CURRICULUM

(REGULATIONS 2019 V21)

FOR

B.E. COMPUTER SCIENCE AND ENGINEERING

CYBER SECURITY

CHOICE BASED CREDIT SYSTEM

(Applicable to the students admitted from the Academic Year 2022-23 onwards)

EASWARI ENGINEERING COLLEGE

(Autonomous Institution)
BharathiSalai, Ramapuram, Chennai - 600 089

[A Unit of SRM Group of Educational Institutions, Approved by AICTE | Affiliated to Anna University, Chennai | NAAC Accredited 'A' Grade | 2(f) & 12(B) Status (UGC) | ISO 9001:2015 Certified | NBA Accredited Programmes | FIST Funded (DST) | SIRO Certified (DSIR)]

SEMESTER I								
S.No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
THEORY								
1.	191LEH101T	Technical English	HS	3	-	-	-	3
2.	191MAB101T	Engineering Mathematics I	BS	3	2	-	-	4
3.	191PYB101T	Engineering Physics	BS	3	-	-	-	3
4.	191CYB101T	Engineering Chemistry	BS	3	-	-	-	3
5.	191GES101T	Engineering Graphics	ES	2	-	4	-	4
6.	191GES102T	Problem Solving through Python Programming	ES	3	-	-	-	3
LABORATORY								
7.	191GEB111L	Physics and Chemistry Laboratory	BS	-	-	4	-	2
8.	191GES111L	Python Programming Laboratory	ES	-	-	3	1	2
TOTAL CREDITS								**24**
MANDATORY COURSE								
9.	191GEM101L	Induction Training[&]	MC	-	-	2	-	1[&]
10.	191GEM102T	தமிழர்மரபு / Heritage of Tamils	MC	1	-	-		1[^]

[^] Mandatory to register for the course and earn one credit

[&] Mandatory to attend Induction training programme and earn one credit.

SEMESTER II								
S.No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
THEORY								
1.	191LEH201T	Professional Communication – BEC Certification	HS	3	-	-	-	3
2.	191MAB201T	Engineering Mathematics II	BS	3	2	-	-	4
3.	191PYB202T	Physics for Information Science	BS	3	-	-	-	3
4.	191GES201T	Basic Electrical and Electronics Engineering	ES	3	-	-	-	3
5.	191GES204T	Programming in C	ES	3	-	-	-	3
LABORATORY								
6.	191GES211L	Engineering Practices Laboratory	ES	-	-	4	-	2
7.	191GES213L	C Programming Laboratory	ES	-	-	3	1	2
MANDATORY COURSE								
8.	191CYM201T	Environmental Science[&&]	MC	3	-	-	-	3[&&]
9.	191GEM211L	NSS / NCC /YRC – Phase - I[*]	MC	-	-	2	-	1*
10.	191GEM202T	தமிழரும்தொழில்நுட்பமும்/ Tamils and Technology	MC	1	-	-	-	1[^]
TOTAL				**18**	**2**	**9**	**1**	**20**

[^] Mandatory to register for the course and earn one credit

&& Mandatory to register for the course and earn three credits

* The student may opt for any one. They have to complete the respective Phase II and Phase III. Those who are not opting NSS/NCC/YRC have to opt for Foreign language / Indian constitution in the sixth semester.

SEMESTER III								
S.No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
THEORY								
1.	191MAB302T	Discrete Mathematics	BS	3	2	-	-	4
2.	191ECS321T	Digital Principles and System Design	ES	3	-	-	-	3
3.	191CSC301T	Software Engineering	PC	3	-	-	-	3
4.	191CSC302T	Object Oriented Programming with C++	PC	3	-	-	-	3
5.	191CSC303T	Data Structures	PC	3	-	-	-	3
6.	191CSC304T	Computer Architecture	PC	3	-	-	-	3
LABORATORY								
7.	191CSC311L	Data Structures Laboratory in C	PC	-	-	4	-	2
8.	191CSC312L	Object Oriented Programming Laboratory	PC	-	-	3	1	2
HUMAN EXCELLENCE COURSE								
9.	191GEH311L	Yoga / Social Service – Phase – I **	HS	-	-	2	-	1
TOTAL CREDITS								**24**
EMPLOYABILITY ENHANCEMENT COURSE								
10.	191CSA311I	Internship / Industrial Training#	EEC	-	-	-	-	1#
11	191CSA301I	Industry Supported Course (Optional) ##	EEC	-	-	-	-	1##
ONLINE COURSE								
12		Online Course (Optional) $	PE	-	-	-	-	3$

** Student may opt for any one. They have to complete the respective Phase II in semester V.

Mandatory to do Internship and earn minimum one credit between 3rd and 6th semester.

Students may earn credits in lieu of Professional elective - V in 8th semester.Please refer Clause 26.1.1 of B.E. Regulations 2019.

$ Online courses of three credits each can be considered in lieu of ProfessionalElective – IV and Professional Elective – VI. A student earned only three credits can drop only Professional Elective – VI. Please refer Clause14.9 of B.E. Regulations 2019.

SEMESTER IV								
S. No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
THEORY								
1.	191MAB403T	Probability And Number Theory	BS	3	2	-	-	4
2.	191CSC401T	Design and Analysis of Algorithms	PC	3	-	-	-	3
3.	191CSC402T	Operating Systems	PC	3	-	-	-	3
4.	191CSC403T	Database Management Systems	PC	3	-	-	-	3
5.	191CSC404T	Programming in Java	PC	3	-	-	-	3
LABORATORY								
6.	191CSC411L	Operating Systems Laboratory	PC	-	-	4	-	2
7.	191CSC412L	Database Management Systems Laboratory	PC	-	-	3	1	2
8.	191CSC413L	Java Programming Laboratory	PC	-	-	4	-	2
TOTAL CREDITS								**22**
MANDATORY COURSE								
9.	191GEM411L	NSS / NCC / YRC – Phase - II *	MC	-	-	2	-	1*
EMPLOYABILITY ENHANCEMENT COURSE								
10.	191CSA411I	Internship / Industrial Training#	EEC	-	-	-	-	1#
11.	191CSA401I	Industry Supported Course (Optional) ##	EEC	-	-	-	-	1##
ONLINE COURSE								
12.		Online Course (Optional) $	PE	3	-	-	-	3$

* Students have to complete the respective phase II.

\# Mandatory to do Internship and earn minimum one credit between 3rd and 6th semester.

Students may earn credits in lieu of Professional elective – V in 8th semester. Please refer Clause 26.1.1 of B.E. Regulations 2019.

