1	3	3	3	2	2						1	1	3	1	1
CO2	3	3	3	2	2						1	1	3	1	1
CO3	3	3	3	2	2						1	1	3	1	1
CO4	3	3	3	2	2						1	1	3	1	1
CO5	3	3	3	2	2						1	1	3	1	1



Course Contents:

Unit	Contents	Hours
I	Introduction: Introduction to discrete signals & Systems, Operations on Discrete signals, Z- Transform representation, ROC, Z-transform properties, Inverse Z-Transforms Methods, applications of Z- Transform & Inverse Z-Transforms.	8
II	Transform Analysis of LTI Systems: Frequency analysis of discrete time signals, Discrete Time Fourier Transform and Discrete Fourier Transform, Properties, Inverse Discrete Fourier Transform, Efficient Computation of DFT using FFT algorithms, Linear Filtering approach to computation of DFT, FFT of long sequences using overlap add and overlap save method.	8
III	Digital Systems Structures: Structures for FIR Systems and IIR Systems, representation of Structures using Block diagram & Signal Flow Graph	8
IV	Digital Filters: Design of IIR filters from analog filters using Impulse Invariant Method, Bilinear Transformation, Matched Z-Transformation, Butterworth Approximation, Chebyshev, FIR filters design Methods- Windowing, Hamming & Kaiser.	8
V	DSP Processor & Applications: Desirable Features of DSP Processors, Types of Architectures of DSP processor, Multirate signal processing, Adaptive filtering, Case study, Advanced topics based on course.	8

Text Books	1.	Digital Signal Processing, Principles, Algorithms, and Applications, J. G. Proakis and D. G. Manolakis, Prentice Hall, 2006,4th
	2.	Theory and Applications of Digital Signal Processing. R. Rabiner, and B., Gold, Prentice Hall,2000,3rd
E--Books	1.	http://electronicsforu.com/resources/cool-stuff-misc/8-free-ebooks-digital-signal-processing
	2.	http://www.freebookcentre.net/Electronics/DSP-Books-Download.html
Reference Books	1.	Digital Signal Processing, A. V. Oppenheim and R. W. Schaffer, Prentice Hall,1998
	2.	Understanding of Digital Signal Processing, Richards Lyons , Pearson, 2011, 3rd Edition
	3.	Digital Filters: Analysis Design and Application, A. Antonion, Prentice Hall,1999,
	4.	Digital Signal Processing, A Computer based approach, S. K. Mitra, Mc Graw Hill, 4 th edition
On line TL Material	1.	https://nptel.ac.in/courses/117102060/
	2.	https://freevideolectures.com/course/2499/elec3104-digital-signal-processing http://eemedia.ee.unsw.edu.au/ELEC3104/index.htm https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/study-materials/



Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Write a MATLAB program to generate standard discrete time signals & plot them
2	Write a MATLAB code to verify Sampling theorem.
3	Write a MATLAB program to compute frequency response of first order system $h(n)=0.8^n u(n)$
4	Write a MATLAB program to calculate Circular convolution of two sequences using DFT and IDFT
5	Write a MATLAB Program to perform Z Transform of $X(Z)=1 + Z^{-1} + 2 Z^{-2} / 1 - 0.25 Z^{-2}$ using partial fraction expansion method
6	Write a MATLAB program to find N point Fast Fourier Transform (FFT) & Inverse Fast Fourier Transform (IFFT)
7	Write a MATLAB program to design Butterworth and Chebyshev Low pass and high pass filter
8	To Study DSP processor architecture and perform Echo generation using DSK6713 Processor
Open Ended Experiments / New Experiments	
1	To Study Code Composer Studio (CCS) and verify Linear convolution using CCS
2	Write a MATLAB program to verify Power Spectral Density of various mathematical signals
Details of on line Laboratory Resource Material Instruction / Operating Manuals	
1.	https://www.iitk.ac.in/new/digital-signal-processing-laboratory
2.	http://vlabs.iitkgp.ac.in/dsp/
3.	http://users.ece.utexas.edu/~bevans/courses/realtime/lectures/laboratory/c6748winDSK/index.html



Course Title: Universal Human Values 2 : Understanding Harmony										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TA E	CAE	ESE	INT	EXT
Course Category	H	3	--	--	3	10	15	50	--	--
Course Code	UHUL304									
Teaching Mode	Offline	3 Hrs			Total	75			--	
Duration of ESE	2 Hrs					75				

Course Objectives	1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence
	2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
	3. Strengthening of self-reflection and development of commitment and courage to act.
Course Outcomes	1. Students are expected to become more aware of themselves.
	2. Students are expected to become more aware of their surroundings (family, society, nature).
	3. Students should become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
	4. Students would have better critical ability, they would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
	5. Students would be able to apply what they have learnt to their own self in different day-to-day settings in real life.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	P O2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1						2		3	1			2			
CO2			3			2		2		2		2			
CO3			3			3	3	2							
CO4			2			2	2	2							
CO5			1			1	1	2				3			



Course Contents:

Unit	Contents	Hours
I	<p>Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, Self-Exploration, Continuous Happiness and Prosperity, Right understanding relationship and physical facility, Understanding happiness and prosperity correctly, Method to fulfil the above human aspirations.</p>	8
II	<p>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', Understanding the Body as an instrument of 'I', Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body.</p>	8
III	<p>Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding values in human-human relationship, Understanding the meaning of Trust, Understanding the meaning of Respect, Understanding the harmony in the society, Visualizing a universal harmonious order in society</p>	8
IV	<p>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, Understanding Existence as Co-existence, Holistic perception of harmony</p>	8
V	<p>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, Strategy for transition from the present state to Universal Human Order: a) At the level of individual, b) At the level of society.</p>	8



Text Books	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)
	4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
	5.	Small is Beautiful - E. F Schumacher.
	6.	Slow is Beautiful - Cecile Andrews
	7.	Economy of Permanence - J C Kumarappa
	8.	Bharat Mein Angreji Raj - Pandit Sunderlal
	9.	Rediscovering India - by Dharampal
	10.	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
	11.	India Wins Freedom - Maulana Abdul Kalam Azad
	12.	Vivekananda - Romain Rolland (English)
	13.	Gandhi - Romain Rolland (English)



Course Title: Employability Skills										
Semester	VI	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	EVEN					TAE	CAE	ESE	INT	EXT
Course Category	A	--	--	2	1				25	--
Course Code	UHUP302									
Teaching Mode	Offline	2Hrs			Total	--			25	
Duration of ESE	--					25				

Course Objectives	1. To introduce them with the current market scenarios
	2. To equip the students with the essential skills for employability
	3. To demonstrate self-sufficiency to be highly employable or venture their start-ups
Course Outcomes	CO1: Students shall exhibit their ability to set clear and realistic professional objective
	CO2: Enabling them to make well informed choices and commercially equipped
	CO3: Master Verbal (LSRW) and non-verbal communication skills required in the process of recruitment
	CO4: Students shall exhibit improved Interpersonal skills for better professional conduct
	CO5: Students shall exercise higher order thinking skills, creativity skills, convincing and Negotiation skills

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1															
CO2															
CO3															
CO4															
CO5															

Course Contents:

Unit	Contents	Hours
I	Orientation - Researching Job and Company- Emerging Market Trends: Experience sharing of Major Campus interviews, Skill Requirements, Current Market trends, Researching the Job and company	
II	Personal and company commercial: Guidelines for preparing a 30- 90 second self-Introduction. Questions to think about in developing a commercial Understand " What to avoid" in a commercial	



	<p>Self-Selling Proficiency: What to say and do, How to demonstrate commercial awareness in an interview ,Post Interview activity, Telephone etiquette in a phone Interview</p> <p>Resume Building : Guidelines on framing resume and cover letter Checklist to ensure completeness , Sample resumes and cover letter references Basic Guidelines on Video Resume an its difference with conventional</p>	
III	<p>Verbal and Non-Verbal Communication: Format of Business Correspondence, Email and Letter writing etiquette, Hands on training on email and letter writing with case study, Body Language in an Interview- Dos' and Donts', Tips and techniques on Essay Writing How to knot the crux on Essay writing Practice on some common essay writing topics in an interview</p> <p>Voice Versant Neutralization : Voice Modulation, Pitch and tone training and Accent Neutralization</p>	
IV	<p>Personal Interview- Group Discussion: Preparation tips on GD and Extempore: Dos' and Donts', Presentation on PI Preparation and FAQs - Role Plays/ Mock Interview with Technical Faculty and Mock Interview by Faculty</p> <p>Assessment and feedback series:</p>	

Text Books	1.	Employability Book – Global Education Ltd(Under Review)
Reference Books	1.	Employability Skills by NIMI Chennai, First Edition Aug 2019
	2.	What employers wants by Karen Holmes, March 2017 Edition
E-Learning	1.	Udemy , Coursera, Alison, Edx, WPA Apprentice, Hubspot, Codecademy



Course Contents:

Unit	Contents	Hours
I	Orientation to Aptitude: Orientation on syllabus, Emerging aptitude requirement, Pre-assessment on existing knowledge	
II	Quantitative Aptitude: Number System, Problem on Numbers, Ratio and Proportion, Averages, Percentage, Profit/ Loss and Discount, Simple Interest and Compound Interest, Partnership, Mixtures and Alligations, Speed, Time & Distance, Time & Work, Boats and Stream, Pipes and Cistern, Permutation & Combination, Probability, Progression, Mensuration	
III	Logical Reasoning: Blood Relation, Direction, Analogy, Puzzles, Seating Arrangement, Syllogism, Clocks, Calendar, Cubes & Dices, Coding and Decoding, Spatial and 2-D Ability, Data Sufficiency, Number Series	
IV	Data Interpretation: Table chart, pie chart, bar graph and line graph, problems based on the various data , such as combination of gender, city, profession, salary, sports, vehicle, problems based on Pie chart, degree of fraction occupied by the commodity, line chart and bar chart	

Text Books	1.	Book on Aptitude and Verbal Ability- Global Education Ltd(Under Review)
Reference Books	1.	Quantitative Aptitude- R S Aggarwal - 2017 Edition- S. Chand
	2.	Campus Recruitment- Paxis Group
E-Learning	1.	Wifi study,indiabix.com,freshers world, sawal.com,unacademy



Course Title: Data Preprocessing										
Semester	III	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	ODD					TAE	CAE	ESE	INT	EXT
Course Category	C	--	--	4 Hrs.	2	-	-	-	25	
Course Code	UAIP_203									
Teaching Mode	Online	4 Hrs			Total	--			25	
Duration of ESE	--					25				

Course Objectives	1. To learn the applicability of the techniques in data pre-processing
	2. To understand the necessity of data pre-processing
	3. To relate the pre-processing techniques to real-world applications.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand data using Statistical tools and techniques
	CO2: Apply appropriate techniques for Data Cleaning
	CO3: Apply Feature Scaling , Data Labeling techniques
	CO4: Visualize data through graph plots
	CO5: Apply the data pre-processing techniques on real world datasets.

Mapping of Course Outcomes with Program Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Introduction , Definitions, need of data preprocessing , understanding data preprocessing	4
II	Step and type of Data preprocessing , missing , noise data, data integration , data transformation	4
III	Data Reductions , Dimensionality Reduction, Clustering, data Sampling, Data Discretization	6



IV	Categorical Data, Feature Scaling, Encoding categorical features, Normalization and its type, Binarization, Data Labeling, Data Feature Selection, Principal Component Analysis (PCA), Correlation Matrix with Heatmap	8
----	--	---

Sr. No.	Name of Experiments
1	Implementation of Basic Python Libraries
2	Find out missing data in dataset
3	Perform the Categorization of dataset
4	Execute feature scaling on given dataset
5	Implement normalization on dataset
6	Perform proper data labeling operation on dataset
7	Implement principal component analysis algorithm
8	Perform Encoding categorical features on given dataset
Open Ended Experiments / New Experiments	
1	Apply the appropriate Binarization methods on given dataset
2	Perform the Standardization operation on dataset

***Note- Atleast 2 practicals should be performed over large datasets (big data).**

Text Books	1.	Gerardus Blokdyk , Data pre-processing The Ultimate Step-By-Step Guide,
	2.	M. Shron, O'Reilly, Thinking with Data: How to Turn Information into Insights, Publisher: O'Reilly Media, 2014
	3.	T. Fawcett and F. Provost, Data Science for Business: What you Need to Know about Data Mining and Data Analytic Thinking, Publisher: O'Reilly Media, 2013
E-Books	1.	Salvador García, Julián Luengo, Francisco Herrera, Data Preprocessing in Data Mining, Volume 72, Springer http://users.ece.utexas.edu/~ethomaz/courses/dm/papers/data-preprocessing-book.pdf
	2.	Winter School on "Data Mining Techniques and Tools for Knowledge Discovery in Agricultural Datasets" http://apps.iasri.res.in/ebook/win_school_aa/notes/Data_Preprocessing.pdf
Reference Books	1.	Ralph Kimball, Margy Ross, The Data Warehouse Toolkit, 3rd edition, Publisher: Wiley, 2013
	2.	J. Han, M. Kamber and J. Pei, Morgan Kaufmann, Data Mining, Concepts and Techniques, Publisher: Elsevier, 2006
	3.	Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence and Analytics: Systems for Decision Support, Publisher: Pearson/Prentice Hall, 2014
On line TL Material	1.	http://www.prolearninghub.com/courses/data-warehouse-concepts-design-data-integration/



Course Title: Mobile Application Development										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	03	-	02	04	10	15	50	25	-
Course Code	UITL303/ UITP303									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	Understand basic concepts of mobile application development
	Understand the architecture of mobile applications
	Understand basic programming concepts of block programming
	Develop skills to build real life mobile applications.
	Explore carrier opportunities as mobile application developer.
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Develop the mobile application by using major components of API sets
	CO2: Identify and implement the exact method for development of mobile applications
	CO3: Develop UI-rich apps using all the major UI components
	CO4: Design and develop useful mobile applications with underlying database supports
	CO5: Package and prepare applications for distribution on the Play Store

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	-	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	2	3	-	-	-	-	-	-	-	3	-	-	2	-
CO3	-	2	3	-	-	-	-	-	-	-	3	-	-	3	-
CO4	-	2	3	-	-	-	-	-	-	-	3	-	-	2	-
CO5	-	2	3	-	-	-	-	-	-	-	3	-	-	3	-

Course Contents:

Unit	Contents	Hours
I	Basics of Mobile Application Development Introduction, Overview, Environment Setup, Architecture, Application Components, Resources, Activities, Services, Broadcast Receivers. Content Providers, Fragments, Intents/Filters.	5



II	User Interface User Interface, UI Layouts, UI Controls, Event Handling, Styles and Themes, Custom Components, Intents and Broadcast Receivers, Notification and Toast, Menus, Dialogs, UI Animations	5
III	Mobile Application Basic Services Phone Calls, Sending SMS, Sending Email, Drag and Drop, Notifications, Location Based Services, Android Security Package , Publishing Android Application.	5
IV	Working with Storage, Database File handling, working with database: Creation, Insertion, Updating and Retrieving the data. The Local Storage Object, Creating a Table and Storing Data in SQLite & Firebase	5
V	Working with Multimedia Services, Hardware and Sensors, Testing & Advanced Topics: Playing Audio and Video Content, Controlling Play Back of Media, Adjust Volume of Media, Media Position and Duration, Device Info Plugin, Device Orientation Plugin, Network Information Plugin, Battery Status Plugin. Working with Sensors: Motion Sensors, Environmental sensors, Position sensors. Package and prepare applications for distribution on the Play Store. App Testing using virtual device forms, PWA development, Google Maps, SWIFT framework	5

Text Books	1.	Lee, Wei-Ming. Beginning android 4 application Development. John Wiley & Sons, 2012.
	2.	Mednieks, Zigurd R., et al. Programming android. " O'Reilly Media, Inc.", 2012.
	3.	Horton, John. Android Programming for Beginners. Packt Publishing Ltd, 2015.
E--Books	1.	Wolber, David, et al. App Inventor. " O'Reilly Media, Inc.", 2011.
	2.	Walter, Derek, and Mark Sherman. Learning MIT app inventor: A hands-on guide to building your own android apps. Pearson Education, 2014.
Reference Books	1.	Meier, Reto. Professional Android 4 application development. John Wiley & Sons, 2012.
	2.	Steele, James, and Nelson To. The Android developer's cookbook: building applications with the Android SDK. Pearson Education, 2010.
	3.	Darwin, Ian F. Android Cookbook: Problems and Solutions for Android Developers. " O'Reilly Media, Inc.", 2017.
on line TL Material	1.	https://appinventor.mit.edu/explore/ai2/tutorials
	2.	https://www.coursera.org/learn/app-inventor-android
	3.	https://www.udemy.com/course/complete-android-app-development-course-without-coding/



List of Practical

Sr. No.	Name of Experiment
1.	Creating a New Project, Testing a Project in the Browser
2.	Creating a Multipage UI & Collapsible Content Blocks
3.	Storing Data, Updating and Retrieving Data in offline/online database
4.	Working with multimedia contents
5.	Working with plugins
6.	Working with sensors and hardware
7.	Open Ended: Package and prepare applications for distribution on the Play Store
8.	Open Ended: Running AdSense ads on apps



Course Title: Information Security & Cryptography										
Semester	VI	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3Hrs.	--	2Hrs.	4 Credits	10	15	50	25	-
Course Code	UITL304/ UITP304									
Teaching Mode	Offline	5 Hrs			Total	75 Marks			25 Marks	
Duration of ESE	2 Hrs					100 Marks				

Course Objective:

To understand the fundamentals of Information Security

To understand the importance of cryptography while sharing information over network

To understand the vulnerability, risk & threat in security

To learn types of assessments of information security

To understand windows & OS security

Course Outcome: Up on successful completion of this course, student will be able to:

CO1: To map the concepts of information security in real time data transfer.

CO2: Apply and learn how to use encryption. Identify and use appropriate protection measures against malicious code

CO3: Apply the modern principles to identify the vulnerability & risk analysis

CO4: To do the assessment of information security

CO5: Demonstrate Windows and OS security

CO-PO Mapping

CO	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1:	-	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO2:	-	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3:	-	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4:	-	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5:	-	2	3	-	-	-	-	-	-	-	-	-	2	-	-



Syllabus:

Unit	Contents	Hours
I	What is Information Security & Why do you need it? – Basics Principles of Confidentiality, Integrity Availability Concepts Policies, procedures, Guidelines, Standards Administrative Measures and Technical Measures, People, Process, Technology Current Trends in information Security, Cloud Computing: benefits and Issues related to info Sec. Standards available for InfoSec: Cobit, Cadbury, ISO 27001, OWASP, OSSTMM, etc - An Overview, Certifiable Standards: How, What, When, Who	8
II	Introduction to Cryptography: The physical world security services that we need to replicate in cyberspace. The core information security services and tools provided by cryptography. Core cryptographic concepts and introduces two different types of cryptography, Potential points of weakness in any system using cryptography. Real world applications of cryptography, cryptography presenting society with a dilemma.	8
III	Vulnerability, Threat and Risk, Risk Assessment and Mitigation + Quick fixes, Introduction to BCP / DRP / Incident management, Segregation and Separation of Duties & Roles and responsibilities, IT ACT 2000	8
IV	Types of assessments for Information Security 1. VAPT of Networks 2. Web Appln Audits 3. IT assessments or audits 4. Assessment of Network Equipments 5. Assessment of Security Devices (Web Filtering, Firewalls, IDS / IPS, Routers 6. Data Center Assessment 7. Security of Application Software 8. SAP Security 9. Desktop Security 10. RDBMS Security 11. BCP / DRP assessments 12. Policy reviews NPTEL http://nptel.ac.in Computer Science and Engineering Coordinators: Prof. V. Kamakoti Associate Professor Department of Computer Science & Engineering IIT Madras Network Security & Common and Popular Tools Used	8
V	Windows and Linux security, Types of Audits in Windows Environment: Server Security, Active Directory (Group Policy), Anti-Virus, Mails, Malware, End point protection, Shadow Passwords, SUDO users, etc . Web Application Security: OWASP, Common Issues in Web Apps, What is XSS, SQL injection, CSRF, Password Vulnerabilities, SSL, CAPTCHA, Session Hijacking, Local and Remote File Inclusion, Audit Trails, Web Server Issues, etc, introduction to web security	8

Text Books	1.	Cryptography and networks security principles & practice 2/c by William Stallings (Pearson Education prentice Hall).
	2.	Computer Security: Principles and Practice by William Stallings; Lawrie Brown
E--Books	1.	Cryptography & network security by Atul Kahate https://www.pdfdrive.com/cryptography-network-security-by-atul-kahate-e124796757.html
Reference Books	1.	Cryptography in C and C++ by Michael Welschenbach (A press IDG Books India).



	2.	Introduction to Computer Security, 2004 Matt Bishop , Addison-Wesley, ISBN 0-321-24744
online TL Material	1.	NPTEL course: https://nptel.ac.in/courses/106/106/106106129/
	2.	Courseera: https://www.coursera.org/learn/information-security-data#about

List of Practical's:

Pr. No.	Title of Practical
1.	Implementation of packet capturing from unsecure websites using following tools Ethereal & Wireshark
2.	Implement the necessary security constraints to build a secure website
3.	Implement file & email encryption using PGP
4.	Create a Trojan to get backdoor access of target system & perform the functions remotely.
5.	Learn & implement Email spoofing
6.	Implement intrusion detection system using SNORT
7.	Basic computer information security techniques
8.	Explore the hardware tools used in security
9.	Implement LSB technique to hide& retrieve information in images
10.	Explore open source cryptographic tools



Course Title: Digital Image Processing										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL420 UECP420									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	To treat the 2-D systems as an extension of the 1-D systems and discuss the techniques for the 2-D systems.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: understand the need for image transforms different types of image transforms and their properties
	CO-2: learn different techniques employed for the enhancement of images.
	CO-3: To understand the Image segmentation and morphological image processing & techniques
	CO-4: To understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
CO-5: To understand the various image transform and object recognition technique	

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1	3	3	3	2	2						1	1	3	1	1
CO2	3	3	3	2	2						1	1	3	1	1
CO3	3	3	3	2	2						1	1	3	1	1
CO4	3	3	3	2	2						1	1	3	1	1
CO5	3	3	3	2	2						1	1	3	1	1



Course Contents:

Unit	Contents	Hours
I	Introduction and Digital Image Fundamentals: Digital Image Fundamentals, Human Visual System, Image as a 2-Dimensional (2D) Data, Image Representation Gray Scale and Color Images, Image Acquisition and Camera Model , Image Sampling and Quantization. Image Enhancement in Spatial Domain: Basic Grey Level Transformations, Histogram Processing Techniques, Spatial Filtering, Low Pass Filtering, High Pass Filtering	9
II	Filtering In the Frequency Domain: Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering Image Restoration and Reconstruction: Noise Models, Noise Reduction, Inverse Filtering, MMSE (Wiener) Filtering	9
III	Image Segmentation: Point, Line and Edge Detection, Thresholding, Regions Based Segmentation, Edge Linking and Boundary Detection, Hough Transform Object Recognition and Case Studies Morphological Image Processing: Erosion, Dilation, Opening, Closing, Basic Morphological Algorithms: Hole Filling, Connected Components, Thinning, Skeletons	9
IV	Color Image Processing: Color Fundamentals, Color Models, Pseudo Color Image Processing Image Compression: Fundamentals of Redundancies, Basic Compression Methods: Huffman Coding, Arithmetic Coding, LZW Coding, JPEG Compression Standard	7
V	Image Transformations: 2D-DFT, DCT, DST, Hadamard, Walsh, Hotelling transformation, 2D-Wavelet transformation, Wavelet packets. Object Recognition- Features, Patterns and Pattern Classes, Recognition Based on Decision – Theoretic Methods, Structural Methods, Application based on AI and CNN	6

Text Books	1.	<i>A.K.Jain, " Fundamentals of Digital Image Processing", PHI,1995</i>
	2.	<i>R. C.Gonzalez, R.E.Woods, " Digital Image processing", Pearson edition, Inc3/e,2008</i>
Reference Books	1.	<i>J.C. Russ, " The Image Processing Handbook", (5/e), CRC, 2006</i>
	2.	<i>R.C.Gonzalez & R.E. Woods; "Digital Image Processing with MATLAB", Prentice Hall, 2003</i>



Course Title: Big Data Computing (Elective-I)										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3Hrs.	--	2Hrs.	4 Credits	10	15	50	25	-
Course Code	UITL305/ UITP305									
Teaching Mode	Offline	5 Hrs per Week			Total	75 Marks			25 Marks	
Duration of ESE	2 Hrs					100 Marks				

Course Objective:

1. Introduction of basic concepts and techniques of Big data.
2. To Learn Hadoop Distributed File System (HDFS) & its applications
3. Understand MapReduce and its qualities and retain advanced MapReduce thoughts.
4. Understand Different Big Data tools and Framework.
5. Make aware of Pig, HIVE and Spark tools.

Course Outcome: Upon successful completion of the course, students

- CO1: Acquire basic concepts and techniques of Hadoop and Big data computing.
- CO2: Develop skills for implementation of various Hadoop ecosystem component
- CO3: Shall able to apply ecosystem knowledge to real time problems of moderate complexity
- CO4: Implement and Design different Big Data framework.
- CO5: Implementing data science and big data analysis in various applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

CO	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1:		2	3	-	3	-	-	-	-	-	-	-	-	2	2
CO2:		2	3	-	3	-	-	-	-	-	-	-	-	3	2
CO3:		3	3	-	3	-	-	-	-	-	-	-		2	3
CO4:		3	3	-	3	-	-	-	-	-	-	-		3	3
CO5:		3	3	-	3	-	-	-	-	-	-	-	-	3	2



Syllabus:

UNIT	DETAILS	HRS
I	Unit I: Big data and Hadoop Introduction to Hadoop and Big Data, Big data, challenges for processing big data, technologies support big data, History of Hadoop, Use cases of Hadoop, RDBMS vs Hadoop When to use and when not to use Hadoop.	10
II	Unit II: HDFS Hadoop Distributed File System, Significance of HDFS in Hadoop, Features of HDFS, Data Storage in HDFS: Introduction about Blocks, Data replication. Accessing HDFS: CLI (Command Line Interface) and admin commands, Java Based Approach, Fault tolerance. Download Hadoop, Installation and set-up of Hadoop., Start-up & Shut down process	10
III	Unit III: Map Reduce Map Reduce: Map Reduce Story, Map Reduce Architecture, How Map Reduce works, Developing Map Reduce, Map Reduce Programming Model, Different phases of Map Reduce Algorithm, Different Data types in Map Reduce	9
IV	Unit IV: Pig And HIVE Introduction to Apache Pig, Map Reduce Vs. Apache Pig, Modes of Execution in Pig, Loading data, Exploring Pig Latin commands, HIVE: Hive introduction, Hive architecture, Data types and schemas, Partitions and buckets, Concept of HBASE.	8
V	Unit V: Spark Spark Shell, Spark Application, Flume, SQOOP introduction and application.	9

Text Books	1.	Tom White, "Hadoop: The Definitive Guide", 3rd edition, O'Reilly Media.
	2.	Big Data (Black Book), Wiley
E--Books	1.	Big Data Now current perspective from O'Reilly Media
	2.	Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer
Reference Books	1.	V. Ankam, Big Data Analytics, Packt Pub Ltd.
	2.	N. Dasgupta, Practical Big Data Analytics, Packt Pub Ltd.
online TL Material	1.	https://www.udemy.com/big-data-hadoop-the-complete-course/
	2.	https://www.cloudera.com/more/training/certification.html
	3.	https://www.edureka.co/big-data-and-hadoop https://www.simplilearn.com/big-data-and-analytics/big-data-and-hadoop-training



Experiment Number	Title of the Experiments	COs	Duration
Experiment No. 1	To install Hadoop framework, configure it and setup a single node cluster. Use web based tools to monitor your Hadoop setup	CO1	2 Hrs
Experiment No. 2	To implement file management tasks in Hadoop HDFS like adding, retrieving and deleting files	CO1	2 Hrs
Experiment No. 3	To implement a word count application using the MapReduce API.	CO2	2 Hrs
Experiment No. 4	Creating the HDFS tables and loading them in Hive	CO2	2 Hrs
Experiment No. 5	To create HDFS tables and load them in Hive and implement joining of tables in Hive.	CO3	2 Hrs
Experiment No. 6	To install, deploy & configure Apache Spark Cluster. To Select the fields from the dataset using Spark SQL. To explore Spark shell and read from HDFS	CO3	2 Hrs
Experiment No. 7	To install and run Pig and then write Pig Latin scripts to sort, group, join, project, and filter your data	CO4	2 Hrs
Experiment No. 8	To perform Graph analytics and visualization using Tableau.	CO4	2 Hrs
Experiment No. 9	To implement basic functions and commands in R Programming. better visualization than a data table	CO5	2 Hrs
Experiment No. 10	To use following platforms for solving any big data analytic problem of your choice. (1) Amazon web services,(2) Microsoft Azure, (3)Google App engine	CO6	2 Hrs



Course Title: Artificial Neural Networks										
Semester	VI	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs	-	-	3	10	15	50	-	-
Course Code	UAIL317									
Teaching Mode	Offline/ Online	3 Hrs			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	1. Provide a sound and comprehensive understanding of artificial neural networks
	2. Solve practical problems via implementation of these techniques via simulation;
	3. Promote further independent learning on the topics of artificial neural networks and machine learning;
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the basics of Artificial Neural Networks
	CO2: Identify different neural network architectures, algorithms, applications and their limitations
	CO3: Understand appropriate learning paradigms and its applications rules for each of the architectures and learn several neural network
	CO4: Develop different single layer/multiple layer Perception learning algorithms
CO5: Reveal different applications of these models to solve engineering and other problems.	

Mapping of Course Outcomes with Program Outcomes:

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



Course Contents:

Unit	Contents	Hours
I	Introduction to Artificial Neural Networks, Artificial Neuron Model and Linear Regression, Gradient Descent Algorithm, Nonlinear Activation Units and Learning Mechanisms, Learning Mechanisms-Hebbian,Competitive,Boltzmann	6
II	Associative Memory Model, Condition for Perfect Recall in Associative Memory, Statistical Aspects of Learning, V.C. Dimensions: Typical Examples Importance of V.C. Dimensions Structural Risk Minimization	6
III	Single-Layer Perceptions, Unconstrained Optimization: Gauss-Newton's Method, Linear Least Squares Filters, Least Mean Squares Algorithm, Perceptron Convergence Theorem, Bayes Classifier & Perceptron: An Analogy, Bayes Classifier for Gaussian Distribution, Back Propagation Algorithm	8
IV	Solution of Non-Linearly Separable Problems Using MLP, Heuristics For Back-Propagation, Multi-Class Classification Using Multi-layered Perceptrons, Radial Basis Function Networks: Cover's Theorem, Regularization Networks and Generalized RBF Comparison Between MLP and RBF, Learning Mechanisms in RBF	8
V	Introduction to Principal Components and Analysis, Dimensionality reduction Using PCA, Hebbian-Based Principal Component Analysis, Introduction to Self Organizing Maps, Cooperative and Adaptive Processes in SOM	8

***Note - TAE should include practical based assignment on Artificial Neural Networks**

Text Book	1.	Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications By S. Rajasekaran, G. A. Vijayalakshmi Pai. EEE
	2.	Simon O. Haykin, Neural Networks and Learning Machines, Pearson Education https://cours.etsmtl.ca/sys843/REFS/Books/ebook_Haykin09.pdf
E-Books	1.	Kevin Gurney, An Introduction to Artificial Neural Networks, UCL Press Ltd. https://www.inf.ed.ac.uk/teaching/courses/nlu/assets/reading/Gurney_et_al.pdf
	2.	Michael Nielsen, Neural Networks and Deep Learning https://static.latexstudio.net/article/2018/0912/neuralnetworksanddeeplearning.pdf
Reference Books	1.	Deep Learning, by Ian Goodfellow and Yoshua Bengio, The MIT Press, 2016.
	2.	C. Bishop, Neural Networks and Machine Learning, Springer, 1998.
Online Material:	1.	https://nptel.ac.in/courses/117/105/117105084/



Course Title: Soft Computing										
Semester	V	Teaching Scheme				Evaluation Scheme				
		Theory		Practical						
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs	-	-	3	10	15	50	-	-
Course Code	UAIL301									
Teaching Mode	Offline	5			Total	75			-	
Duration of ESE	3 hrs					75				

Course Objectives	1. Understand Soft Computing concepts, technologies, and applications
	2. Understand the underlying principle of soft computing with its usage in various application. .
	3. Understand different soft computing tools to solve real life problems.
Course Outcomes	CO1: Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
	CO2: Solving single-objective optimization problems using GAs.
	CO3: Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs)
	CO4: Implement various Neural Network Architectures for solving complex problems
	CO5: Develop application on different soft computing techniques like Fuzzy, GA and Neural network

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1		2	2	2											
CO2			3	3										3	
CO3			3	3										3	
CO4			3	3											
CO5			3	3	3							3		3	