$ Online courses of three credits each can be considered in lieu of ProfessionalElective – IV and Professional Elective – VI. A student earned only three credits can drop only Professional Elective – VI. Please refer Clause14.9 of B.E. Regulations 2019

SEMESTER V								
S.No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
THEORY								
1.	191CSC501T	Computer Networks	PC	3	2	-	-	4
2.	191CCC501T	Cyber Security Essentials	PC	3	-	-	-	3
3.	191CCC502T	Cryptography	PC	3	-	-	-	3
4.		Professional Elective-I	PE	3	-	-	-	3
5.		Open Elective - I	OE	3	-	-	-	3
LABORATORY								
6.	191CSC511L	Computer Networks Laboratory	PC	-	-	3	1	2
7.	191CCC511L	Cryptography and Cyber Security Laboratory	PC	-	-	2	-	1
HUMAN EXCELLENCE COURSE								
8.	191GEH511L	Yoga / Social Service – Phase -II**	HS	-	-	2	-	1
TOTAL CREDITS								**20**
EMPLOYABILITY ENHANCEMENT COURSE								
9.	191CSA511I	Internship / Industrial Training#	EEC	-	-	-	-	1#
10.	191CSA501I	Industry Supported Course (optional) ##	EEC	-	-	-	-	1##
ONLINE COURSE								
11.		Online Course (Optional) $	PE	3	-	-	-	3$

** Students have to complete the respective phase II.

Mandatory to do Internship and earn minimum one credit between 3rd and 6th semester.

Students may earn credits in lieu of Professional Elective - V in 8th semester. Please refer Clause 26.1.1 of B.E. Regulations 2019.

$ Online courses of three credits each can be considered in lieu of Professional Elective – IV and Professional Elective – VI. A student earned only threecredits can drop only Professional Elective – VI. Please refer Clause 14.9 of B.E. Regulations 2019.

SEMESTER VI								
S.No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
THEORY								
1.	191CCC601T	Cyber Threat Intelligence	PC	3	-	-	-	3
2.	191CCC602T	Network Security	PC	3	-	-	-	3
3.	191CSC603T	Compiler Design	PC	3	2	-	-	4
4.		Professional Elective – II	PE	3	-	-	-	3
5.		Open Elective - II	OE	3	-	-	-	3
LABORATORY								
6.	191LEH611L	Interpersonal Skills / Listening and Speaking	HS	-	-	2	-	1
7.	191CCC611L	Security and Penetration Testing Laboratory	PC	-	-	3	1	2
TOTAL CREDITS								**19**
MANDATORY COURSE								
8.	191GEM611L	NSS / NCC / YRC – Phase - III*	MC	-	-	2	-	1*
9.	191GEM601T	Foreign Language / Indian Constitution &	MC	3	-	-	-	3&
EMPLOYABILITY ENHANCEMENT COURSE								
10.	191CSA611I	Internship / Industrial Training #	EEC	-	-	-	-	1#
11.	191CSA601I	Industry Supported Course (optional) ##	EEC	-	-	-	-	1##
ONLINE COURSE								
12.		Online Course (Optional) $	PE	3	-	-	-	3$

* Students have to complete the respective phase III.

& Students those who have not earned 3 credits through NSS / NCC / YRC must register for this course and earn 3 credits.

Mandatory to do Internship and earn minimum one credit between 3rd and 6th semester.

Students may earn credits in lieu of Professional Elective -V in 8th semester.Please refer Clause 26.1.1 of B.E. Regulations 2019.

$ Online courses of three credits each can be considered in lieu of Professional Elective – IV and Professional Elective – VI. A student earned only three credits can drop only Professional Elective – VI. Please refer Clause 14.9 of B.E. Regulations 2019.

SEMESTER VII								
S.No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
THEORY								
1.	191MBH721T	Professional Ethics	HS	3	-	-	-	3
2.	191CCC701T	Cyber Forensics	PC	3	-	-	-	3
3.		Professional Elective – III	PE	3	-	-	-	3
4.		Professional Elective – IV	PE	3	-	-	-	3
5.		Open Elective - III	OE	3	-	-	-	3
6.	191CSA701T	Comprehension@	PE	-	-	-	-	3@
LABORATORY								
7.	191CCC711L	Cyber Forensics Laboratory	PC	-	-	3	1	2
EMPLOYABILITY ENHANCEMENT COURSE								
8.	191CSP711J	Project Work / Startup - Phase - I	EEC	-	-	-	4	2
9.	191CSA711I	Internship / Industrial Training #	EEC	-	-	-	-	1
TOTAL CREDITS								**20**
EMPLOYABILITY ENHANCEMENT COURSE								
10.	191CSA701I	Industry Supported Course (optional) ##	EEC	-	-	-	-	1##

@ Students may earn credits in lieu of Professional elective – III in 7th semester. Please refer clause 26.2 of B.E. Regulations 2019

Mandatory to earn at least one credit by doing internship between 3rd and 6th semester with one credit reflecting in this semester for CGPA calculation.

Students may earn credits in lieu of Professional Elective - V in 8th semester. Please refer Clause 26.1.1 of B.E. Regulations 2019.

$ Online courses of three credits each can be considered in lieu of Professional Elective – IV and Professional Elective – VI. A student earned only three credits can drop only Professional Elective – VI. Please refer Clause 14.9 of B.E. Regulations 2019.

SEMESTER VIII								
S.No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
THEORY								
1.		Professional Elective - V	PE	3	-		-	3
2.		Professional Elective - VI	PE	3	-		-	3
EMPLOYABILITY ENHANCEMENT COURSE								
3.	191CSP811J	Project Work / Start up – Phase - II	EEC	-	-	-	20	10
TOTAL				**6**	**-**	**-**	**20**	**16**

PROGRAMME TOTAL CREDITS = 165

LIST OF SUBJECTS

HUMANITIES & SOCIAL SCIENCE COURSES (HS)

S.No	Course Code	Course Title	Semester	Credits
1	191LEH101T	Technical English	I	3
2	191LEH201T	Professional Communication - English / Japanese / French	II	3
3	191GEH311L	Yoga / Social Service – Phase – I **	III	1
4	191GEH511L	Yoga / Social Service – Phase - II**	V	1
5	191LEH611L	Interpersonal Skills / Listening and Speaking	VI	1
6	191MBH721T	Professional Ethics	VII	3
TOTAL CREDITS				**12**

BASIC SCIENCE COURSES (BS)

S.No	Course Code	Course Title	Semester	Credits
1	191MAB101T	Engineering Mathematics I	I	4
2	191PYB101T	Engineering Physics	I	3
3	191CYB101T	Engineering Chemistry	I	3
4	191GEB111L	Physics and Chemistry Laboratory	I	2
5	191MAB201T	Engineering Mathematics II	II	4
6	191PYB202T	Physics for Information Science	II	3
7	191MAB302T	Discrete Mathematics	III	4
8	191MAB403T	Probability And Number Theory	IV	4
TOTAL CREDITS				**27**

ENGINEERING SCIENCE COURSES (ES)