Course Contents:

Unit	Contents	Hours
I	Introduction to Soft Computing, Introduction to Fuzzy logic, Fuzzy membership functions, Operations on Fuzzy sets, Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences	6
II	Defuzzyfication Techniques-I, Defuzzyfication Techniques-II, Fuzzy logic controller-I, Fuzzy logiccontroller-II	6
III	Solving optimization problems, Concept of GA, GA Operators: Encoding, GA Operators: Selection-I, GA Operators: Selection-II, GA Operators: Crossover-I, GA Operators: Crossover-II, GA Operators: Mutation	6
IV	Introduction to EC-I, Introduction to EC-II, MOEA Approaches: Non-Pareto, MOEA Approaches: Pareto-I, MOEA Approaches: Pareto-II	6
V	Introduction to Artificial Neural Networks, Learning rules and various activation functions, Single layer Perceptrons , Back Propagation networks, Architecture of Backpropagation(BP)Networks, Backpropagation Learning, Introduction to Associative Memory, Adaptive Resonance theory and Self OrganizingMap, Recent Applications.	6

Text Books	1.	R. Rajasekaran and G. A and Vijayalakshmi Pa, <i>Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications</i> , Prentice Hall of India
	2.	D. E. Goldberg, <i>Genetic Algorithms in Search, Optimisation, and Machine Learning</i> , Addison-Wesley
	3.	M Amirthavalli, <i>Fuzzy Logic and Neural Networks</i> , Scitech Publications
E-Books	1.	Timothy J Ross, <i>Fuzzy Logic with Engineering Applications</i> https://www.academia.edu/5333146/Fuzzy_Logic_with_Engineering_Applications_Third_Edition
	2.	Mitchell Melanie, <i>An Introduction to Genetic Algorithms</i> , https://www.boente.eti.br/fuzzy/ebook-fuzzy-mitchell.pdf
Reference Books	1.	Jacek M. Zurada, <i>Artificial Neural Systems</i> , PWS Publishing, Boston, 1992 (ISBN 0-314-93391-3)
	2.	“Fuzzy Logic with Engineering Applications” by Timothy J Ross
	3.	<i>Evolutionary Computation: A Unified Approach</i> by Kenneth A. DeJong, MIT Press, 2006, ISBN: 0262041944
On line TL Material	1	https://nptel.ac.in/courses/106/105/106105173/



UITL421 / UITP421: Industry-Based Elective Offered in Academic Session 2022-23 (Even Semester-6th Semester) as Elective-I

Course Title: Advanced UI Development using Trello Project Management Tool										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	--	2	4	10	15	50	25	--
Course Code	UITL421/ UITP421									
Teaching Mode	Offline	5 Hrs			Total	75 Marks			25 Marks	
Duration of ESE	2 Hrs					100 Marks				

Course Objectives	1. To study HTML5 Tags for Web user interface designing.
	2. To Study design of Web User Interface using Bootstrap 5
	3. To study Agile Methodology.
	4. To Study Trello Projects management tools.
	5. To have an knowledge of IT industry Working Culture.
Course Outcomes	CO1: Apply the knowledge of HTML 5 & Bootstrap
	CO2: Design Responsive user Interface
	CO3: Apply different approaches of Trello Projects management tools.
	CO4: Aware about Industry Working Culture with Agile Methodology.
	CO5: Identify and use recent trends in User Interface development

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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



Syllabus:

Unit	Contents	Hours
I	<u>Advance HTML</u> HTML Introduction, HTML Editors, HTML Basic, HTML Layout, HTML Element, HTML Attributes, HTML Heading, HTML Paragraphs, HTML Styles, HTML Formatting, HTML Quotations, HTML Comments, HTML Colors (RGB:-rgb (red, green, blue), HEX:- hex (red, green blue), HSL:- hsl(hue, saturation, lightness)), HTML CSS(Inline, internal, External), HTML Classes, HTML ID, HTML Link(link Colors, Link Bookmarks), HTML Images (Images Map, Background Images, The Picture Element), HTML Tables (Table Borders, Table Sizes, Table Headers, Padding & Spacing, Colspan & Rowspan, Table Styling, Table Colgroup), HTML Lists (Unordered Lists, Ordered Lists, Other Lists), HTML Forms, HTML Footer, HTML Favicon, Project practice	06
II	<u>CSS</u> CSS Introduction, CSS Syntax, CSS Selectors, CSS Backgrounds (Background Color, Background Image, Background Repeat, Background Attachments, Background Shorthand), CSS Borders (Border Width, Border Color, Border Sides, Border Shorthand, Rounded Borders), CSS Margins (Margin Collapse), CSS Padding CSS Height/Width, CSS Box Model CSS Outline (Outline Width, Outline Color, Outline Shorthand, Outline Offset), CSS Text (Text Color, Text Alignment, Text Decoration, Text Transformation, Text Spacing, Text Shadow), CSS Fonts (Font Family, Font Web Safe, Font Fallbacks, Font Style, Font Size, Font Google), Font Pairings, Font Shorthand, CSS Links, CSS Lists, CSS Tables (Table Borders, Table Size, Table Alignment, Table Style, Table Responsive), CSS Float, Css Align, CSS Forms, CSS Icons, CSS Animations, CSS Hover, project practice.	06
III	<u>Bootstrap</u> Get Started, Containers, Grid Basic, Multi Grid, Typography, Colors (Text Colors, Background Colors), Table, Images, Jmboturn, Buttons, Button Groups, Alters, Badges, Progress Bar, Spinners, Pagination, List Group, Card, Dropdowns, Collapse, Navs, Navbar, Forms, Inputs, Carousel, Modal, Tooltip, Popover, Toast, Icons, bootstrap responsive, project practice.	08
IV	<u>Tools/ Configuration</u> Agile Methodology, Trello Projects Management Tool, Bitbucket, VS Code, Scrum Master, Sprint Planning, Development using SDLC, Documentation process, Online DSM Culture.	06
V	<u>Project</u> : Two live projects	06

Online TL Material	1	https://www.w3schools.com/
	2	https://en.wikipedia.org
	3	https://getbootstrap.com/
	4	https://trello.com/
	5	https://code.visualstudio.com/

**List of Experiments:**

Experiment	Title of the Experiments
1	To study What is trello ? Use of trello?
2	To Understand HTML structure and overview html topics. 2.1 Create Page in HTML. Sample Page already attached. 2.2 Create Page in HTML. Sample Page already attached.
3	Create Grid Structure Design
4	Overview and Implement Bootstrap topics
5	Create 2 simple form design
6	Pizzahut Sides Page Design on click Deals menu under footer section
7	Domino's Home Page Design
8	Create Burger King Page Design
9	Create Mina e-Commerce Page Design
10	Create sample responsive block design
11	Create Burger King Page Design
12	Design the Mina e-Commerce Page and make it responsive
13	Design dribbble learn page and make it responsive



Pool of Elective Courses:

VI Semester.....Elective-I

VII Semester.....Elective-II To Elective-VI

Elective	Language & Software Development	Course Code	Networks and Security	Course Code	Signal Processing	Course Code	Data Base Management & Analysis	Course Code	Artificial Intelligence & Machine Learning	Course Code	Soft Computing	Course Code
Track	Track-I		Track-II		Track-III		Track-IV		Track -V		Track-IV	
Electives with Laboratory												
Elective-I (Credits :4) (Semester- VI)	Mobile Application Development	UITL303 UITP303	Information Security and Cryptography	UITL 304 UITP 304	Digital Image Processing	UECL 420 UECP 420	Big Data Computing	UITL 305 UITP 305	Artificial Neural Network	UAIL 317 UAIP 317	Soft Computing	UAIL 301 UAIP 301
Elective-II (Credits :4) (Semester-VII)	Scripting Language	UITL401 UITP401	Wireless Adhoc Network	UITL 409 UITP 409	Audio and Speech Signal Processing	UECL 413 UECP 413	Unstructured Database Management System	UITL 418 UITP 418	Deep Learning	UAIL 411 UAIP 411	Cloud Computing	UITL 414 UITP 414
Electives without Laboratory												
Elective-III (Credits :3) (Semester-VII)	Natural Language Processing	UAIL302	Digital Marketing	UCSL 413	Bio-Informatics: Algorithms and Applications	UISL 402	Blockchain Technology	UCSL 412	Brain Machine Interface	UECL 418	Reconfigurable Computing	UISL 410
Elective-IV (Credits :3) (Semester-VII)	Business Intelligence	UAIL210	Digital Forensics	UDIL 418	Digital Video Processing	UITL 410	Distributed Database & Object Oriented Database	UITL 411	Artificial Intelligence and Expert Systems	UAIL 421	Neuromorphic Computing	UISL 405
Elective-V (Credits :3) (Semester-VII)	Embedded System Design and RTOS	UECL303	Wireless Sensor Network	UECL412	Biomedical Imaging	UISL 411	AWS: Cloud Computing Services	UITL 402	Pattern Recognition	UAIL 211	Mobile Computing	UITL 406
Elective-VI (Credits :3) (Semester-VII)	Mobile Game Development	UITL407	DevOps : Software Development & IT Operations	UITL 403	Multirate Signal Processing	UITL 408	Agile Scrum Master	UCSL 428	Virtual & Augmented Reality	UAIL 414	Git: Control System for Tracking Changes	UITL 404



Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
			L	T	P	Total Hrs		Theory			Practical		Total Marks
								TA	EA	EE	SE	IN	
SEMESTER-VII													
UXXLXXX UXXPXXX	Elective-II	EL	3		2	5	4	10	15	50	25		100
UXXLXXX	Elective - III	EL	3			3	3	10	15	50			75
UXXLXXX	Elective - IV	EL	3			3	3	10	15	50			75
UXXLXXX	Elective - V	EL	3			3	3	10	15	50			75
UXXLXXX	Elective - VI	EL	3			3	3	10	15	50			75
UITP412	Project	P			8	8	4				50	50	100
TOTAL			15	10	25	20	20	50	75	250	75	50	500



Course Title: Scripting Language										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective	3	-	2	4	10	15	50	25	-
Course Code	UITL401 UITP401									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				
Course Outcomes	After completing this course, students will be able to									
	CO1: Acquire programming skills in scripting language									
	CO2: Develop web based application using suitable client side and server side web technologies.									
	CO3: Enhance the concept & Develop the Application using Angular JS & Node JS									
	CO4: Design & Develop the Web Based Application using Ruby									
CO5: Implement the web based Application Using Perl										

Mapping of **Course Outcomes** with **Program Outcomes** and **Program Specific Outcomes**:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	-	3	-	-	-	3	1	3	2	3	1	1
CO2	3	2	3	-	3	-	-	-	2	1	2	2	3	3	3
CO3	3	3	2	1	3	-	-	-	1	1	1	2	3	2	2
CO4	3	2	3	2	3	-	-	-	1	1	1	2	3	3	3
CO5	3	1	3		3	-	-	-	1	1	1	2	3	3	3



Course Contents:

Unit	Contents	Hours
I	INTRODUCTION TO PHP Database Language PHP : Starting to script on server side, Arrays, function and forms, advance PHP Databases : Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables.	8
II	Angular JS and Node JS Angular JS : dependency injection, custom directives, Internationalization. Introduction to NodeJS and Struts: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.	8
III	SERVER-SIDE WEB SCRIPTING Rails, PHP, Zope, the JSP expression language; The evils of scriptlets; Scripting and the Semantic Web.	8
IV	Introduction to Ruby Introduction to Ruby, Rails, The structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, cookies, Choice of Webservers, SOAP and webservices, RubyTk – Simple Tk Application, widgets, Binding events, Canvas, scrolling	8
V	Introduction to PERL Introduction to PERL, Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.	8

Text Books	1. Achyut Godbole & Atul Kahate, "Web Technologies: TCP/IP to Internet Application Architectures", McGraw Hill Education publications, ISBN, 007047298X, 9780070472983
	2. Ralph Moseley & M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13 : 9788126538676
	3. The World of Scripting Languages, David Barron, Wiley Publications.
	4. Ruby Programming language by David Flanagan and Yukihiro Matsumoto O'Reilly
Reference Books	1. Robin Nixon, "Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY, ISBN: 13:978-93-5213-015-3
	2. Web Technologies, Black Book, Dreamtech Press Ian Dodson, The Art of Digital Marketing, Wiley Publications.
	3. Open Source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP, J. Lee and B. Ware (Addison Wesley) Pearson Education.



List of Experiments:

1. Develop simple calculator for addition, subtraction, multiplication and division operation using JavaScript(Design & Develop a Web Based Application using Java Script)
2. Design and develop web application using PHP and MySQL as a back-end for Customer data with insert, Display operations.
3. Create an application for Bill Payment Record using AngularJS.
4. Create an application for Result Calculation and display in Proper Format using AngularJS.
5. Implement Node.js web-based application
6. Implement Node.js as a File Server for Read files, Create files, Update files, Delet files, Rename files
7. Count the frequency of base G in a given DNA sequence using perl.(Calculate:
 1. How many hours are in a year.
 2. How many minutes are in a decade?
 3. How many seconds old are you?Using irb in ruby.)
8. Calculate:
 1. How many hours are in a year.
 2. How many minutes are in a decade?
 3. How many seconds old are you?Using irb in ruby. (Count the frequency of base G in a given DNA sequence using perl)



Course Title: Wireless Adhoc Network										
Semester	VII	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	ODD					TAE	CAE	ESE	INT	EXT
Course Category	Elective	3	-	2	4	10	15	50	25	-
Course Code	UITL409 UITP409									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				
Course Outcomes	After completing this course, students will be able to									
	CO1: Describe importance and use of Wireless Ad-hoc Networks									
	CO2: Analysis the Issues involved in MAC Protocol									
	CO3: Recognize importance of localization and routing techniques									
	CO4: Explore the Design Goals & Classification involved in Transport Layer									
CO5: Understand importance of security in Wireless Ad-hoc Networks.										

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	2	2	2	-	2	3	3	3	3	3	2	3
CO2	3	3	3	2	3	2	-	-	3	2	2	2	3	2	2
CO3	3	3	3	2	3	2	-	-	3	2	1	2	3	2	2
CO4	3	2	3	2	3	2	-	-	3	2	1	2	3	2	2
CO5	3	3	3		3	2	-	-	2	2	1	2	3	2	1

Course Contents:

Unit	Contents	Hours
I	Introduction: Ad-hoc Wireless Networks Introduction, definition, characteristics, features, applications, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet, Adhoc Mobility Models- Indoor and outdoor models.	8
II	MAC: MAC Protocols for Ad hoc wireless Networks: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC	8



	protocols, Contention based protocols with reservation mechanisms. Contention-based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols.	
III	Routing: Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.	8
IV	Transport Layer: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks	8
V	Security : Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning, Network security attacks, Key management, Secure routing in Ad hoc wireless Networks.	8

Text Books	1. C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011
Reference Books	1. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
	2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
	3. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

List of Experiments:

1. Installation of NS2 & NS3 in Fedora 19 (32 bit) OS Linux. (Installation of NS2 / NS3)
2. Simulating IEEE 802.11 wireless LAN in Ad-Hoc Mode using NS2(Simulating IEEE 802.11 wireless LAN in Ad-Hoc Mode using NS)
3. Implementation a Bluetooth network in NS3 with application as transfer of a file from one device to another(Implementation a Bluetooth network in NS with application as transfer of a file from one device to another)
4. To implement and compare MAC layer protocols, MACAW, MACA-BI and MACA with piggybacked Reservation using NS-3
5. A car acts as a malicious node and can be analysed for the packet loss before and after malicious activity. Using SUMO and MOVE.
6. Create a simulation for road traffic with 6 junctions. There are various vehicles going on and your own car also. Select a shortest route for your car. Demonstrate with simulation software SUMO and MOVE.
7. Create an Ad-hoc Network using nessi Simulation software and include events incorporate dropped packets, infected flows, compromised machines, unavailable services etc, and check its performance
8. Explore and use security tools like WEP & WPA and evaluate its performance on mobile terminal



Course Contents:

Unit	Contents	Hours
I	Introduction to Business Intelligence BI concept, BI architecture, BI in today's perspective, BI Process, Applications of BI like Financial analysis, statistical analysis, sales analysis, CRM, result pattern and ranking analysis, Balanced Scorecard, BI in Decision Modelling: Optimization, Decision making under uncertainty. Ethics and business intelligence.	7
II	Data Science The concept, process and typical tools in data science. Example of different algorithms i.e segmentation, classification, validation, regressions, recommendations. Exercises using Excel and R to work on histograms, regression, clustering and text analysis. Co-relation between Algorithm and Code in data science	8
III	Data Visualization and Dashboard Design Responsibilities of BI analysts by focusing on creating data visualizations and dashboards. Importance of data visualization, types of basic and composite charts.	8
IV	Performance Dashboard Measuring, Monitoring and management of Business, KPIs and dashboard, the types of dashboards, the common characteristics of Enterprise dashboard, design of enterprise dashboards, and the common pitfalls of dashboard design.	7
V	Modelling and Analysis Exploring Excel Modeling capabilities to solve business problems, summarize and present selected data, introduction to business metrics and KPIs, creating cubes using Microsoft Excel. Future of Business Intelligence-Emerging Technologies.	8

Text Books	1.	Efraim Turban, Ramesh Sharda, Dursun Delen, “Decision Support and Business Intelligence Systems”, 9th Edition, Pearson 201
	2.	David Loshin Morgan, Kaufman, “Business Intelligence: The Savvy Manager’s Guide”, Second Edition, 2012.
E-Books	1.	https://www.tableau.com/learn/articles/business-intelligence-books
Reference Books	1.	Carlo Verzellis, “Business Intelligence: Data Mining and Optimization for Decision Making”, Wiley Publications, 2009.
	2.	Larissa T. Moss, S. Atre, “Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making”, Addison Wesley, 2003
On line TL Material	1.	https://nptel.ac.in/courses/110/107/110107092/

* TAEs may be based on Data Visualization using Tablea

Course Title: Blockchain Technology										
Semester	V	Teaching Scheme				Evaluation Scheme				
		Th	Tu	Pr	Credits	Theory			Practical	
Term	ODD					TAE	CAE	ESE	INT	EXT
Course Category		3	NA	NA	3	10	15	50	NA	NA
Course Code	UCSL412									
Teaching Mode	Offline	3 Hrs				75			NA	
Duration of ESE	2 Hrs					75				

Course Title: Soft Computing										
Semester	V	Teaching Scheme				Evaluation Scheme				
					Theory			Practical		
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs	-	-	3	10	15	50	-	-
Course Code	UAIL301									
Teaching Mode	Offline	5			Total	75			-	
Duration of ESE	3 hrs					75				

Course Objectives	1. Understand Soft Computing concepts, technologies, and applications
	2. Understand the underlying principle of soft computing with its usage in various application. .
	3. Understand different soft computing tools to solve real life problems.
Course Outcomes	CO1: Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
	CO2: Solving single-objective optimization problems using GAs.
	CO3: Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs)
	CO4: Implement various Neural Network Architectures for solving complex problems
	CO5: Develop application on different soft computing techniques like Fuzzy, GA and Neural network

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1		2	2	2											
CO2			3	3										3	
CO3			3	3										3	
CO4			3	3											
CO5			3	3	3							3		3	

Course Contents:

Unit	Contents	Hours
I	Introduction to Soft Computing, Introduction to Fuzzy logic, Fuzzy membership functions, Operations on Fuzzy sets, Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences	6
II	Defuzzification Techniques-I, Defuzzification Techniques-II, Fuzzy logic controller-I, Fuzzy logic controller-II	6
III	Solving optimization problems, Concept of GA, GA Operators: Encoding, GA Operators: Selection-I, GA Operators: Selection-II, GA Operators: Crossover-I, GA Operators: Crossover-II, GA Operators: Mutation	6
IV	Introduction to EC-I, Introduction to EC-II, MOEA Approaches: Non-Pareto, MOEA Approaches: Pareto-I, MOEA Approaches: Pareto-II	6
V	Introduction to Artificial Neural Networks, Learning rules and various activation functions, Single layer Perceptrons, Backpropagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.	6

Text Books	1.	R. Rajasekaran and G. A and Vijayalakshmi Pa, <i>Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications</i> , Prentice Hall of India
	2.	D. E. Goldberg, <i>Genetic Algorithms in Search, Optimisation, and Machine Learning</i> , Addison-Wesley
	3.	M Amirthavalli, <i>Fuzzy Logic and Neural Networks</i> , Scitech Publications
E-Books	1.	Timothy J Ross, <i>Fuzzy Logic with Engineering Applications</i> https://www.academia.edu/5333146/Fuzzy_Logic_with_Engineering_Applications_Third_Edition
	2.	Mitchell Melanie, <i>An Introduction to Genetic Algorithms</i> , https://www.boente.eti.br/fuzzy/ebook-fuzzy-mitchell.pdf
Reference Books	1.	Jacek M. Zurada, <i>Artificial Neural Systems</i> , PWS Publishing, Boston, 1992 (ISBN 0-314-93391-3)
	2.	“Fuzzy Logic with Engineering Applications” by Timothy J Ross
	3.	<i>Evolutionary Computation: A Unified Approach</i> by Kenneth A. DeJong, MIT Press, 2006, ISBN: 0262041944
On line TL Material	1	https://nptel.ac.in/courses/106/105/106105173/

Course Contents:

Unit	Contents	Hours
I	Introduction and Basic: Text Processing, Spelling Correction, Language Modeling, Advanced smoothing for language modeling, POS tagging	8
II	Sequential Models for Tagging – MaxEnt, CRF, Syntax – Constituency Parsing, Dependency Parsing, Distributional Semantics.	6
III	Sentence Framing: Lexical Semantics, Topic Models, Entity Linking.	8
IV	NLP Operations: Information Extraction, Text Summarization, Text Classification.	8
V	NLP Applications: Sentiment Analysis and Opinion Mining	8

Text Books	1.	Speech and Language Processing: An Introduction to Natural Language Processing by Dan Jurafsky and James Martin, 3 rd Edition , Pearson Publication
	2.	Natural Language Processing with Python: Analysing Text with the Natural Language Toolkit by Steven Bird, Ewan Klein, Edward Loper, O'Reilly Publication
	3.	Foundations of Statistical Natural Language Processing, Chris Manning and Hinrich SchütZ, MIT Press, Cambridge
E--Books	1.	Applied Natural Language Processing, by Dr. Ramasesan R, CMI Publication. URL: https://drive.google.com/file/d/1UuSzMRvYnpg6cnnhJZmN6CidUEq_XYcN/view
	2.	Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit URL: https://www.nltk.org/book/
Reference Books	1.	Natural Language Understanding, Second Edition, by Allen James, Lebanon, Indian Publication
	2.	Foundations of Statistical Natural Language Processing, Manning, Christopher and Heinrich, Schutze, MIT Press, 1999
	3.	Statistical Language Learning, Charniack, Eugene, MIT Press
On line TL Material	1.	NPTE: Natural Language Processing URL: https://nptel.ac.in/courses/106/105/106105158/
	2.	NPTEL: Applied Natural Language Processing URL: https://nptel.ac.in/courses/106/106/106106211/
	3.	DataCamp : Natural Language Processing in Python URL: https://www.datacamp.com/tracks/natural-language-processing-in-python

Sr. No.	Name of Experiments / Mini Projects/ Case Studies
1	Program should be based on Natural Language Understanding
2	Program should be based on Natural Language Generation
3	Program should be based on Errors Detection and Corrections
4	Program should be based on Sentence Framing
5	Programs should be based on NLP Operations
6	Program should be based on Part-of-Speech (POS) tagging
7	Program should be based on NLP Applications
8	Program should be based on NLP Applications
9	Program should be based on Text Classification
Open Ended Experiments / New Experiments	
1	Develop NLP Model to find stemming in other than English Language
2	Study and understand the BERT Model
3	Study and understand Google's LaMDA Model
Details of on line Laboratory Resource Material Instruction / Operating Manuals	
1.	N-Grams Smoothing Virtual Lab URL: https://nlp-iiith.vlabs.ac.in/
2.	Summarize a chunk of text to a summary of a user's preference URL: http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/The_Big_Bang_Nerds/labs/exp1/index.html
3.	Online Lab at GitHub URL: https://github.com/virtual-labs/natural-language-processing-iiith

Course Title: Artificial Neural Networks										
Semester	VI	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3 Hrs	-	-	3	10	15	50	-	-
Course Code	UAIL317									
Teaching Mode	Offline/ Online	3 Hrs			Total	75			--	
Duration of ESE	2 Hrs.					75				

Course Objectives	1. Provide a sound and comprehensive understanding of artificial neural networks
	2. Solve practical problems via implementation of these techniques via simulation;
	3. Promote further independent learning on the topics of artificial neural networks and machine learning;
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the basics of Artificial Neural Networks
	CO2: Identify different neural network architectures, algorithms, applications and their limitations
	CO3: Understand appropriate learning paradigms and its applications rules for each of the architectures and learn several neural network
	CO4: Develop different single layer/multiple layer Perception learning algorithms
CO5: Reveal different applications of these models to solve engineering and other problems.	

Mapping of Course Outcomes with Program Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Introduction to Artificial Neural Networks, Artificial Neuron Model and Linear Regression, Gradient Descent Algorithm, Nonlinear Activation Units and Learning Mechanisms, Learning Mechanisms-Hebbian,Competitive,Boltzmann	6
II	Associative Memory Model, Condition for Perfect Recall in Associative Memory, Statistical Aspects of Learning, V.C. Dimensions: Typical Examples Importance of V.C. Dimensions Structural Risk Minimization	6
III	Single-Layer Perceptions, Unconstrained Optimization: Gauss-Newton's Method, Linear Least Squares Filters, Least Mean Squares Algorithm, Perceptron Convergence Theorem, Bayes Classifier & Perceptron: An Analogy, Bayes Classifier for Gaussian Distribution, Back Propagation Algorithm	8
IV	Solution of Non-Linearly Separable Problems Using MLP, Heuristics For Back-Propagation, Multi-Class Classification Using Multi-layered Perceptrons, Radial Basis Function Networks: Cover's Theorem, Regularization Networks and Generalized RBF Comparison Between MLP and RBF, Learning Mechanisms in RBF	8
V	Introduction to Principal Components and Analysis, Dimensionality reduction Using PCA, Hebbian-Based Principal Component Analysis, Introduction to Self Organizing Maps, Cooperative and Adaptive Processes in SOM	8

***Note - TAE should include practical based assignment on Artificial Neural Networks**

Text Book	1.	Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications By S. Rajasekaran, G. A. Vijayalakshmi Pai. EEE
	2.	Simon O. Haykin, Neural Networks and Learning Machines, Pearson Education https://cours.etsmtl.ca/sys843/REFS/Books/ebook_Haykin09.pdf
E-Books	1.	Kevin Gurney, An Introduction to Artificial Neural Networks, UCL Press Ltd. https://www.inf.ed.ac.uk/teaching/courses/nlu/assets/reading/Gurney_et_al.pdf
	2.	Michael Nielsen, Neural Networks and Deep Learning https://static.latexstudio.net/article/2018/0912/neuralnetworksanddeeplearning.pdf
Reference Books	1.	Deep Learning, by Ian Goodfellow and Yoshua Bengio, The MIT Press, 2016.
	2.	C. Bishop, Neural Networks and Machine Learning, Springer, 1998.
Online Material:	1.	https://nptel.ac.in/courses/117/105/117105084/

Course Title: Deep Learning										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3	--	2	4	10	15	50	25	-
Course Code	UAIL411 UAIL411									
Teaching Mode	Offline	5Hrs			Total	75			25	
Duration of ESE	2.30 Hrs.					100				

Course Objectives	1.To understand the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data.
	2.To apply Deep learning Techniques to various engineering and social applications.
Course Outcomes	CO1:Understand and master basic knowledge, theories and methods in artificial neural networks
	CO2:To develop various deep learning architectures
	CO3L: To train and test the model using deep learning algorithms
	CO4:To tune model parameters for different deep learning techniques.
	CO5:To evaluate and validate deep learning models

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	-	-	-	-	-	-	1	2	2
CO2	-	3	-	-	3	-	-	-	-	-	1	-	3	3
CO3	-	-	-	-	3	-	-	-	-	-	-	-	2	2
CO4	-	-	3	3	3	-	-	-	-	-	-	-	3	3
CO5	-	-	3	3	3	-	-	-	-	-	-	-	1	1

Course Contents:

Unit	Contents	Hours
I	History of Deep Learning, Deep Learning Success Stories, Thresholding Logic, Perception Learning Algorithm, Multilayer Perception (MLPs),Representation Power of MLPs, Linear Vector Quantization.	6

II	Optimizer& Its Basic: Representation Power of Feed forward Neural Networks Feed Forward Neural Networks, Back propagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Ada Grad, RMS Prop, Adam,	8
III	Optimization for Training Deep Models: Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second Order Methods, Optimization Strategies and Meta-Algorithms	8
IV	Regularization for Deep Learning: Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier	8
V	Transfer Learning Model: Convolution Neural Networks, GANLeNet, AlexNet, ZF-Net, VGGNet, GoogleNet, ResNet Learning Vectorial Representations Of Words, Recurrent Neural Networks, LSTM	5

List of Practical's

Sr. NO	Name Of Experiment
1	Perform And Implement Perception Model
2	Perform And Implement Back Propagation Neural Network
3	Perform And Implement Feed Forward Neural Network For Diabetic Classification
4	Perform And Implement Feed Forward Neural Network For Iris Classification With Different Optimizer
5	Perform And Implement Noise Reduction Using Auto Encoder
6	Perform And Implement Image Compression Using Auto Encoder
7	Perform And Implement ECG Signal Classification Using CNN With Different Optimizer
8	Perform And Implement Brain Tumor Classification Using CNN
9	Perform And Implement Pre-trained Model(VGG16) for Real Time Classification
10	Perform And Implement For Real Time Image Classification

Text Books	1.	Patrick Henry Winston, Artificial Intelligence, Addition-Wesley,1992
	2.	Elaine Rich, Kevin Knight, Shivshankar Nair, artificial Intelligence, McGraw Hill
E-book	1.	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach 3 rd Edition , Prentice Hall,2009
	2.	R. C. Schank and C.K. Riesbeck: Inside Computer Understanding: Five

		Programs Plus Miniatures, Lawrence Erlbaum, 1981
Online	1	http://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs42/

Course Contents:

Unit	Contents	Hours
I	Introduction to Virtual and Augmented Reality: Introduction to Augmented-Virtual reality, Need for Virtual and Augmented and Virtual reality, Applications, Chronological order of VR, AR apps- Google lens, mathematics solver, Challenges with AR.	6
II	Representing the Virtual World : Basic components of VR Systems, Types of VR systems, Basic features of VR systems, Architecture of VR systems, VR hardware - VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays.	8
III	Visual Perception , Rendering, motion and tracking: Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information, Visual Rendering - Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies.	6
IV	AR Hardware : Displays – Audio Displays, Haptic Displays, Visual Displays, and Other sensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model. Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.	8
V	AR Devices & Components: AR Components – Scene Generator, Tracking system, monitoring system, display, Game scene AR Devices – Optical See - Through HMD, Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking.	6

Text Books	1.	Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
	2.	Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
	3.	Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009
	4.	Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
	5.	Allan Fowler-AR Game Developmentll, 1st Edition, A press Publications, 2018, ISBN 978- 1484236178

Reference Books	1.	Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005.
	2.	Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”, Addison Wesley, USA, 2005.
	3.	Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Merging Real and Virtual Worlds”, 2005.
	4.	Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience, India, 2003.
	5.	Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
	6.	Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN: 9781491962381
E--Books	1.	http://lavallo.pl/vr/book.html
	2.	https://www.vtresearch.com/sites/default/files/pdf/science/2012/S3.pdf
	3.	https://docs.microsoft.com/en-us/windows/mixed-reality/
	4.	https://docs.microsoft.com/en-us/archive/msdn-magazine/2016/november/hololensintroduction-to-the-hololens
Online TL Material	1.	https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/what-is-virtual-reality
	2.	https://www.softwaretestinghelp.com/what-is-virtual-reality/#VR_Devices
	3.	https://tutorials.one/virtual-reality/
	4.	https://www.softwaretestinghelp.com/what-is-augmented-reality/

Course Title: Artificial Intelligence & Expert Systems										
Semester	VII	Teaching Scheme				Evaluation Scheme				
					Theory			Practical		
Term	VII	TH	TU	PR	CREDITS	TAE	CAE	ESE	INT	EXT
Course Category	Elective	3 Hrs	-	-	3	10	15	50	NA	NA
Course Code	UAIL421									
Teaching Mode	Offline	3 Hrs			Total	75			--	
Duration of ESE	2 ½ Hours					75				

Course Objectives	1.To study the idea of intelligent agents and search methods.
	2.To study about representing knowledge.
	3.To construct plans and methods for generating knowledge.
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Understand various searching techniques, constraint satisfaction problem
	CO2: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and reasoning
	CO3: Acquire the knowledge of real-world knowledge representation
	CO4: Analyze and design a real-world problem for implementation and understand the dynamic behavior of a system
	CO5: Understand the concepts of expert systems.