S.No	Course Code	Course Title	Semester	Credits
1	191GES101T	Engineering Graphics	I	4
2	191GES102T	Problem Solving through Python Programming	I	3
3	191GES111L	Python Programming Laboratory	I	2
4	191GES201T	Basic Electrical and ElectronicsEngineering	II	3
5	191GES204T	Programming in C	II	3
6	191GES211L	Engineering Practices Laboratory	II	2
7	191GES213L	C Programming Laboratory	II	2
8	191ECS321T	Digital Principles and System Design	III	3
TOTAL CREDITS				22

PROFESSIONAL CORE COURSES (PC)

S.No	Course Code	Course Title	Semester	Credits
1	191CSC301T	Software Engineering	III	3
2	191CSC302T	Object Oriented Programming with C++	III	3
3	191CSC303T	Data Structures	III	3
4	191CSC304T	Computer Architecture	III	3
5	191CSC311L	Data Structures Laboratory in C	III	2
6	191CSC312L	Object Oriented Programming Laboratory	III	2
7	191CSC401T	Design and Analysis of Algorithms	IV	3
8	191CSC402T	Operating Systems	IV	3
9	191CSC403T	Database Management Systems	IV	3
10	191CSC404T	Java Programming	IV	3
11	191CSC411L	Operating Systems Laboratory	IV	2
12	191CSC412L	Database Management Systems Laboratory	IV	2
13	191CSC413L	Java Programming Laboratory	IV	2
14	191CSC501T	Computer Networks	V	4
15	191CCC501T	Cyber Security Essentials	V	3
16	191CCC502T	Cryptography	V	3
17	191CSC511L	Computer Networks Laboratory	V	2
18	191CCC511L	Cryptography and Cyber Security Laboratory	V	1
19	191CSC603T	Compiler Design	VI	4
20	191CCC601T	Cyber Threat Intelligence	VI	3
21	191CCC602T	Network Security	VII	3
22	191CCC611L	Security and Penetration Testing Laboratory	VII	2
23	191CCC701T	Cyber Forensics	VI	3
24	191CCC711L	Cyber Forensics Laboratory	VI	2
TOTAL CREDITS				**64**

LIST OF OPEN ELECTIVES

Semester V								
S.No	Course Code	Course Title	Category	Hours / Week				CREDITS
				L	T	P	R	
1	191CSO501T	Programming in C	OE	3	-	-	-	3
2	191CSO502T	Programming in C++	OE	3	-	-	-	3
3	191CSO503T	Software Engineering	OE	3	-	-	-	3
Semester VI								
1	191CSO601T	Programming in JAVA	OE	3	-	-	-	3
2	191CSO602T	User Interface Design	OE	3	-	-	-	3
3	191CSO603T	Internet of Things	OE	3	-	-	-	3
Semester VII								
1	191CSO701T	Web Designing	OE	3	-	-	-	3
2	191CSO702T	Introduction to Database Systems	OE	3	-	-	-	3
3	191CSO703T	Fundamentals of Data Structure	OE	3	-	-	-	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	Course Code	Course Title	Semester	Credits
1		Internship / Industrial Training	III to VII	1
2		Industry Supported Course(optional)	III to VII	--
3	191CSP711J	Project work / Startup Phase I	VII	2
4	191CSP811J	Project work / Startup Phase II	VIII	10
TOTAL CREDITS				**13**

MANDATORY COURSES (MC)

S.No	Course Code	Course Title	Semester	Credits
1	191GEM101L	Induction Training[&]	I	1[&]
2	191GEM102T	தமிழர்மரபு / Heritage of Tamils	I	1^
3	191CYM201T	Environmental Science [&&]	II	3[&&]
4	191GEM202T	தமிழரும்தொழில்நுட்பமும்/ Tamils and Technology	II	1^
5	191GEM211L	NSS / NCC /YRC - Phase I[*]	II	1*
6	191GEM411L	NSS / NCC / YRC - Phase II[*]	IV	1*
7	191GEM611L	NSS / NCC / YRC - Phase III[*]	VI	1*
8	191GEM601T	Foreign Language / Indian Constitution[&]	VI	3[&]

CREDIT DISTRIBUTION

SEMESTER	I	II	III	IV	V	VI	VII	VIII	CREDIT
Humanities and Social Sciences (HS)	3	3	1		1	1	3		**12**
Basic Sciences(BS)	12	7	4	4					**27**
Engineering Sciences (ES)	9	10	3						**22**
Professional Core (PC)			16	18	13	12	5		**64**
Professional Electives (PE)					3	3	6	6	**18**
Open Electives (OE)					3	3	3		**09**
Employability Enhancement Courses (EEC)							3	10	**13**
Total Credit	**24**	**20**	**24**	**22**	**20**	**19**	**20**	**16**	**165**

NON CGPA COURSES DETAILS

	I	II	III	IV	V	VI	VII	VIII	Minimum credits to be earned for awarding degree
In plant Training / Internship			√	√	√	√	√		**1**
Industry Supported Course			√	√	√	√	√		**-**
Mandatory courses (MC)	√	√		√		√			**7**
Online Courses (PE)			√	√	√	√	√		**-**

SYLLABUS OF

SEMESTER – I

COURSES

191LEH101T	TECHNICAL ENGLISH (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To develop the basic writing skills of the First year Engineering students.
2.	To help learners develop their listening skills, which will, enable them to listen to lectures and enhance their ability to comprehend by asking questions and seeking clarification.
3.	To help learners develop their speaking skills and help them to speak fluently.
4.	To inculcate reading habit and to develop effective reading skills.
5.	To help students improve their active and passive vocabulary.

UNIT	TITLE	PERIODS
I		9
Short comprehension passages – skimming, scanning, predicting and inference of the passage – Tips for effective writing –Hints development – Purpose of a good conversation – Tips for improving Conversation – Active and Passive listening – Types of listening – Barriers to listening – listening for specific purposes – Listening to lectures and note taking - Parts of Speech - Tenses – WH Questions – Yes/No questions – Prefixes and Suffixes – Word formation.		
UNIT	TITLE	PERIODS
II		9
Longer Comprehension passages - Questions – multiple choice –short questions – open-ended questions – Sentence structure - Types of paragraph – Short narrative paragraphs– Comparison and contrast – argumentative paragraph – analytical paragraph – Techniques for writing precisely - Introducing your friend – Exchange information – Expressing opinion/ agreeing /disagreeing - Telephonic conversation - If Clause – Subject verb agreement – degrees of comparison – Pronouns - adverbs.		
UNIT	TITLE	PERIODS
III		9
Short texts – Cloze passage guessing from context – Note making – Use of reference words – Discourse markers – Connectives – Jumbled sentences –Product description–Process description - Prepositions - Direct/Indirect speech – Connotations – One word substitution – Idiomatic expressions.		
UNIT	TITLE	PERIODS
IV		9
Different types of texts – Newspapers/ magazines/short stories - Inference – Tips for effective writing – Letter writing –– Letter to the Editor - Speaking about oneself/ hometown – Review of books – listening to native speakers – American accent and neutral accent - Countable/Uncountable nouns – Articles – Synonyms and Antonyms – Phrasal verbs.		