Mapping of Course Outcomes with Program Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Introduction: Intelligent agents, Perception, Problem Solving agents, Uniformed Search: Notion of a State, Uniformed Search: Search Problem and Examples, Basic Search Strategies, Iterative Deepening DFS, Bidirectional Search	8
II	Informed Search: Best First Search, Greedy Best First Search, A* Algorithm, Iterative Deepening A*, Depth First Branch & Bound. Adversarial Search- Minimax Algorithms for 2 player games, Alpha Beta Pruning and its Analysis.	8

III	Different Knowledge Representation Systems: Logic in AI, Propositional logic, First Order Logic, Syntax and semantics, Inference in First Order Logic.	7
IV	Uncertainty in AI: Conditional Reasoning & Bayes Rule, Uncertainty, Acting under uncertainty, Basic probability notation, Axioms of probability, Baye's rule, Bayesian Networks, Probabilistic reasoning, Making simple decisions.	6
V	EXPERT SYSTEMS: Definition, Features of an expert system, Organization, Characteristics, Prospector, Knowledge Representation in expert systems, Expert system tools, MYCIN, EMYCIN.	6

Text Books	1.	Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009
	2.	Elaine Rich, Kevin Knight, Shivshankar Nair, Artificial Intelligence, McGraw Hill.
	3.	Donald A. Waterman, 'A Guide to Expert Systems', Pearson Education.
E-Books	1.	Handbook of Artificial Intelligence, Edited By Avronn Barr and Edward Feigenbaum https://stacks.stanford.edu/file/druid:qn160ck3308/qn160ck3308.pdf
	2.	Patrick Henry Winston. Artificial Intelligence, Addison-Wesley, 1992. https://courses.csail.mit.edu/6.034f/ai3/rest.pdf
Reference Books	1.	George F. Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', Fourth Edition, Pearson Education, 2002.
	2.	Murray Shanahan: A Circumscriptive Calculus of Events. Artificial. Intelligence 77(2), pp. 249-284, 1995.
	3.	W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003.
	4.	Janakiraman, K. Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science.
Online Material	1	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs42/

Course Title: UCSSL412 Blockchain Technology										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective	3	NA	NA	3	10	15	50	NA	NA
Course Code	UCSSL412									
Teaching Mode	Offline	3 Hrs			Total	75			NA	
Duration of ESE	2.5 Hrs					75				
Course Objectives	1. Understand how blockchain systems (mainly Bitcoin and Ethereum) work									
	2. Demonstrate blockchain network, smart contracts and distributed applications									
	3. Integrate ideas from blockchain technology into their own projects									
Upon successful completion of the course, students shall be able to--										
Course Outcomes	CO1: Understand and explore the working of Blockchain technology									
	CO2: Interpret the concept of blockchain network									
	CO3: Analyze mining process of crypto currency in learning with hyperledger									
	CO4: Justify security, privacy, and efficiency of a given blockchain system.									
	CO5: Investigate Blockchain applications in a structure manner.									

Mapping of **Course Outcomes** with **Program Outcomes** and **Program Specific Outcomes**:

Course Outcomes	Program Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2
CO1	-	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	-	3	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	-	2	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	3	-	-	-	-	-	-	-

Course Contents:

Unit	Contents	Hours
I	Fundamentals of Blockchain: Introduction to distributed computing, What is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, types of Blockchain, Life of Blockchain application.	7
II	Blockchain Network: Advantage over conventional distributed database, P2P Systems, Blockchain Network, Distributed Consensus, Merkle Patricia Tree, Mining Mechanism, Reward, Transactional Blocks in blockchain, Anonymity, Chain Policy, Soft & Hard Fork, Private and Public blockchain.	7
III	BitCoin and Hyperledger: What is Bitcoin, Digital Currency, The Bitcoin Mining Process, Mining Developments, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger Fabric, Hyperledger Composer.	7
IV	Distributed Consensus & Cryptocurrency: Nakamoto consensus, Validation, Gas Limit, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. Bitcoin protocols, Ethereum Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin	7
V	Cryptocurrency Regulation & Applications: Stakeholders, Legal Aspects-Crypto currency Exchange Applications: Internet of Things, Medical Record Management System, Domain Name Service, Recent trends in Blockchain.	7

Text Books	1.	Block chain technology: concepts and applications, Kumar Saurabh, Ashutosh Saxena ,Wiley Publication edition (2020)
	2.	Blockchain Technology And Applications 1St Edition by Pethuru Raj, Kavita Saini , Taylor & Francis Ltd, September 2020.
EBooks	1.	BLOCKCHAIN ,Cybrosys Limited Edition, E-BOOK https://www.blockchainexpert.uk/book/blockchain-book.pdf
Reference Books	1	Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies. Mastering Blockchain - Imar Bashir - Second edition - Packt - 2018.
	2	DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
	3	Antonopoulos and G. Wood, Mastering Ethereum.
Online	1.	Introduction to Blockchain Technology and Applications, Prof. Sandeep Shukla, IIT Kanpur https://nptel.ac.in/courses/106/104/106104220/

Course Title: UCSL413 Digital Marketing										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective	3	NA	NA	3	10	15	50	NA	NA
Course Code	UCSL413									
Teaching Mode	Offline	3 Hrs			Total	75			NA	
Duration of ESE	2.5 Hrs					75				
Course Objectives	1. To understand digital marketing technologies.									
	2. Get knowledge in the areas of digital marketing communications									
	3. To learn methodologies, tools and technologies involved in digital marketing.									
Course Outcomes	Upon successful completion of this course, student will be able to:									
	CO1: Recognize the importance of the digital marketing for marketing success									
	CO2: Compare various Search Engine Optimization and Social Media Optimization techniques.									
	CO3: Sketch a digital marketing plan, starting from the SWOT analysis and defining a target group.									
	CO4: Plan the use of effective digital marketing tools by applying relevant marketing theories and frameworks.									
	CO 5: Design a good and secure digital marketing plan that will address common marketing challenges									

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	3	-	2	-	-	-	-	-	-	-	-	-
CO3	1	2	3	2	3	2	-	-	-	-	-	-	2	3
CO4	1	2	2	3	3	-	-	-	-	-	-	-	2	2
CO5	1	2	3	-	3	-	-	-	-	-	2	-	-	2

Course Contents:

Unit	Contents	Hours
I	Introduction: Introduction to Digital Marketing, Difference between traditional marketing & digital marketing, Discussion on Ecommerce, Discussion on new trends and current scenario of the world, Digital marketing a tool of success for companies, Analysis of recent info graphics released by companies about digital marketing, Digital marketing channels, Diagnosis of the present website and business, SWOT analysis of business, present website and media or promotion plan, Setting up vision, mission and goals of digital marketing. Understanding a Blog, Portal and Website, static and dynamic websites.	7Hrs
II	Search Engine Optimization (SEO) –SEO: SEO audit and features of SEO, on-page optimization techniques, off-page Optimization techniques, Reports, writing SEO content.	7Hrs
III	Social Media Optimization (SMO)– Introduction to Social Media Marketing, Advanced Facebook Marketing, visual identity of the Facebook page, Optimization of Instagram profile, Word Press blog creation, Twitter marketing, LinkedIn Marketing, Creating a campaign on LinkedIn, Google plus marketing, Social Media Analytical Tools, Web Analytics, Web Analytics level	7Hrs
IV	Search Engine Marketing– Search Engine Marketing: Introduction to Search Engine Marketing, Tools used for Search engine Marketing, Display advertising techniques, Report generation, Email marketing, Email marketing plan, Email marketing campaign analysis.	7Hrs
V	Ethical Marketing- Introduction to Ethical Marketing, Principles of Ethical Marketing, Ethical Marketing Examples, Ethical phishing, Protecting against cyber-attacks, Recent trends in Digital Marketing.	7Hrs

Text Books	1.	Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the
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	2.	Digital Generation, Kogan Page Limited.
E-Books	1.	50 Shades of Digital Marketing, Francesca James; Hannah Durham https://www.7boats.com/academy/wp-content/uploads/2016/10/50-shades-of-digital-marketing.pdf
	2.	Beginner's Guide to SEO https://www.reliablesoft.net/free-marketing-ebooks/
Reference Books	1.	Fundamentals of Digital Marketing, Second Edition, Pearson by Puneet Bhatia
	2.	Digital Marketing Essentials You Always Wanted to Know by Vibrant Publishers.
Online TL Material	1.	The Ultimate Guide to Digital Marketing https://www.digitalmarketer.com/digital-marketing/assets/pdf/ultimate-guide-to-digital-marketing.pdf
	2.	Email Marketing for beginners, eMarketing Institute, https://www.emarketinginstitute.org/free-ebooks/email-marketing-for-beginners/
	3.	Digital marketing tools: https://careerfoundry.com/en/blog/digital-marketing/digital-marketing-tools/

Course Title: Digital Forensics										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	E-VI	3	-	2	4	10	15	50	25	-
Course Code	UDIL 418 UDIP 418									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	To understand underlying principles and many of the techniques associated with the digital forensic practices and cyber-crime.
	To develop an excellent understanding of current cyber security issues (Computer Security Incident) and analyze the ways that exploits in securities.
	To investigate attacks, IDS. Technical exploits and router attacks and “Trap and Trace” computer networks.
	To learn the importance of evidence handling and storage for various devices.
	To apply digital forensic knowledge to use computer forensic tools and investigation report writing.
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
	CO2: Develop appropriate security solutions against cyber attacks..
	CO3: Select different types of tools for various phases of forensics investigation
	CO4: Create reports as per standards of digital forensics.
	CCO5: Understand the method to generate legal evidence and supporting investigation reports and will also be able to use various digital forensic tools.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Fundamentals of Digital Forensics Foundations of Digital Forensic: Digital evidence, Awareness, Principles of Digital Forensic, Challenging aspects of digital evidence, Cyber trail. Language of Computer Crime Investigation: Role of Computers in crime, Cybercrime law, offenses, jurisdiction. Traffic analysis, Fraud, IT Act	6
II	Computer Forensic Digital Evidence : Digital evidence in courtroom: Duty of experts, Admissibility, Locard's exchange principle, Types of Evidence, The Rules of Evidence, Volatile Evidence, Evidence collection and Archiving , Methods of Collection , Collection Steps, Controlling Contamination: The Chain of Custody. Processing Computer Crime : Introduction to Crime Scenes, Seizing and storing digital evidence at scene, Documenting the Scene and the Evidence , Dealing with Live Systems and Dead Systems, Using Hashing to Verify the Integrity of Evidence.	7
III	Data Acquisition and Data Recovery Data acquisition- Understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools Data Recovery: Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution Hiding and Recovering Hidden Data, Data Handling tools.	6

IV	Mobile device Forensic and Email Forensics Mobile Device Forensics, Types of evidence on mobile device, Handling mobile device as a sources of evidence, Forensic prevention of mobile devices, Forensic examination & analysis of mobile devices, Forensic acquisition & examination of SIM cards (Architecture, Data Storage, Files, Mobile Operating System), Investigative reconstruction using mobile devices, Mobile Forensics and its challenges Email Forensics: EMail Header Analysis, Function & Forensics, Chat and Social Networking Evidence.	7
V	Forensic Investigation Report and Forensic Tools: Goals of Report, Layout of an Investigative Report, Guidelines for Writing a Report, sample for writing a Forensic report. Computer Forensic Tools: need and types of computer forensic tools, task performed by computer forensic tools. Study of open source Tools like SFIT, Autopsy etc. to acquire, search, analyze and store digital evidence	7

Text Books	<ol style="list-style-type: none"> 1. Digital Evidence & Computer Crime – Forensic science, Computers & The Internet’, Eoghan Casey, 3rd edition 2. ‘Computer Forensics Computer Crime scene investigation’, 2nd edition, John R. Vacca 3. Cyber Law Simplified, Vivek Sood 4. Basics of Digital Forensics, Second edition – John Sammons
Reference Books	<ol style="list-style-type: none"> 4. Computer Forensics Investigating Network Intrusions & Cybercrime’, EC– Council press, Cengage Learning 5. Guide to Computer Forensics & Investigations, 4th edition, Bill Nelson, Amelia Phillips & Christopher Steuart, Cengage Learning 6. ‘Guide to Integrating Forensic Techniques into Incident Response’, NIST, Karen Kent, Suzanne Chevalier Tim Grance, Hung Dang

Sr.no	Name of Experiments
1	Study of Digital Forensics and different tools used for forensic investigation
2	How to Recover Deleted Files using Forensics Tools
3	Study the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt.
4	How to Extract Exchangeable image file format (EXIF) Data from Image Files using Exifreader Software.

5	How to make the forensic image of the hard drive using EnCase Forensics
6	How to Restoring the Evidence Image using EnCase Forensics
7	How to Collect Email Evidence in Victim PC
8	How to Extracting Browser Artifacts
9	How to View Last Activity of Your PC
10	Find Last Connected USB on your system (USB Forensics)

Course Contents:

Unit	Contents	Hours
I	Introduction: Introduction, Anatomy and physiology of speech production, categorization of speech sounds, Prosody, Parameters of Speech: Pitch and Formants.	8
II	Analysis and Synthesis of Speech and Audio signals: Spectral Analysis Models, Linear Predictive Coding Model, Modulation Models , The autocorrelation method, The covariance method, Short-Time Fourier Transform Analysis and Synthesis	8
III	Pitch Estimation Methods: A correlation-based Pitch Estimator, Pitch Estimation based on Comb Filter, Pitch Estimation based on a Harmonic Sine wave Model.	6
IV	Speech Coding: Vector Quantization, Frequency-Domain Coding, Transform based Approach , Model-based Coding. Audio Compression techniques	8
V	Enhancement of Speech and Audio Signals: Spectral subtraction, Cepstral Mean Subtraction, Wiener Filtering, Speaker Recognition: Spectral Features required for Speaker Recognition, Minimum Distance classifier, Gaussian Mixture Model. Applications / Case studies,	10

Text Books	1.	T.F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice, Prentice Hall.
	2.	L.R.Rabiner, R.W.Schafer, Theory and Applications of Digital Speech Processing, Prentice Hall
Reference Books	1.	B. Gold, N. Morgan, D. Ellis, Speech and Audio Signal Processing: Processing and Perception of Speech and Music, Wiley-Blackwell
	2.	T. Dutoit, F. Marqués, L.R. Rabiner, Applied signal processing: a MATLAB-based Proof of Concept, Springer
	3.	Ian Vince Mcloughlin. Speech and Audio Processing: A MATLAB-based Approach, Cambridge University Press
	4.	A.K.Jain, "Fundamentals of Digital Image Processing", PHI,1995

Name of Laboratory: Digital Signal Processing		Location: E-31
Course Code: BECP330	Course Name: Audio and Speech Signal Processing	Semester: VI
Session: 2020 - 21		
Course Objectives:	Course Outcomes: Student shall be able to	
<ol style="list-style-type: none"> 1. To introduce speech signal characteristics 2. To show the computation and use of techniques such as short time Fourier transform, autocorrelation in the analysis of speech 3. To understand effect of echo, reverberation, sampling frequency related to sound 4. To be able to develop text to speech model 	<ol style="list-style-type: none"> 1. Understand the types of speech signal viz. voiced/unvoiced. 2. Evaluate the spectrum of speech signal 3. Analyze the spectrum of speech signal 4. Apply autocorrelation algorithm for evaluation of pitch of sound 5. Understand Echo, reverberation, effect of changing the sampling frequency of a sound 6. Create text to speech conversion model 	

S. N.	Name of the Experiments	Mapped Course Outcomes
1.	Write MATLAB program to record voiced speech signal	CO1, CO3
2.	Write MATLAB program to record unvoiced speech signal	CO1,CO3, CO4
3.	Write MATLAB program to plot spectrum of voiced and unvoiced speech signal	CO3, CO4
4.	Write the MATLAB program to change the sampling frequency of music	CO1, CO3, CO6
5.	Write a MATLAB program to develop echo effect in music	CO1,CO3
6.	Write a MATLAB program to find pitch of the audio signal using autocorrelation and plot the pitch graph	CO1, CO4, CO5
New Experiment		

1.	Develop simulink model for reverberation	CO4, CO5, CO6
2.	Write a MATLAB program to generate musical instrument sound using mathematical equation	CO1
Open Ended Experiments		
1.	Write a MATLAB program for Text to Speech conversion	CO1,CO2, CO6
2.	Write a MATLAB program to generate music of a song	CO1,CO2, CO6

VI	Audio & Speech Signal Processing	5	To express the characteristics of speech waveform in terms of the production characteristics, by identifying/locating voiced/unvoiced/plosive/silence regions, and providing acoustic phonetic description of the regions.	https://ssp-iiith.vlabs.ac.in/exp/production-mechanism/index.html
			To understand the issues in short-time spectrum analysis of speech signals.	https://ssp-iiith.vlabs.ac.in/exp/short-time-spectrum-analysis/
			To study the effect of size of the analysis window (less than one pitch period, one pitch period, two to four pitch periods).	https://ssp-iiith.vlabs.ac.in/exp/short-time-spectrum-analysis/
			To study the effect of shape of the analysis window (rectangular, Hamming and Hanning window functions).	https://ssp-iiith.vlabs.ac.in/exp/short-time-spectrum-analysis/
			To study the relation between formant frequencies of a vocal tract system and the perception of sounds.	https://ssp-iiith.vlabs.ac.in/exp/formant-synthesis/

Elective-IV

Course Title: Brain Machine Interface										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-

Course Code	UECL418 UECP418									
Teaching Mode	Offline	4			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	Understand the basic concepts of brain computer interface
	Study the various signal acquisition methods
	Learn about the signal processing methods used in BMI
	Understand the various machine learning methods of BMI
	Learn the various applications of BMI
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: Comprehend and appreciate the significance and role of this course in the present contemporary world.
	CO-2: Evaluate concept of BMI.
	CO-3 Assign functions appropriately to the human and to the machine.
	CO-4 Select appropriate feature extraction methods
	CO-5 Use machine learning algorithms for translation.

Mapping of Course Outcomes with Program Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	INTRODUCTION TO BMI Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BMI -Partially Invasive BMI - Non Invasive BMI, Structure of BMI System, BMI Monitoring Hardware, EEG, ECoG, MEG, fMRI, Electrophysiological Sensors.	8
II	BRAIN ACTIVATION Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.	8
III	FEATURE EXTRACTION METHODS Data Processing – Spike sorting, Frequency domain analysis, Time domain analysis, Time- Frequency domain analysis, Non-linear methods, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization and coherence	8
IV	MACHINE LEARNING METHODS FOR BMI Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis, CNN, DNN	8
V	APPLICATIONS OF BMI Case Studies - Invasive BMIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Non-invasive BMIs:P300 Mind Speller, Visual cognitive BMI, Emotion detection. Ethics of BMI, Medical Application,	8

Text Books	1.	Rajesh.P.N.Rao, “Brain-Computer Interfacing: An Introduction”, Cambridge University Press, First edition, 2013.
	2.	Jonathan Wolpaw, Elizabeth Winter Wolpaw, “Brain Computer Interfaces: Principles and practice”, Oxford University Press, USA, Edition 1, January 2012.
Reference Books	1.	Ella Hassianien, A &Azar.A.T (Editors), “Brain-Computer Interfaces Current Trends and Applications”, Springer, 2015.
	2.	Bernhard Graimann, Brendan Allison, Gert P furtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
	3	Ali Bashashati, MehrdadFatourech, Rabab K Ward, Gary E Birch,” A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals” Journal of Neural Engineering, Vol.4, 2007, PP.32-57
	4	Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida.
	5	Bishop C.M., “Neural networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.
	6	Andrew Webb, “Statistical Pattern Recognition”, Wiley International, Second Edition,

		2002.
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Course Contents:

Unit	Contents	Hours
I	Introduction: Wireless communication technology fundamentals, the electromagnetic spectrum radio propagation, wireless channels characteristics, modulation, and multiple access techniques, wireless LANs, PANs, WANs, MANs, and also the Internet.	8
II	Introduction to Adhoc/sensor networks: Key definitions of ad-hoc/ sensor networks, unique constraints, and challenges, advantages of ad-hoc/sensor networks, driving applications, Adhoc wireless network issues, issues in the design of the sensor network, architecture of sensor network, data dissemination, and gathering.	8
III	MAC Protocols : Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.	8
IV	Routing Protocols: Designing routing and power-aware routing protocol issues, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical.	8
V	QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.	8

Text Books	1.	C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.
Reference Books	1.	Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication - 2004.
	2.	Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.
	3.	William Stallings, "Wireless Communications and Networks ", Pearson Education - 2004

Course Title: Embedded System Design and RTOS										
Semester	V	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	ODD	Th	Tu	Pr		TAE	CAE	ESE	INT	EXT
Course Category	C	3	-	2	4	10	15	50	25	-
Course Code	UECL303 UECP303									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2Hrs					100				

Course Objectives	1. To understand the design parameters of embedded systems applications
	2. To study and impart different tools for embedded system and IoT application design.
	3. To understand RTOS and IDE for Embedded Systems.
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1 Demonstrate the principle of embedded systems and Microcontroller
	CO2 Make Use of ARM Controller for Designing of Embedded Applications
	CO3 Develop programming for applications develop real time applications
	CO4 Interfacing peripherals with ARM.
CO5 Understand concept of RTOS and IDE.	

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	P O 1	P O 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1			3	2	3			3				3	3		
CO2			3	2	3			3				3	3		
CO3			3	2	3			3				3	3		
CO4			3	2	3			3				3	3		
CO5			3	2	3			3				3	3		

Course Contents:

Unit	Contents	Hours
I	Embedded System Concepts: Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, Architecture of embedded	8

	systems, Hardware architecture, and Software architecture, Application Software, Communication Software, Development and debugging Tools. Design Process in Embedded System	
II	ARM Family Processors: Introduction to ARM processors and its versions, ARM7, ARM9 & ARM11 features, advantages & suitability in embedded application, registers, CPSR, SPSR, ARM and RISC design philosophy, ARM7 data flow model, programmers model, modes of operations	8
III	ARM7 Based Microcontroller ARM7 based Microcontroller LPC2148: Features, Architecture. System Block(PLL and VPB divider), Memory Map, GPIO, Pin connect Block, timer, Instruction set basic programming in assembly language.	8
IV	Real World Interfacing with ARM7 Based Microcontroller Interrupt structure of LPC2148, Interfacing with LED, LCD, simple LPC2148 GPIO Programming examples Using timers of LPC2148 to generate delay, serial communication programming for transmission and reception from computer, programming for UART. C Programming. Introduction to Cortex.	8
V	RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads, Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores, selection of an RTOS, Advance Topic	8

Text Books	1.	Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK.
	2.	David Seal “ARM Architecture Reference Manual”, 2001 Addison Wesley, England; Morgan Kaufmann Publishers
	3.	
Reference Books	1.	Andrew N Sloss, Dominic Symes, Chris Wright, “ARM System Developer's Guide - Designing and Optimizing System Software”, 2006, Elsevier.
	2.	Steve Furber, “ARM System-on-Chip Architecture”, 2nd Edition, Pearson Education
	3.	Cortex-M series-ARM Reference Manual

Course Title: Digital Image Processing										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	TH	TU	PR	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	-	2	4	10	15	50	25	-
Course Code	UECL420 UECP420									
Teaching Mode	Offline	5			TOTAL	75			25	
Duration of ESE	2 Hrs.					100				

Course Objectives	To treat the 2-D systems as an extension of the 1-D systems and discuss the techniques for the 2-D systems.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO-1: understand the need for image transforms different types of image transforms and their properties
	CO-2: learn different techniques employed for the enhancement of images.
	CO-3: To understand the Image segmentation and morphological image processing & techniques
	CO-4: To understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
	CO-5: To understand the various image transform and object recognition technique

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1	3	3	3	2	2						1	1	3	1	1
CO2	3	3	3	2	2						1	1	3	1	1
CO3	3	3	3	2	2						1	1	3	1	1
CO4	3	3	3	2	2						1	1	3	1	1
CO5	3	3	3	2	2						1	1	3	1	1

Course Contents:

Unit	Contents	Hours
I	Introduction and Digital Image Fundamentals: Digital Image Fundamentals, Human Visual System, Image as a 2-Dimensional (2D) Data, Image Representation Gray Scale and Color Images, Image Acquisition and Camera Model , Image Sampling and Quantization. Image Enhancement in Spatial Domain: Basic Grey Level Transformations, Histogram Processing Techniques, Spatial Filtering, Low Pass Filtering, High Pass Filtering	9
II	Filtering in the Frequency Domain: Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering Image Restoration and Reconstruction: Noise Models, Noise Reduction, Inverse Filtering, MMSE (Wiener) Filtering	9
III	Image Segmentation: Point, Line and Edge Detection, Thresholding, Regions Based Segmentation, Edge Linking and Boundary Detection, Hough Transform Object Recognition and Case Studies Morphological Image Processing: Erosion, Dilation, Opening, Closing, Basic Morphological Algorithms: Hole Filling, Connected Components, Thinning, Skeletons	9
IV	Color Image Processing: Color Fundamentals, Color Models, Pseudo Color Image Processing Image Compression: Fundamentals of Redundancies, Basic Compression Methods: Huffman Coding, Arithmetic Coding, LZW Coding, JPEG Compression Standard	7
V	Image Transformations: 2D-DFT, DCT, DST, Hadamard, Walsh, Hotelling transformation, 2D-Wavelet transformation, Wavelet packets. Object Recognition- Features, Patterns and Pattern Classes, Recognition Based on Decision – Theoretic Methods, Structural Methods, Application based on AI and CNN	6

Text Books	1.	A.K.Jain, "Fundamentals of Digital Image Processing", PHI, 1995
	2.	R. C.Gonzalez, R.E.Woods, "Digital Image processing", Pearson edition, Inc3/e, 2008
Reference Books	1.	J.C. Russ, "The Image Processing Handbook", (5/e), CRC, 2006
	2.	R.C.Gonzalez & R.E. Woods; "Digital Image Processing with MATLAB", Prentice Hall, 2003

ELECTIVE-II UITL401/ UITP401: SCRIPTING LANGUAGE

Teaching Scheme:	Credit:	Examination Scheme:													
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks													
Prerequisite (If any):															
Course Outcomes: After completing this course, students will be able to															
CO1: Acquire programming skills in scripting language															
CO2: Develop web based application using suitable client side and server side web technologies.															
CO3: Enhance the concept & Develop the Application using Angular JS & Node JS															
CO4: Design & Develop the Web Based Application using Ruby															
CO5: Implement the web based Application Using Perl															
Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
C01	3	1	1	-	3	-	-	-	3	1	3	2	3	1	1
C02	3	2	3	-	3	-	-	-	2	1	2	2	3	3	3
C03	3	3	2	1	3	-	-	-	1	1	1	2	3	2	2
C04	3	2	3	2	3	-	-	-	1	1	1	2	3	3	3
C05	3	1	3		3	-	-	-	1	1	1	2	3	3	3
Course Contents															Hrs.
UNIT I: INTRODUCTION TO PHP Database Language															8
PHP : Starting to script on server side, Arrays, function and forms, advance PHP Databases : Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables.															
UNIT II: Angular JS and Node JS															8
Angular JS : dependency injection, custom directives, Internationalization. Introduction to NodeJS and Struts: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.															
UNIT III: SERVER-SIDE WEB SCRIPTING															8
Rails, PHP, Zope, the JSP expression language; The evils of scriptlets; Scripting and the Semantic Web.															
UNIT IV: Introduction to Ruby															8

Introduction to Ruby, Rails, The structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, cookies, Choice of Web servers, SOAP and webservices, RubyTk – Simple Tk Application, widgets, Binding events, Canvas, scrolling		
UNIT V: Introduction to PERL		8
Introduction to PERL, Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.		
Text Books	1	Achyut Godbole & Atul Kahate, "Web Technologies: TCP/IP to Internet Application Architectures", McGraw Hill Education publications, ISBN, 007047298X, 9780070472983
	2	Ralph Moseley & M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13 : 9788126538676
	3	The World of Scripting Languages, David Barron, Wiley Publications.
	4	Ruby Programming language by David Flanagan and Yukihiro Matsumoto O'Reilly
Reference Books	1	Robin Nixon, "Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY, ISBN: 13:978-93-5213-015-3
	2	Web Technologies, Black Book, Dreamtech Press Ian Dodson, The Art of Digital Marketing, Wiley Publications.
	3	Open Source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP, J. Lee and B. Ware (Addison Wesley) Pearson Education.

List of Practical (UITP401)

Teaching Scheme:	Credit:	Examination Scheme:
Practical: 02 Hrs./Week	1	INT: 25 Marks EXT :-NIL
List of Practical		
1	Develop simple calculator for addition, subtraction, multiplication and division operation using JavaScript (Design & Develop a Web Based Application using Java Script)	
2	Design and develop web application using PHP and MySQL as a back-end for Customer data with insert, Display operations.	
3	Create an application for Bill Payment Record using AngularJS.	
4	Create an application for Result Calculation and display in Proper Format using AngularJS.	
5	Implement Node.js web-based application	
6	Implement Node.js as a File Server for Read files, Create files, Update files, Delete files, Rename files	
7	Count the frequency of base G in a given DNA sequence using perl. (Calculate: 1. How many hours are in a year. 2. How many minutes are in a decade? 3. How many seconds old are you? Using irb in ruby.)	
8	Calculate: 1. How many hours are in a year. 2. How many minutes are in a decade? 3. How many seconds old are you? Using irb in ruby. (Count the frequency of base G in a given DNA sequence using perl)	

ELECTIVE-II UITL409/UITP409 : WIRELESS ADHOC NETWORK

Teaching Scheme:	Credit:	Examination Scheme:
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks

Prerequisite (If any): Foundation of Computer Network, Computer Network

Course Outcomes: After completing this course, students will be able to

CO1: Describe importance and use of Wireless Ad-hoc Networks

CO2: Analysis the Issues involed in MAC Protocol

CO3: Recognize importance of localization and routing techniques

CO4: Explore the Design Goals & Classification involved in Transport Layer

CO5: Understand importance of security in Wireless Ad-hoc Networks.

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	1	2	2	2	-	2	3	3	3	3	3	2	3
CO2	3	3	3	2	3	2	-	-	3	2	2	2	3	2	2
CO3	3	3	3	2	3	2	-	-	3	2	1	2	3	2	2
CO4	3	2	3	2	3	2	-	-	3	2	1	2	3	2	2
CO5	3	3	3		3	2	-	-	2	2	1	2	3	2	1

Course Contents	Hrs.
UNIT I: INTRODUCTION	8
Ad-hoc Wireless Networks Introduction, definition, characteristics, features, applications, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet, Adhoc Mobility Models- Indoor and outdoor models.	
UNIT II: MAC	8
MAC Protocols for Ad hoc wireless Networks: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols, Contention based protocols with reservation mechanisms. Contention-based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols.	
UNIT III: Routing	8
Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.	
UNIT IV: Transport Layer	8
Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks	
UNIT V: SECURITY	8
Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning, Network security attacks, Key management, Secure routing in Ad hoc wireless Networks.	