UNIT	TITLE	PERIODS
V		9
Reading for specific purpose – Short essays – developing an outline –Group discussion – Giving advice – Modal verbs – Instructions and Recommendations - Collocations.		

TOTAL PERIODS:	**45**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Listening – Listen and comprehend lectures and talks in their area of specialization successfully
CO2:	Speaking- Speak appropriately and effectively in varied formal and informal contexts**.**
CO3:	Reading – Read technical texts and write area- specific texts effortlessly
CO4:	Writing- Write reports and winning job applications
CO5:	Speak convincingly and participate in Group Discussions
CO6:	Communicate effectively through emails and analyze issues, technical articles and involve in speed reading

TEXT BOOKS:	
1.	Sanjay Kumar, PushpLata. English Language and Communication Skills for Engineers, Oxford University Press 2018

REFERENCE BOOKS:	
1.	Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2.	Dutt P. Kiranmai and RajeevanGeeta. Basic Communication Skills, Foundation Books: 2013
3.	Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning USA: 2007

WEBSITES:	
1.	https://www.usingenglish.com, http://grammarbook.com

JOURNALS:	
1	National Council for Teachers of English https://www2.ncte.org/resources/journals/college-english/

EXTENSIVE READER:	
1.	Spencer Johnson, Who Moved My Cheese, Putnam Adult, 1998

191MAB101T	ENGINEERING MATHEMATICS – I (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		3	2	0	0	4

PREREQUISITES:
NIL

UNIT	TITLE	PERIODS
I	MATRICES	12
Overview of system of Linear Equations - Eigen values and Eigen vectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigen vectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.		
UNIT	TITLE	PERIODS
II	DIFFERENTIAL CALCULUS	12
Limit of a function - Continuity - Derivatives – Differentiation Rules – Mean Value Theorem – Interval of increasing and decreasing functions – Maxima and Minima - Interval of concavity and convexity –Taylor's Series for one variable.		
UNIT	TITLE	PERIODS
III	MULTIVARIABLE CALCULUS	12
Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties Taylor's series for functions of two variables – Maxima, minima and saddle points - Method of Lagrange multipliers.		
UNIT	TITLE	PERIODS
IV	INTEGRAL CALCULUS	12
Definite Integrals and its properties –Fundamental theorem of Calculus - Techniques of integration for Indefinite Integrals using basic integration formulas – Integration by parts – Trigonometric Substitutions – Integration of Rational functions by Partial Fractions.		
UNIT	TITLE	PERIODS
V	MULTIPLE INTEGRATION	12
Double integrals – Change the order of integration in double integrals - Change of variables (Cartesian to polar) - Applications: areas and volumes - Triple integrals (Cartesian, Cylindrical and Spherical coordinates).		

TOTAL PERIODS:	60

COURSE OUTCOMES:	
The Course aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.	
The students will learn:	
CO1:	Examine the consistency of given linear Homogeneous and Non-Homogeneous simultaneous equations by using rank method.
CO2:	Find Eigen values, Eigen vectors of square matrices to convert quadratic form in to canonical form
CO3:	Find the extreme values of functions of single and multivariable functions by using derivatives and partial derivatives respectively.
CO4:	Evaluate single integral involving trigonometry, algebraic, exponential and logarithmic functions by using methods of substitution and integration by parts.
CO5:	Find area enclosed by simple closed curve using double integral and volume of solid by using triple integral

TEXT BOOKS:	
1.	Grewal B.S., - Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Ed., 2014.
2	Joel Hass, Christopher Heil and Maurice D.Weir —Thomas‘ Calculus‖, 14th Edition, Pearson.

REFERENCE BOOKS:	
1.	Bali N.P.and Manish Goyal — Engineering Mathematics‖ (For Semester I) Third Edition, University Science Press.
2.	Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons.
3.	Fritz John and Richard Courant, —Introduction to Calculus and Analysis‖ Springer.
4.	James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi, 2015.
5	Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi.

191PYB101T	ENGINEERING PHYSICS (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT	TITLE	PERIODS
I	PROPERTIES OF MATTER	9
Stress - Strain relationship, Hooke‘s law, Elastic moduli, Stress - Strain diagram for various engineering materials, Ductile and Brittle materials - Torsional pendulum – Beam, Expression for bending moment - Cantilever, Uniform and Non- uniform bending, Theory and Experimental determination of Young‘s modulus.		
UNIT	TITLE	PERIODS
II	SOUND WAVES AND VIBRATIONS	9
Propagation, Intensity, Loudness of sound waves – Determination of absorption coefficient, Reverberation, Sabine‘s formula for reverberation time - Factors affecting acoustics of buildings and their remedies - Acoustic Quieting: Aspects, Methods, Quieting for Specific observers, Mufflers, Soundproofing - Ultrasonic waves and properties, Methods of Ultrasonic production, Applications of Ultrasonic in engineering and medicine.		
UNIT	TITLE	PERIODS
III	THERMAL PHYSICS	9
Fundamentals of thermal energy – Expansion joints - Bimetallic strips - Thermal conductivity, conductions in solids, Differential equation of one dimensional heat flow- Forbe‗s and Lee‗s disc method - Conduction through compound media Thermal insulation – thermal shock resistance - Applications: Solar water heater- tempered glass- cryogenic materials.		
UNIT	TITLE	PERIODS
IV	QUANTUM MECHANICS	9
Inadequacies of Classical Mechanics – Black body radiation- Planck‘s theory of radiation - Dual nature of electromagnetic radiation – De Broglie hypothesis for matter waves – Heisenberg‘s uncertainty principle – Schrodinger‘s time dependent and independent wave equation, significance of wave function - Born interpretation - Particle confinement in 1D box.		
UNIT	TITLE	PERIODS
V	APPLIED OPTICS	9
Spontaneous and Stimulated emission - Einstein co-efficients (derivation) – Spatial and Temporal coherence – Schawlow- Townes condition for population inversion (Qualitative study) - Types of lasers – Nd:YAG, Semiconductor - Applications of Laser in science, engineering and medicine. Principle and propagation of light in optical fibre, Derivation for Numerical aperture and Acceptance angle - Types and losses of optical fibre - Fibre Optical Communication (Block diagram) - Active and Passive sensors - Medical endoscope.		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
At the end of this course:	
CO1:	Choose the material for required elastic properties
CO2:	Design ultrasonic devices for engineering and medical disciplines
CO3:	Design thermal devices for real life domestic applications
CO4:	Apply the principles of quantum mechanics to one dimensional motion of particles.
CO5:	Select the appropriate laser and optical fibers for industry, medicine and telecommunication applications.