Text	1	C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011
Reference Books	1	Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
	2	Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
	3	C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

List of Practical (UITP409)

Teaching Scheme:		Credit:	Examination Scheme:
Practical: 02 Hrs./Week		1	INT: 25 Marks
List of Practical			EXT :-NIL
1	Installation of NS2 & NS3 in Fedora 19 (32 bit) OS Linux. (Installation of NS2 / NS3)		
2	Simulating IEEE 802.11 wireless LAN in Ad-Hoc Mode using NS2(Simulating IEEE 802.11 wireless LAN in Ad-Hoc Mode using NS)		
3	Implementation a Bluetooth network in NS3 with application as transfer of a file from one device to another(Implementation a Bluetooth network in NS with application as transfer of a file from one device to another)		
4	To implement and compare MAC layer protocols, MACAW, MACA-BI and MACA with piggybacked Reservation using NS-3		
5	A car acts as a malicious node and can be analysed for the packet loss before and after malicious activity. Using SUMO and MOVE.		
6	Create a simulation for road traffic with 6 junctions. There are various vehicles going on and your own car also. Select a shortest route for your car. Demonstrate with simulation software SUMO and MOVE.		
7	Create an Ad-hoc Network using nessi Simulation software and include events incorporate dropped packets, infected flows, compromised machines, unavailable services etc, and check its performance		
8	Explore and use security tools like WEP & WPA and evaluate its performance on mobile terminals		

Elective-II UITL418/UITP418: UNSTRUCTURED DATABASE MANAGEMENT

Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Odd	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3 Hrs	NA	2 Hrs	4	10	15	50	25	NA
Course Code	UITL418 / UITLP418									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	To explore the emergence, requirements and benefits of a NoSQL database
	To site principles behind the NoSQL databases, such as modern distributed database theory, P2P indexing or the Map Reduce programming model;
	To understand the basic architecture and data models of a NoSQL database (key-value stores, document databases, column-family stores, graph databases);
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: To Differentiate between a relational database and a non-relational (NoSQL) database
	CO2: To Perform CRUD operations (create, read, update and delete) on data in NoSQL environment
	CO3: To Define, compare and use the four types of NoSQL Databases (Document-oriented, Key Value Pairs, Column-oriented and Graph).
	CO4: To Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
CO5: To implement the advanced unstructured database management techniques	

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	--	--	3	1	--	--	--	--	3	2	--	2
CO2	2	--	3	--	3	1	--	--	--	--	3	2	--	1
CO3	2	--	--	3	3	1	--	--	--	--	3	2	--	2

CO4	2	--	3	--	3	1	--	--	--	--	3	2	--	2
CO5	2	--	3	--	3	1	--	--	--	--	3	2	--	2

Course Contents:

Unit	Contents	Hours
I	Introduction: Overview, and History of NoSQL Databases Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points	6
II	Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases, Replication and sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication	8
III	NoSQL Key/Value databases using MongoDB, Document Databases, What Is a Document Database? Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.	8
IV	Column- oriented NoSQL databases using Apache HBASE, Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, What Is a Column-Family Data Store? Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage, When Not to Use, Introduction to Bigdata and hadoop	6
V	NoSQL Key/Value databases using Riak, Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets, Any case study.	8

Text Books	1.	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence , Author: Sadalage, P. & Fowler, Publication: Pearson Education
	2.	Shashank Tiwari. Professional NoSQL. John Wiley and Sons. ISBN: 978-0-470-94224-6.
E-Books	1.	Managing Multimedia and Unstructured Data in the Oracle Database: A revolutionary approach by Marcelle Kratochvil https://www.pdfdrive.com/managing-multimedia-and-unstructured-data-in-the-oracle-database-a-revolutionary-approach-to-understanding-managing-and-delivering-digital-objects-assets-and-all-types-of-data-e185839907.html

Reference Books	1.	Name: Redmond, E. & Wilson, Author: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement Edition: 1st Edition.
On line Material	1.	https://nptel.ac.in/courses/106/104/106104189/

Sr. No.	Name of Practical (UITL418/UITP418) (The practical's are divided into tools: MongoDB and Cassandra.)
1	Installation and setup of MongoDB client and server
2	<p>Create a database and collection using MongoDB environment. For example a document collection meant for analyzing Restaurant records can have fields like restaurant_id, restaurant_name, customer_name, locality, date, cuisine, grade, comments. etc.</p> <p>Create database using INSERT, UPDATE, UPSERTS, DELETE and INDEX.</p> <p>Practice writing simple MongoDB queries such as displaying all the records, display selected records with conditions</p>
3	Experiment with MongoDB comparison and logical query operators - \$gt, \$gte, \$lt, \$lte, \$in, \$nin, \$ne, \$and, \$or, \$not
4	Practice exercise on element, array based and evaluation query operators - \$exists, \$type, \$mod, \$regex
5	Exercise on MongoDB shell commands and user management
6	Installation and configuration of Cassandra. Find out two use cases where Cassandra is preferred over MongoDB
7	Create database in Casandra using – Create, Alter and Drop. Add records using Inset, Update, Delete and Truncate.
8	Exercise based on Cassandra Query Language i.e. selecting records, select records with specific conditions
9	Mini-project

ELECTIVE-IV UITL410 : DIGITAL VIDEO PROCESSING

Teaching Scheme:	Credit:	Examination Scheme:
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks

Prerequisite (If any):

Course Outcomes: After completing this course, students will be able to

C01: To understand the concepts of Digital Video and its formation

C02: To understand the concepts of motion detection and estimation & its techniques

C03: To Apply techniques for video enhancement and restoration

C04: To analyze motion segmentation and motion tracking in digital video.

C05: To understand and apply the concept of video Surveillance and its applications

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
C01	3	2	1	1	1	1	-	-	3	3	3	3	2	1	-
C02	3	3	3	1	3	-	-	-	3	2	2	2	2	1	-
C03	3	3	3	1	3	-	-	-	3	2	1	2	2	1	-
C04	3	3	3	1	3	-	-	-	3	2	2	2	2	1	-
C05	3	3	3	1	3	-	-	-	3	2	1	2	2	1	-

Course Contents	Hrs.
UNIT I: INTRODUCTION TO VIDEO PROCESSING	8
Video Sampling and Interpolation, Basic Linear Filtering with Applications to Image Enhancement, Computational Models of Early Human Vision, Basic Steps of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.	
UNIT II: MOTION DETECTION AND ESTIMATION	8
Motion Detection and Estimation, Optical Flow Methods, Motion Compensated Filtering, 2-D Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.	
UNIT III: VIDEO ENHANCEMENT AND RESTORATION	8
Video Enhancement and Restoration, Video Quality Assessment, Restoration, Super-resolution	
UNIT IV: VIDEO SEGMENTATION AND TRACKING	8

Video Segmentation, Motion Segmentation, Motion Tracking in Video, 2D and 3D Motion Tracking in Digital Video, Methods using Point Correspondences, Optical Flow and Direct Methods		
UNIT V: OPTIMIZATION AND APPLICATIONS		8
Pel-Recursive Methods, Bayesian Methods, Video Stabilization and Mosaicking, A Unified Framework for Video Indexing, Summarization, Browsing and Retrieval, Video Surveillance		
Text	1	Digital Video Processing (DV), A. Murat Tekalp, Prentice-Hall, 1995
	2	The essential guide of video processing, Al Bovik, Elsevier, 2009
Reference Books	1	Video Processing and Communications, by Yao Wang, Jorn Oysterman, Ya-Qin Zhang, Prentice Hall, 2002
	2	Video Engineering, by Inglis and Luther, Second Ed., McGraw-Hill, 1996
	3	Multidimensional Signal, Image, and Video Processing and Coding, Second Edition, John W. Wood, Academic Press, 2011.

ELECTIVE-IV UITL411: DISTRIBUTED DATABASE & OBJECT ORIENTED DATABASE

Teaching Scheme:	Credit:	Examination Scheme:
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks

Prerequisite (If any):

Course Outcomes: After completing this course, students will be able to

CO1: Identify advance database concepts and database models.

CO2: Explore the Design Strategies for Distributed Database

CO3: Apply and analyze various terms related to transaction management.

CO4:Comprehend the difference between object oriented database & other Data models

CO5: analyze data modeling and database development process for object oriented DBMS.

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	2	2	3	-	-	-	2	2	1	1	3	2	2
CO2	2	3	2	2	3	-	-	-	2	2	1	1	-	-	-
CO3	3	3	2	2	3	-	-	-	2	2	1	1	1	1	1
CO4	2	3	2	2	3	-	-	-	2	2	1	1	-	-	-
CO5	3	3	2	2	3	-	-	-	2	2	1	1	1	1	1

Course Contents	Hrs.
UNIT I: INTRODUCTION TO DISTRIBUTED DATABASE	8
Introduction to Distributed Database, Data Processing, Distributed vs Centralized Database System, advantages and Application. Performance, Transparency & reliability. Problem areas of Distributed Database. Integrity Constraints in Distributed Databases. Distributed Database architecture: Client/Server architecture, Peer-to-Peer distributed systems and MDBS Architecture.	
UNIT II: DISTRIBUTED DATABASE DESIGN	8
Design strategies and issues of DB. Data Replication. Data Fragmentation for Horizontal, Vertical and Mixed. Resource allocation. Semantic Data Control in Distributed DBMS.	
UNIT III: DISTRIBUTED TRANSACTION MANAGEMENT	8
The concept and role of distributed transaction. ACID Properties of transactions, Distributed Transaction Architecture aspects, Serialization. Distributed Concurrency Control: Lock-based and Timestamp-based Concurrency Control methods. Deadlock management prevention, avoidance detection, and resolution. Nested distributed transaction.	
UNIT IV: OBJECT ORIENTED DATABASE CONCEPTS	8
Evolution of Object Oriented Concepts and Data types, Characteristics of Object Oriented Data Model. Generalization, Specialization, Aggregation. Object Schema. Inter object Relationships, Similarities and difference between Object Oriented Database model and Other Data models.	
UNIT V: OBJECT ORIENTED DATABASE ARCHITECTURE	8
The Object Oriented DBMS Architecture, Performance Issue in Object Oriented DBMS, Application	

Selection for Object Oriented DBMS, the Database Design for an Object Relational DBMS. The Structured Typed and ADTs, Object identity, Extending the ER Model ,Storage and Access Methods, Query Processing Query Optimization, Data Access API		
Text Books	1	Peter Rob, Carlos Coronnel: Database Systems – Design, Implementation and Management; Course Technology.
	2	Silberschatz, Abraham, Henry F. Korth and S. Sudarshan: Database System Concepts; McGrawHill International Edition.
Reference Books	1	Principles of Distributed Database Systems; Ozsu, M. Tamer and Patrick Valduriez. Pearson Education.
	2	Object Oriented Database System – Approaches and Architectures ; C.S.R. Prabhu, PHI
	3	R.Cattel: "Object Data management",(1993),Addison-Wesley

ELECTIVE-V UITL402: AWS: CLOUD COMPUTING SERVICES

Teaching Scheme:	Credit:	Examination Scheme:													
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks													
Prerequisite (If any): Computer Network, Operating System															
Course Outcomes: After completing this course, students will be able to															
CO1: Understand the Concepts of cloud Computing & its Services .															
CO2: Apply and Create the different types of Storage Services on AWS cloud.															
CO3: Analysis the Concepts of EC2 Services on AWS Cloud															
CO4: Demonstrate the Importance of VPC and RDS service on AWS cloud.															
CO5: Demonstrate the Importance of VPC Security Group and NACL															
Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	2	2	2	1	-	-	-	2	2	1	2	3	2	2
CO2	2	3	2	2	2	1	-	-	2	2	2	2	1	1	1
CO3	3	3	2	2	3	1	-	-	2	2	3	2	1	1	1
CO4	2	3	2	2	2	1	-	-	2	2	2	2	1	1	1
CO5	3	3	2	2	3	1	-	-	2	2	3	2	1	1	1
Course Contents															Hrs.
UNIT I: INTRODUCTION CLOUD COMPUTING															8
Cloud Computing - Definition, History of Cloud Computing - Cloud Architecture - Benefits and Challenges of Cloud Computing, Application of Cloud Computing. Cloud Deployment models: private cloud - public cloud - hybrid cloud, Community cloud, Multi-Cloud. Cloud computing Service delivery model-SaaS ,PaaS ,IaaS and UCaaS.															
UNIT II: AWS, AWS IAM And Storages Services.															8
What is AWS,AWS Uses and Services, What are AWS Components, What are AWS Products, Features of AWS, Steps for Creating AWS Account ,AWS IAM, IAM roles ,IAM Identities ,IAM uses Cases ,Creating IAM roles ,AWS S3,AWS S3 Concepts ,AWS Storage ,Classes ,AWS versioning, Cross region replication .															
UNIT III: AWS EC2 SERVICE.															8
Introduction to EC2, EC2- Pricing Options, Types of Reserved Instances, What is EBS? EBS Volume and its Types, AWS AMI, What is Load Balancer, Lambda, Cloud Watch EC2.															
UNIT IV: AWS VPC PART-I															8
What is VPC, Architecture of VPC, VPC Direct Connect, NAT Gateways, How to create NAT Gateway, VPC Private and Public Subnet, What are a Bastion Host, Architecture of Bastion Host, VPC Endpoint and VPC Flow Log.? VPC NACL.															
UNIT V: AWS VPC PART-II AND RDS															8
VPC Security Group, Differences between Security Group and NACL, AWS Data Pipeline, AWS Lightsail, Cloud Formation, AWS CLI, Amazon Relational Database Service, AWS Athena, Difference Between Microsoft SQL Server And Amazon Athena. Introduction to RDS and Creation the RDS on AWS.															
Text Books	1.	Cloud Computing Principles and Paradigms, Raj Kumar Buyya Wiley													
	2.	Distributed and Cloud Computing, Kai Hwang, Mk Publication.													

Reference Books	1.	AWS Administration – The Definitive Guide, written by <i>Yohan Wadia</i> .
	2.	Programming Amazon EC2, O'reilly Publication
	3.	Practical Amazon EC2, SQS, Kinesis, and S3: A Hands-On Approach to AWS. by Sunil Gulabani (auth.)
E-Resources	1.	https://www.javatpoint.com/aws-tutorial .
	2.	https://www.tutorialspoint.com/amazon_web_services/amazon_web_services_account.htm
	3.	https://aws.amazon.com/
	4.	https://docs.aws.amazon.com/general/latest/gr/aws-general.pdf

ELECTIVE-V UITL406 : MOBILE COMPUTING

Teaching Scheme:	Credit:	Examination Scheme:
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks

Prerequisite (If any): Computer Network

Course Outcomes: After completing this course, students will be able to

C01: Understand the mobile computing architecture, foundation for mobile computing.

C02: Analyze GSM technologies, SMS concepts in mobile Computing

C03:Explore the Services & application of GPRS

C04: Apply the concept of mobile IP network & Transport Layer.

C05: Understanding data Dissemination and data synchronization in mobile computing

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C01	3	2	2	2	2	1	-	-	3	3	2	32	2	2	3
C02	3	3	2	2	2	2	-	-	3	3	2	3	2	2	3
C03	3	3	2	2	2	2	-	-	3	3	2	3	2	2	3
C04	3	2	2	2	2	1	-	-	3	3	2	3	2	2	3
C05	3	2	2	2	2	1	-	-	3	3	2	3	2	2	3

Course Contents	Hrs.
UNIT I: Introduction	8
Mobile Computing, Middleware and gateways, application and services, security in mobile computing. Mobile Computing Architecture: Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Mobile IP, Internet Protocol version 6(IPV6).	
UNIT II: GSM & GPRS	8
Global Systems for Mobile Communication,(GSM) GSM Architecture, GSM Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Short Message Service (SMS): Mobile Computing over SMS, value added service through SMS, accessing the SMS bearer. General Packet Radio Service (GPRS):GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Limitations of GPRS, Billing and Charging in GPRS. Wireless Application Protocol(WAP): WAP,MMS,GPRS applications. CDMA and 3G:spread spectrum technology,IS-95,CDMA versus GSM, Wireless data, Third Generation Networks, applications of 3G.	
UNIT III: Mobility Support in Ip and Tcp	8
Mobile IP – Mobile Agent, Foreign Agent, Care of Address, Registration, Advertisement and Discovery, Tunneling, IP within IP – Mobility Support in IPV6 – Mobility Header, Mobility Options, Dynamic Home Agent Address Discovery, Cache Management, Bidirectional Tunneling – TCP Over Wireless Networks – Indirect TCP -Snoop TCP – Mobile TCP.	
UNIT IV: Mobile IP Network and Transport Layer	8

IP & Mobile IP Network Layers, Packet Delivery & Handover Management, Location Management, Registration, Tunneling & Encapsulation, Route Optimization, Dynamic Host Configuration Protocol, IPSec, Mobile Transport Layer, Conventional TCP/IP Transport Layer Protocol, Indirect TCP, Mobile Ad-hoc Networks(MANET), Routing and Routing Algorithms in MANET, security in ad-hoc networks.		
UNIT V: Data Dissemination and Synchronization		8
Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization–Introduction, Software, and Protocols.		
Text	1	Ashok Talukder, Roopa Yavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.
	2	Dr. Sunil kumar S. Manavi, Mahabaleshwar S. Kakkasageri, Wireless and Mobile Networks, concepts and protocols, Wiley, India.
Reference Books	1	Martyn Mallik: Mobile and wireless design essentials, Wiley ,India,2003
	2	Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi
	3	Iti Saha Misra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.

ELECTIVE-VI UTIL407: MOBILE GAME DEVELOPMENT

Teaching Scheme:	Credit:	Examination Scheme:
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks

Prerequisite (If any):

Course Outcomes: After completing this course, students will be able to

C01: Understand the concepts of Computer Graphics.

C02: Explore the various component of Game Engine Design.

C03: Demonstrate Android application program for Games.

C04: Explore various platforms & Framework for gaming

C05: Design & Develop the Game Application using DirectX or Python or Java

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
C01	3	2	3	2	1				2	2	2	2	2	2	
C02	3	3	3	2	2				2	2	1	3	3	2	
C03	3	3	3	3	2				2	2	2	3	3	2	1
C04	3	3	3	3	2				2	2	2	3	3	3	1
C05	3	3	3	3	2				2	2	2	3	3	3	1

Course Contents	Hrs.
UNIT I 3D GRAPHICS FOR GAME PROGRAMMING	8
Introduction to Computer Graphics , Graphics Transformations, Quaternions, 3D Modeling And Rendering, Ray Tracing, Shader Models, Lighting, Color, Texturing, Camera And Projections, Culling And Clipping, Character Animation, Physics-Based Simulation, Scene Graphs.	
UNIT II GAME ENGINE DESIGN	8
Game Engine Architecture, Engine Support Systems, Resources And File Systems, Game Loop And Real-Time Simulation, Human Interface Devices, Collision And Rigid Body Dynamics, Game Profiling.	
UNIT III GAME PROGRAMMING	8
Introduction to Andriod Operating System Architecture, Application Layer, Game Logic, Game Views, Managing Memory, Controlling The Main Loop, Loading And Caching Game Data, User Interface Management, Game Event Management.	
UNIT IV GAMING PLATFORMS AND FRAMEWORKS	8
2D And 3D Game Development Using Flash, DirectX, Java, Python, Game Engines – DX Studio, Unity.	
UNIT V GAME DEVELOPMENT	8
Developing 2D And 3D Interactive Games Using DirectX Or Python – Isometric And Tile Based Games, Puzzle Games, Single Player Games, Multi-Player Games Virtual Reality	

Text Books	1	Mike Mc Shaffrfy and David Graham, "Game Coding Complete", Fourth Edition, Cengage Learning, PTR, 2012.
	2	Jason Gregory, "Game Engine Architecture", CRC Press / A K Peters, 2009.
	3	David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach To Real-Time Computer Graphics" 2nd Editions, Morgan Kaufmann, 2006.
Reference Books	1	Eric Lengyel, "Mathematics For 3D Game Programming And Computer Graphics", 3rd Edition, Course Technology PTR, 2011
	2	Jesse Schell, The Art Of Game Design: A Book Of Lenses, 1st Edition, CRC Press, 2008.

ELECTIVE-VI UITL403: DevOpS: SOFTWARE DEVELOPMENT & IT OPERATIONS

Teaching Scheme:	Credit:	Examination Scheme:													
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks													
Prerequisite (If any): Linux, Virtualization, Cloud Computing Fundamentals															
Course Outcomes: After completing this course, students will be able to															
C01: Understand the benefits of DevOps over other software development processes .															
C02: Explore Version Control System for DevOps															
C03: Design, Test & Deployment Configuration Management Tools Automation															
C04: .Analyze different DevOps Tools															
C05: Demonstrate different working of the DevOps Delivery Pipeline.															
Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C01	3	2	2	2	2	-	-	-	2	3	2	2	2	2	2
C02	3	3	3	3	2	-	-	-	2	3	2	2	2	3	2
C03	3	3	3	3	2	-	-	-	2	3	2	2	2	3	2
C04	3	3	3	3	2	-	-	-	2	3	2	2	2	3	2
C05	3	3	3	3	2	-	-	-	2	3	2	2	2	3	2
Course Contents															Hrs.
UNIT I: INTRODUCTION TO DEVOPS															8
Concepts of SDLC, Agile, ITIL and Need for DevOps, History of DevOps, Role of a DevOps Engineer, Terminologies in DevOps															
UNIT II: VERSION CONTROL SYSTEMS															8
Introduction to Version Control Systems (VCS), Need for using a Version Control Systems, Types of Version Control Systems: Simple VCS, Centralized VCS and Distributed VCS, Introduction to GIT, SVN and Bitbucket, Git Essentials, Git Commandline, Git architecture and versions of Git, Cloning, Check-in and Commit of Git Repositories, Fetching the Repositories, Git Pull and Git Branching Technique.															
UNIT III: CONFIGURATION MANAGEMENT TOOLS															8
Introduction to Configuration Management tools, Types of Configuration Management Tools : Push-based & Pull-based, Introduction to Ansible, Puppet, Chef & Salt, Ansible : What is Ansible and its Architecture, Why do we need Ansible, Ansible Terminologies, Advantages, Infrastructure-as-a-code, Writing Ansible Playbooks using YAML, Ansible Case Study : SPLUNK, Best practices															
UNIT IV: VAGRANT AND CONTAINERIZATION															8
Introduction to Vagrant and its Uses, Installation of Vagrant in Linux and Windows, Understanding the Vagrant File, Provisioning Virtual Machines with Vagrant using Virtual															

box, Networking & Port Forwarding with Vagrant.		
Introduction to Containerization, Docker Essentials, What is Docker Hub and Images, Fundamentals of Micro services, Understanding the Docker File, Docker Compose and Docker Swarm, Difference between Docker Swarm and Kubernetes for Container Orchestration.		
UNIT V: CI/CD PIPELINES AND CONTINUOUS MONITORING		8
What is Continuous Integration and Continuous Deployment (CI/CD), Need of CI/CD in DevOps, Practical Implementation of CI/CD pipelines using Jenkins, Understanding the Jenkins Plugins, Continuous Testing & E-mail notifications, Benefits of a production-ready software		
Introduction to Continuous Monitoring, Why Continuous Monitoring is essential, Continuous Monitoring with Nagios, Datadog and AWS CloudWatch, Application Performance Monitoring with New Relic, Centralized Logging with ELK (Elasticsearch-Logstash-Kibana). Successful paths to automate the IT processes.		
Text Books	1	The DevOps Handbook, Authors: Gene Kim, Jez Humble, Patrick Debois, John Allspaw and John Willis.
	2	Effective DevOps, Authors: Jennifer Davis and Ryn Daniels
Reference Books	1	U. Emily Freeman, DevOps For Dummies, John Wiley & Sons (2019), ISBN: 1119552222, 9781119552222
	2	Joakim Verona, Practical DevOps – Second Edition, May 2018, Packt Publishing, ISBN: 9781788392570

Elective-VI UITL408 : Multirate Signal Processing

Teaching Scheme:	Credit:	Examination Scheme:
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks
Prerequisite (If any):		
Course Objectives:		
1. To define basic sampling rate conversion algorithms.		
2. To draw and describe different kinds of Multirate Systems		
3. To analyze how the different filter banks work.		
Course Outcomes: After completing this course, students will be able to		
CO1: To understand the concepts of sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques.		
CO2: To explain how the multirate system and its implementation work.		
CO3: To implement different Multirate filter banks and its conversion.		
CO4: To Understand the concept of Para-unitary Perfect Reconstruction (PR) Filter Banks		
CO5 : To Demonstrate the Concepts of Multidimensional and Mutirate Filters		
Course Contents		Hrs.
UNIT I: Review of digital signal processing fundamentals		8
Sampling of continuous-time signals and the sampling theorem, The Fourier-transform and z-transform of discrete-time signals , Discrete Fourier transform , Design of IIR and FIR filters , Spectral analysis of signals		
UNIT II: Fundamentals of Multirate Systems		8
Fundamentals of multirate digital signal processing: Upsampling, down sampling, interpolation decimation , Resampling with rational factor , Polyphase decomposition, Multi-stage Interpolation and Decimation systems		
UNIT III: Maximally Decimated Filter Banks		8
Introduction, Errors Created in the QMF Bank, A Simple Alias-Free QMF System, Power Symmetric QMF Banks, M-channel Filter Banks, Polyphase Representation, Perfect Reconstruction (PR) Systems ,Alias-Free Filter Banks, Tree Structured Filter Banks ,Transmultiplexers		
UNIT IV: Paraunitary Perfect Reconstruction (PR) Filter Banks		8
Introduction, Lossless Transfer Matrices, Filter Bank Properties Induced by Paraunitariness, Two Channel FIR Paraunitary QMF Banks, The Two Channel Paraunitary QMF Lattice, M-channel FIR Paraunitary Filter Banks ,Transform Coding and the "LOT"		
UNIT V: Multidimensional Multirate Systems		8
Introduction, Multidimensional Signals, Sampling a Multidimensional Signal, Minimum Sampling Density, Multirate Fundamentals, Alias-Free Decimation, Cascade Connections, Multirate Filter Design ,Special Filters and Filter Banks ,Maximally Decimated Filter Banks		

Text Books	1.	Shafer, and J. Buck, "Discrete-time signal processing," Prentice-Hall, 1999.
	2.	L. C. Ludeman, "Fundamentals of digital signal processing," John Wiley and Sons,
Reference Books	1.	N.J.Fliege , John Wiley and Sons, Multirate Digital Signal Processing.
	2.	J. Proakis and D. Manolakis, "Digital Signal Processing: Principles, algorithms and applications," Prentice-Hall, 1996.
	3.	C. Sidney Burrus et al., "Computer-Based Exercises for Signal Processing using MATLAB," Prentice-Hall, 1994.
	4.	Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia, Wavelet Transforms Introduction to Theory and Application.

ELECTIVE-VI UITL404 Git : CONTROL SYSTEM FOR TRACKING CHANGES

Teaching Scheme:		Credit:		Examination Scheme:											
Lectures: 03 Hrs./Week		3		TAE: 10 Marks CAE: 15 Marks ESE : 50 Marks											
Prerequisite (If any):															
Course Outcomes: After completing this course, students will be able															
CO1: To Understand the basics concepts of Git Installation.															
CO2: To Understand the basics Terminology of Git															
CO3: To Identify the Git Branching Techniques for Tracking Changes															
CO4: To Create and manage repositories on Gitlab															
CO5: To Demonstrate The Concepts of different Project Distributed GIT															
Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	2	3	2	3	2	1	2
CO2	2	3	2	2	2	-	-	-	2	3	2	3	2	2	2
CO3	2	2	3	3	2	-	-	-	2	3	2	3	2	3	2
CO4	2	3	3	2	2	-	-	-	2	3	2	3	2	3	2
CO5	2	3	3	2	2	-	-	-	2	3	2	3	2	3	2
Course Contents						Hrs.									
UNIT I: Introduction						7									
Git Introduction, What is GitHub , open link, Git vs GitHub, Git vs SVN, Git vs Mercurial ,Version Control System. Install Git on Windows, Install Git on Linux, Install Git on Mac, Git Environment, Setup Git Tools, it Terminology, Git Commands, Git Flow.															
UNIT II: Basics of Gits						7									
Repositories, Git Object Types, Index, Content Addressable Names, Git Track Content, Pathname Vs Content, Pack Files, Object Store Pictures, Git Concept at work,															
Unit III: Git Branching						8									
Branching in Nutshell-creating a new branch, Listing switching branches, branching and merging, branch management, branching workflows, remote branches, Rebasing, Rebase Vs Merge															
UNIT IV: Git on the Server						7									
The protocols, Getting git on Server, SSH Access, Generating SSH public Key, Git Daemon, Smart HTTP GitWeb, GitLab,															
UNIT V: Distributed Git & Github						7									
Distributed Workflow, Contributing to a project, Maintaining a Project, Merging Workflow, Account setup & Configuration, Case Studies.															
Text Books	1	Pro Git: Scott Chacon and Ben Straub, Apress Publication Second Edition													
	2	Version Control with Git: Jon Loeliger & Mathew McCullough, Oreilly publisher, 2 nd Edition													
Reference Books	1	Learn Git in a Month of Lunches , Rick Umali, Manning Publications													

Elective-V UITL416 : Pervasive Computing

Teaching Scheme:	Credit:	Examination Scheme:
Lectures: 03 Hrs./Week	3	TAE: 10 Marks ,CAE: 15 Marks, ESE :50 Marks
Prerequisite (If any):		
Course Objectives:		
1. To introduce pervasive computing abilities.		
2. To introduce tools and techniques used while solving problems using pervasive computing.		
3. To study algorithmic examples in distributed, concurrent and parallel environments		
Course Outcomes: After completing this course, students will be able to		
CO1. To present a survey on pervasive computing building blocks		
CO2. To create presentations using pervasive computing techniques and devices.		
CO3. To solve problems for multi-core or distributed, concurrent/Parallel environments.		
CO4: To understand the communication Architecture		
CO5: To understand the security issues in Pervasive Networks		
Course Contents		Hrs.
UNIT I: Introduction		8
Distributed Computing Concept, Mobile and Pervasive Computing, Wearable Computing, Properties of Pervasive Computing, Challenges and Technology of Pervasive Computing.		
UNIT II: Pervasive Computing Devices		7
Smart Environment: CPI and CCI, Smart Devices: Application and Requirements, Device Technology and Connectivity, Middleware for Pervasive Computing Systems, Pervasive Computing Environments.		
UNIT III: HCI(Human Computer Interaction)		7
HCI Service and Interaction Migration, Context-Driven HCI Service Selection, Scenario Study: Video Calls at a Smart Office, and A Web Service–Based HCI Migration Framework are all examples of HCI interfaces in pervasive environments.		
UNIT IV: Middleware for Pervasive		7
Communication Architecture, Communication Aspects Adaptive middleware, Context aware middleware, Mobile middleware, Service Discovery, Mobile Agents.		
UNIT V: Communication & Security in Pervasive Computing		7
Security and Privacy in Pervasive Networks, Experimental Comparison of Collaborative Defense Strategies for Network Security		

Text Books	1.	Stefan Poslad, Ubiquitous Computing, Smart devices, environment and interaction, Wiley.
	2.	Frank Adelstein, Sandeep Gupta, Golden Richard III, Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, Tata McGraw Hills

Reference Books	1.	Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtorff, Thomas Schaeck, Pervasive Computing, Pearson, Eighteenth Impression, 2014.
	2.	BoS Content: Books, Course Notes, Digital contents, Blogs developed by the BoS for bridging the gaps in the syllabus, problem solving approaches and advances in the course

Elective-II (UITL414 / UITP414) : CLOUD COMPUTING

Semester	VII	Teaching Scheme				Evaluation Scheme				
					Credits	Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3 Hrs	NA	2 Hrs	4	10	15	50	25	NA
Course Code	UITL414 / UITP414									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs						100			

Course Objectives	To understand Cloud Computing concepts, technologies, architecture and applications
	To understand the underlying principle of cloud virtualization, cloud storage, data management and data visualization
	To understand different cloud programming platforms and tools to develop and deploy applications on cloud
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Develop and deploy cloud application using popular cloud platforms
	CO2: Design and develop highly scalable cloud-based applications by creating and configuring virtual machines on the cloud and building private cloud
	CO3: Design and deploy a cloud application in a PaaS environment
	CO4: Develop cloud computing solutions for an enterprise
	CO5: Analyze various cloud programming models and apply them to solve problems on the cloud

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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

Course Contents:

Unit	Contents	Hours
I	Introduction to Cloud Computing and Virtualization: Virtualization Concepts, Cloud Computing Fundamental: Overview of Computing Paradigm, Evolution of cloud computing, Defining cloud computing, Components of a computing cloud, Essential Characteristics of Cloud Computing, Cloud Taxonomy. Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service (SaaS), Hardware-as-a-service: (HaaS), Oriented Architecture (SOA)	6
II	Cloud Computing Architecture and Service Management in Cloud: ComputingCloud architectural principles, Role of Web services, Benefits and challenges to Cloud architecture, Cloud Service Models, cloud computing vendors. Cloud Services, Management, Performance and scalability of services, tools and technologies used to manage cloud services deployment	6
III	Data Management in Cloud Computing and Resource Management in Cloud)	5
IV	Cloud Security and Risk Management:Cloud Security: Understanding cloud based security issues and threats, Data security and Storage, Identity& Access Management, Risk Management in cloud, Governance and Enterprise Risk Management.	7
V	Open Source and Commercial Clouds: Openstack, AWS, Google Cloud, Microsoft Azure, Cloud Simulator and IoT Cloud Framework, Research trend in Cloud Computing, Fog Computing,	7

Text Books	1.	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
	2.	Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
E--Books	1.	CLOUD COMPUTING Principles and Paradigms Link: http://dphoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf
Reference Books	1.	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
	2.	Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
Online TL Material	1.	https://nptel.ac.in/courses/106/105/106105167/

List of Practical (UITP414)

Sr. No.	Name of Experiments / Mini Projects/ Case Studies/ Activity based
1	Explore AWS Cloud Based IaaS Service
2	Implement Virtualization using Virtualbox/VMware Workstation
3	Creating a Warehouse Application in SalesForce.com PaaS

4	Explore Cloud Services using CloudSim Simulator
5	Explore Cloud Service using Google Cloud
6	Explore Cloud Service and table formation using Microsoft Azure Cloud
7	Creating a Warehouse Application in SalesForce.com PaaS
8	Explore open source cloud platform Openstack
9	Implement container management with Kubernetes
10	Implement DevOps and MLOPS using Cloud
Open Ended Experiments / New Experiments	
1	Explore different IoT Cloud Framework
2	Explore Fog Computing Framework
Details of on line Laboratory Resource Material Instruction / Operating Manuals	
1	https://cloud.google.com/training
2	https://trailhead.salesforce.com/en
3	https://aws.amazon.com/
4	https://azure.microsoft.com/en-in/