TEXT BOOKS:	
1.	Bhattacharya D.K &T.Poonam, Engineering Physics , Oxford University Press, 2015.
2.	Pandey B.K.&S.Chaturvedi, Engineering Physics, Cengage Learning India, 2012.
3.	Senthilkumar, G.Engineering Physics I, VRB Publishers, 2011.

REFERENCE BOOKS:	
1.	Aruldhas G, Quantum Mechanics, PHI Learning Pvt. Ltd.,New Delhi, 2011.
2.	Arthur Beiser,Concepts of Modern Physics, 6thedn.,McGraw Hill 2003.
3.	Gaur R.K &S.L.Gupta, Engineering Physics, Dhanpat Rai Publishers, 2012.
4.	Halliday D, R.Resnick&J.Walker, Principles of Physics, Wiley, 2015.
5.	Serway R.A &J.W.Jewett, Physics for Scientists and Engineers, Cengage Learning, 2010.
6.	Tipler P.A &G.Mosca, Physics for Scientists and Engineers with Modern Physics, W.H.Freeman, 2007.
7.	Zeemansky M.W and R.H.Dittman, Heat and Thermodynamics, 8thedn., Mc.Graw Hill, NewYork, 2017.

191CYB101T	ENGINEERING CHEMISTRY (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
2.	To get the basic idea about the polymers and applications of polymers and polymer reinforced composites.
3.	It deals with the information about the types of fuels, calorific value calculationsand manufacture of solid, liquid and gaseous fuels.
4.	It enable the students to gain information about Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells
5.	To impart knowledge about the nanomaterials synthesis, properties and applications

UNIT	TITLE	PERIODS
I	WATER TREATMENT AND TECHNOLOGY	9
Introduction – characteristics - alkalinity - types and determination – hardness – types only -boiler feed water-requirements-boiler troubles – scale & sludge -disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) - softening of hard water - external treatment process - demineralization and zeolite, internal treatment - boiler compounds (phosphate, calgon, carbonate and colloidal conditioning methods) – desalination of brackish water –reverse osmosis.		
UNIT	TITLE	PERIODS
II	POLYMERS AND REINFORCED PLASTICS	9
Introduction- classification of polymers - Natural and synthetic - Thermoplastic and Thermosetting, Functionality–Degree of polymerization, types - addition and condensation polymerization – free radical polymerization mechanism - Preparation, properties and uses of PVC, Nylon 6,6, Teflon and Epoxy resin. Plastics - Compounding of plastics – moulding methods –injection, extrusion and compression – FRP – carbon and glass – applications.		
UNIT	TITLE	PERIODS
III	FUELS AND COMBUSTION	9
Classification - Coal – proximate and ultimate analysis, - carbonization -metallurgical coke –manufacture by Otto Hoffmann method – petroleum – refining - cracking –synthetic petrol by Bergius process - knocking in petrol and diesel engines- octane and cetanerating of fuels-synthesis – advantages and commercial application of power alcohol and biodiesel- Gaseous fuels- liquefied petroleum gases (LPG)- compressed natural gas (CNG)- Combustion of fuels: Introduction - calorific value–higher & Lower– theoretical calculation - Flue gas analysis by Orsat method.		

UNIT	TITLE	PERIODS
IV	**ENERGY SOURCES AND STORAGE DEVICES**	9

Energy – Types – Non-renewable energy - Nuclear energy –fission and fusion reactions - differences between nuclear fissionand fusion - nuclear chain reactions - light water nuclear reactor for power generation – breeder reactor – renewable energy - solar energy conversion - solar cells - wind energy

Electrochemical cells – reversible and irreversible cells –Cell construction and representation - Batteries -types of batteries – characteristics – construction and working of primary battery (dry cell) - secondary battery (lead acid battery and lithium-ion-battery) - fuel cells (H2-O2)

UNIT	TITLE	PERIODS
V	**CONCEPTS OF NANO CHEMISTRY AND GREEN CHEMISTRY**	9

Nano chemistry introduction – basics –general properties - distinction between nanoparticles, molecules and bulk materials–size-dependent properties. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electro deposition, chemical vapour deposition, laser ablation - properties of nanoparticles – Types of Nanoparticles:nano cluster, nano rod, nanowire and nano tube – Carbon Nano Tube (Synthesis, properties and applications) – applications of nanoparticles. Green chemistry introduction - Principles – Applications

TOTAL PERIODS:	**45**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Identify an appropriate water treatment technique for the given water sample**.**
CO2:	Choose an appropriate method for polymer synthesis and fabrication of plastics.
CO3:	Select a suitable fuel for an application, based on the fuel properties
CO4:	Design the electrical power generation technology for nuclear, solar, wind and battery sources.
CO5:	Synthesize the nanomaterials for various applications.

TEXT BOOKS:	
1.	Kannan P and Ravikrishnan A, —Engineering Chemistry‖, Sri Krishna, Hitech publishing Company Pvt. Ltd, 2014
2.	Jain P.C. and Monika Jain, —Engineering Chemistry‖ Dhanpat Rai, Publishing Company (P) Ltd.,New Delhi, 2015.

REFERENCE BOOKS:	
1.	Dara S.S &S.S Umare, —A Text book of Engineering Chemistry‖, S.Chand& Company Ltd., New Delhi, 2015.
2.	Palanna O.G, —Engineering Chemistry‖, McGraw Hill Education (India)Pvt. Ltd, Chennai,2017
3.	Vairam S ,P. Kalyani and Suba Ramesh., —Engineering Chemistry, Wiley India PVT, Ltd, New Delhi, 2013.

191GES101T	ENGINEERING GRAPHICS (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		2	**0**	**4**	**0**	**4**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To develop students, graphic skills for communication of concepts, ideas and design of engineering products.
2.	To expose them to existing National standards related to technical drawings.
3.	To Familiarize with basic geometrical constructions and orthographic projections.
4.	To make the students to draw the different projections of the solids.
5.	To view the true shape and apparent shape of the sectioned solids and their developments.
6.	To get an idea about 3D views through isometric projections.

UNIT	**TITLE**	**PERIODS**
0	**CONCEPTS AND CONVENTIONS USED**	**2**
Principles of Engineering graphics and their significance - Use Of drawing Instruments-BIS conventions and specifications-Size, Layout and folding of drawing sheets-Lettering and Dimensioning.		
UNIT	**TITLE**	**PERIODS**
I	**PLANE CURVES, PROJECTION OF POINTS**	**17**
Conic Sections - Construction of Ellipse, Parabola & hyperbola by eccentricity method – Construction of cycloid – Introduction to Scales. Introduction of Orthographic projection - Principal planes - First angle projection - projection of points.		
UNIT	**TITLE**	**PERIODS**
II	**PROJECTION OF LINES AND PLANES**	**17**
Projection of straight lines inclined to both the principal planes by rotating line method. Projection of simple planes inclined to both the principal planes by rotating object method. Projection of simple solids like Prism, Pyramid, Cylinder and Cone when the axis is inclined to one of the principal planes by rotating object method.		
UNIT	**TITLE**	**PERIODS**
III	**PROJECTION OF SOLIDS**	**17**
Projection of simple solids like Prism, Pyramid, Cylinder & Cone when the axis is inclined to one of the principal planes by rotating object method.		
UNIT	**TITLE**	**PERIODS**
IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**	**17**
Sectioning of simple solids (Prism, Pyramid, Cylinder & Cone) in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of surfaces of right regular and sectioned solids.		

UNIT	TITLE	PERIODS
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS**	17
Principles of Isometric projections-Isometric scale- Isometric Views of simple and truncated solids – combination of two solid objects in simple vertical positions. Conversion of Isometric views to Orthographic views of the objects.		
UNIT	**TITLE**	**PERIODS**
VI	**COMPUTER AIDED DRAFTING**	3
(Demonstration Only, Not for Exam**)** The Concepts of Computer Aided Drafting for Engineering drawing, Computer graphics & Geometrical modeling (2D Orthographic Views) and 3D drafting (Isometric Views) using AutoCAD.		

TOTAL PERIODS:	**90**

COURSE OUTCOMES:	
On successful completion of this course, the student will be able to:	
CO1:	Construct conic sections and cycloids
CO2:	Draw the projections of points, Straight lines and planes inclined to both the principal planes.
CO3:	Draw the projections of the simple solids like cylinder, cone, prisms and pyramids inclined to one of the principle planes.
CO4:	Draw the sectional views of simple solids, obtain true shape and develop the sectioned solids.
CO5:	Construct Orthographic views from pictorial views and the isometric view and isometric projection of simple and truncated solids in vertical position.

TEXT BOOKS:	
1.	Natarajan K.V., ―A text book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2009.
2.	Jayapoovan T, ―Engineering Graphics using AUTOCAD‖, Vikas Publishing ,7 th Edition.
3.	Venugopal K. and Prabhu Raja V., ―Engineering Drawingwith AUTOCAD and building drawing‖, New Age International (P) Limited, 2018, 5th edition.

REFERENCE BOOKS:	
1.	Basant Agarwal and Agarwal C.M., ―Engineering Drawing‖, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2.	Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 50th Edition, 2010.
3.	Dinesh Kumar S, K.Sivakumar and R.Ramadoss, ― Engineering Graphics‖, Maruthi Publishers, Chennai,2019.
4.	Gopalakrishna K.R., ―Engineering Drawing‖ (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
5.	Parthasarathy N S and Vela Murali, ―Engineering Graphics‖, Oxford University, Press, New Delhi, 2015.
6.	Shah M.B., and Rana B.C., ―Engineering Drawing‖, Pearson, 2nd Edition, 2009.

191GES102T	PROBLEM SOLVING THROUGH PYTHON PROGRAMMING (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	The course on Python Programming is intended to enhance the computational and logical thinking of students. Upon completion of the course, the students would be able to master the principles of Python programming and demonstrate significant experience in problem solving.

UNIT	TITLE	PERIODS
I	ALGORITHMIC PROBLEM SOLVING	9
Algorithms, building blocks of algorithms (statements, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Case study: Towers of Hanoi, insertion sort, guess an integer number in a range.		
UNIT	TITLE	PERIODS
II	CONTROL FLOW STATEMENTS	9
Python interpreter, interactive mode and script mode; variables, expressions, statements; values and data types; Operators and Precedence of operators, comments; Conditionals: conditional, alternative, chained conditional, nested conditional; Iterations: while, for, break, continue.		
UNIT	TITLE	PERIODS
III	FUNCTIONS AND STRINGS	9
Modules and functions: function definition and use, flow of execution, parameters and arguments; Fruitful functions: return values, composition, recursion; Strings: string slices, immutability, Looping and counting, String methods.		
UNIT	TITLE	PERIODS
IV	LIST, TUPLE AND DICTIONARIES	9
Lists: list operations, list slices, list methods, traversing, mutability, aliasing, list arguments, list comprehension; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and functions, Looping and dictionaries, histogram.		
UNIT	TITLE	PERIODS
V	FILES, EXCEPTIONS	9
Files: text files, reading and writing files, format operator, filenames and paths; Exceptions: handling exceptions, multiple exception blocks, finally block; Case study: tkinter.		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Develop solutions for simple problems using algorithmic problem solving approach.
CO2:	Create programs using simple python statements and expressions
CO3:	Apply the concepts of modularity and reusability through user defined functions.
CO4:	Solve problems using the concepts of sequential datastructures.
CO5:	Build python programs to handle large data using python file handling functions.
CO6:	Use exception handling in python application to handle errors.

TEXT BOOKS:	
1.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist, Version 2.0.17 edition, Updated for Python 3,Shroff/O_ReillyPublishers, (http://greenteapress.com/wp/thinkpython/)
2.	ReemaThareja —Python Programming using Problem solving Approach‖, Oxford University Press.

REFERENCE BOOKS:	
1.	Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.
2.	Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3.	Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd. 2015.

191GEB111L	PHYSICS AND CHEMISTRY LABORATORY (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		0	0	4	0	2

A. PHYSICS LABORATORY

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	The purpose of this course is to develop scientific temper in experimental techniques and to reinforce the physics concepts among the engineering students

INSTRUCTIONAL OBJECTIVES:	
1.	To gain knowledge in the scientific methods and learn the process of measuring different Physical variables
2.	Develop the skills in arranging and handling different measuring instruments
3.	Get familiar on experimental errors in various physical measurements and to plan/ suggest on how the contributions could be made of the same order, so as to minimize the errors.

ANY FIVE EXPERIMENTS:	
1.	Torsion Pendulum – Rigidity modulus of wire and moment of inertia of disc.
2.	Non Uniform Bending – Young‘s modulus determination.
3.	Spectrometer – Wave length of spectral lines using grating.
4.	Lee‘s Disc – Thermal Conductivity of bad conductor.
5.	Semiconductor Laser –Wavelength of laser light, Size of particle and Numerical aperture of optical fiber.
6.	Air Wedge – Measurement of thickness of thin wire.
7.	Determination of the Band gap of a semiconductor.
8.	Ultrasonic Interferometer - Velocity of sound and Compressibility of liquid.

TOTAL PERIODS:	30

TEXT BOOKS:	
1.	G.Rajkumar, Physics laboratory Practical, McGraw Hill publication, 2019.
2.	R.K.Shukla and Anchal Srivastava, Practical Physics, 1st Edition, New Age International (P) Ltd, New Delhi, 2006.
3.	Physics Laboratory Manual, Faculty Members, Department of Physics, Easwari Engineering College, Chennai.

REFERENCE BOOKS:	
1.	Chattopadhyay D, P.C.Rakshit and B.Saha, An Advanced Course in Practical Physics, 2nd ed., Books & Allied Ltd., Calcutta, 1990.
2.	Souires G L , Practical Physics, 4th Edition, Cambridge University, UK, 2001.

B. CHEMISTRY LABORATORY

COURSE OBJECTIVES:	
1.	To make the student to acquire practical skills in the determination of water quality parameters.
2.	To acquaint the students with the determination of molecular weight of polymer by using viscometer.

ANY FIVE EXPERIMENTS:	
1.	Determination of chloride content of water sample by Argentometric method
2.	Determination of strength of given HCl using pH meter
3.	Determination of strength of acid in a mixture using conductivity meter.
4.	Determination of permanent, total and temporary hardness of water sample.
5.	Estimation of Fe^{2+} by Potentiometric titration
6.	Determination of molecular weight of PVA using Ostwald viscometer
7.	Determination of alkalinity in water sample
8.	Estimation of Iron content in water sample using spectrophotometer (1,10 – Phenanthroline/thiocyanate method)
9.	Conductometric titrations of strong acid Vs strong base
10.	Determination of DO Content of water sample by Wrinkles method
11.	Determination of BOD and COD in water sample

TOTAL PERIODS:	**30**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Determine the elastic properties of materials using torsional Pendulum and non-uniform bending.
CO2:	Examine the optical properties of light waves using optical fiber, laser and spectrometer grating.
CO3:	Find the thermal conductivity of a bad conductor using Lee's Disc apparatus
CO4:	Analyze the water quality parameters like hardness, chloride and DO content
CO5:	Determine the molecular weight and classify the polymers.
CO6:	Estimate the strength of acids using different instrumental techniques.

REFERENCE BOOKS:	
1.	Dr. C. Ravichandran, —Engineering Chemistry Laboratory-I‖ Global publications, 2019.
2.	Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., —Vogel‘s Textbook of practical organic chemistry, LBS Singapore (1994).
3.	Jeffery G.H, Bassett J., Mendham J. and Denny R.C., —Vogel‘s Text book of quantitative analysis chemical analysis‖, ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4.	Daniel R. Palleros, —Experimental organic chemistry‖ John Wiley & Sons, Inc.,New York (2001).

191GES111L	PYTHON PROGRAMMING LABORATORY (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		0	0	3	1	2

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	The course on Python programming laboratory is used to write, test and debug simple Python programs. Upon completion of the course, the students would be able to master the concepts of data types, loops, functions, list, tuples, dictionary, files and GUI.

LIST OF PROGRAMS:	
1.	LCM of two numbers.
2.	Sum of squares of first n natural numbers
3.	Fibonacci series.
4.	Armstrong number
5.	Sum of Digits in a Number.
6.	First n prime number.
7.	Factorial of a number using recursion
8.	Count the number of vowels in a string
9.	Matrix multiplication.
10.	Simple calculator
11.	Linear search
12.	Selection sort
13.	Insertion sort
14.	Word count
15.	Mini Project (any ONE): Design GUI for
	Airline reservation system
	Feedback system
	Employee management system
	Student management system
	Banking system

TOTAL PERIODS:	60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Illustrate the essentials of python language like libraries, syntax, data types.
CO2:	Create programs using control flow structures in python.
CO3:	Develop python program for defining functions and calling them.
CO4:	Utilize python lists, tuples, dictionaries for compound data type.
CO5:	Design python programs for file handling and exception handling.
CO6:	Create GUI application for user defined requirement.

SYLLABUS OF

SEMESTER – II

COURSES

191LEH201T	PROFESSIONAL COMMUNICATION-BEC CERTIFICATION (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To strengthen their listening skills which help them comprehend lectures and talks in their areas ofspecialization
2.	To develop their speaking skills to make technical presentations, participate in Group Discussions.
3.	To develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
4.	To foster their ability to write convincing job applications
5.	To equip with appropriate skills for writing effective reports.

UNIT	TITLE	PERIODS
I		9
Communication – Process of Communication – Different forms of communication – Communication flow- Barriers of communication - Purpose and Function expressions – Extended definitions – Cause and Effect expressions - Compound nouns- Homonyms/homophones		
UNIT	TITLE	PERIODS
II		9
Listening to technical talks - Body language pertaining to Presentation– countering stage fright – Preparing PPT for presentation – Interpreting charts/graphs/pie charts/ bar diagram/tabular column/ tree diagram – Words often confused – Active/ Passive/ Impersonal Passive Voice – Numerical adjectives.		
UNIT	TITLE	PERIODS
III		9
Etiquette of Group discussion – discussing GD topics - reading journals and paraphrasing – Report Writing – Accident report/– Industrial visit report – Words often Misspelt – Describing a process using sequence words – Words used as different parts of speech		
UNIT	TITLE	PERIODS
IV		9
Small talk – review on films and books – email etiquette - Cover letter & Resume – Calling for quotations – Placing order – Letter of complaint - escalation letter - Feasibility report - Project report – Abbreviations and Acronyms pertaining to Science and Technology – Types of Essays - Argumentative, Analytical, Descriptive & Expository.		
UNIT	TITLE	PERIODS
V		9
Writing Statements of Purpose-format, Sample – Modifiers, Redundancies-Direct indirect speech-Project Proposal – Minutes of Meeting - Verbal Analogies – Case studies relating to Goal Setting- Writing articles		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Listening – listen/view and comprehend conversations and short talks delivered in English.
CO2:	Speaking- participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
CO3:	Reading – read articles of a general kind in magazines and newspapers.
CO4:	Writing- write short essays of a general kind and personal letters and emails in English
CO5:	Revise and edit effectively all written matter by organizing ideas cohesively, coherently, logically and using a wide vocabulary range.
CO6:	Understand current resources for locating secondary information, and also understand the strategies of effective primary data gathering.

TEXT BOOKS:	
1.	Raymond Murphy, English Grammar in Use: Reference and Practice for Intermediate Students, Cambridge : CUP, 2004

REFERENCE BOOKS:	
1.	M. Ashraf Rizvi ‗Effective Technical Communication', Tata McGraw-Hill, New Delhi, 2005
2.	Richard Johnson - Sheehan, Technical Communication Today, Longman Publishing Group, 2011
3.	Golding S.R. ‗Common Errors in English Language', Macmillan, 1978

WEBSITES:	
1.	https://owl.purdue.edu
2.	https:www.hellolingo.com

JOURNALS:	
1	IEEE/transactions on Professional Communication
2.	https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=47

EXTENSIVE READER:	
1.	Stephen R. Covey, The Seven Habits of Highly Effective People, Free Press, 1989

191MAB201T	ENGINEERING MATHEMATICS – II (Common to all branches of Engineering and Technology)	Periods per week				Credits
		L	T	P	R	
		3	2	0	0	4

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations, complex variables and complex integration.
2.	The Study of Laplace transform help to solve the differential equations that occur in various branches of engineering disciplines.
3.	Vector calculus can be widely used for modelling the various laws of physics.
4.	The various methods of complex analysis can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT	TITLE	PERIODS
I	ORDINARY DIFFERENTIAL EQUATIONS	12
Basic concepts - Separable differential equations - Exact differential equations - Integrating factors - Linear differential equations – Second order linear differential equations with constant coefficients – Particular Integral using operator method and Method of variation of parameters – Homogenous equation of Eulers and Legendres type.		
UNIT	TITLE	PERIODS
II	LAPLACE TRANSFORMS	12
Existence conditions – Transforms of elementary functions –Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Transform of periodic functions - Inverse transforms: Convolution theorem (Statement only) and Partial Fractions - Application to solution of linear second order ordinary differential equations with constant coefficients.		
UNIT	TITLE VECTOR CALCULUS	PERIODS
III		12
Gradient and directional derivative – Divergence and curl – Irrotational and Solenoidal vector fields – Line integral – Surface integral - Area of a curved surface - Green's, Gauss divergence and Stokes' theorems in evaluating line, surface and volume integrals (Planar, Cylindrical and Spherical Surfaces).		
UNIT	TITLE	PERIODS
IV	COMPLEX VARIABLES	12
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian form - Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by function $w = z + c,\ cz,\ \frac{1}{z},\ z^2$ - Bilinear transformation.		

UNIT	TITLE	PERIODS
V	COMPLEX INTEGRATION	12
Complex integral - Cauchy‘s integral theorem – Cauchy‘s integral formula – Taylor‘s and Laurent‘s series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour (No poles on the real axis).		

TOTAL PERIODS:	**60**

COURSE OUTCOMES:	
The Course aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.	
The students will learn :	
CO1:	Solve linear first and higher order ordinary differential equations (ODE).
CO2:	Solve ODEs by using Laplace transform technique.
CO3:	Use vector calculus to convert triple integrals into double and double integrals into single integral.
CO4:	Derive necessary condition for a given complex function to be analytic.
CO5:	Identify a suitable method of complex integration for evaluating certain indefinite integrals

TEXT BOOKS:	
1.	Grewal B.S., —Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Joel Hass, Christopher Heil and Maurice D.Weir Thomas‘ Calculus , 14th Edition, Pearson.

REFERENCE BOOKS:	
1.	Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
2.	N.P.Bali and Manish Goyal — Engineering Mathematics‖(For Semester II) Third Edition, University Science Press .
3.	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi.
4.	O‘Neil, P.V. —Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007 .
5.	James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

191PYB202T	PHYSICS FOR INFORMATION SCIENCE (Common to first year CSE and IT)	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To enrich the understanding of various types of materials and their applications in Engineering and Technology.

UNIT	TITLE	PERIODS
I	CONDUCTING MATERIALS	9
Conductors – Classical free electron theory of metals – Expression for Electrical and Thermal conductivity – Wiedemann – Franz law – Lorentz number – Drawbacks of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – Carrier concentrations in metals.		
UNIT	TITLE	PERIODS
II	SEMICONDUCTING MATERIALS	9
Direct and Indirect band gap semiconductors, Intrinsic Semiconductors - Carriers concentration in Intrinsic Semiconductor (derivation) - Extrinsic Semiconductors (Qualitative study) - Variation of Fermi level with temperature and impurity concentration in n and p type – Carrier transport: Velocity, Electric field relations, Drift and Diffusion transport – Hall effect and Devices – Zener and Avalanche Breakdown in p-n junctions - Ohmic contacts – Tunnel diode - Schottky diode. MOS capacitor - Power transistor.		
UNIT	TITLE	PERIODS
III	MAGNETIC AND SUPERCONDUCTING MATERIALS	9
Magnetism in materials – Magnetic field and Induction – Magnetization - Magnetic permeability and susceptibility – types of Magnetic materials – Ferromagnetism, origin and exchange interaction, Saturation magnetization, Curie temperature, Domain theory - Hard and Soft magnetic materials – Applications in Transducer, Hard disc, Magneto optical recording. Superconductivity: Type I and Type II superconductors, BCS theory of Superconductivity (Qualitative), High Tc Superconductors, Applications in SQUID, Cryotron and Magnetic levitation.		
UNIT	TITLE	PERIODS
IV	OPTICAL AND MODERN ENGINEERING MATERIALS	9
Classification of Optical materials - Photo Detectors – Principle and working of LED - OLED - LCD - Photo Conducting materials – Laser Diode – Optical Data Storage techniques. Modern Engineering Materials: Smart Materials - Shape Memory Alloys - Metallic Glasses.		
UNIT	TITLE	PERIODS
V	NANO MATERIALS	9
Background, Definition and Basic concepts of Nanotechnology, Size dependent property, Quantum size effect - Quantum dot, Wire and Well – Bucky balls - Graphene – Carbon nanotubes, Types, Applications- Potential uses of nanomaterials, carbon nano tube computers, nano sensors, actuators - Medical applications of Nanomaterials, NEMS.		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
At the end of this course :	
CO1:	Gain knowledge on classical and quantum electron theories, and energy band structures
CO2:	Acquire knowledge on basics of semiconductor physics and its applications in various devices
CO3:	Get knowledge on magnetic properties of materials and their applications in data storage
CO4:	Get knowledge on Superconducting materials and their applications in various field
CO5:	Have the necessary understanding on the functioning of optical and Modern Engineering materials
CO6:	Understand the basics of Nano Materials and quantum structures and their applications in real time

TEXT BOOKS:	
1.	P.K.Palanisamy, Materials Science. SCITECH Publishers, 2011.
2.	S.O.Pillai, Solid State Physics. New Age International(P) Ltd., publishers, 2009
3.	V.Rajendran, Materials Science, McGraw Hill Education (India) Private Ltd., 2017

REFERENCE BOOKS:	
1.	Arthur Beiser,Concepts of Modern Physics, 6th edn.,McGraw Hill 2003.
2.	S.O.Kasap, Principles of Electronic Materials and Devices, McGraw-Hill education, 2007.
3.	Yoshinobu Aoyagi and Kotaro Kajikawa, Optical Properties of Advanced Materials, Springer, 2013.
4.	Charles P. Poole Jr., Frank J. Owens, Introduction to nano technology, Wiley, 2003.
5.	T.Pradeep, Nano: The Essentials, Mc Graw Hill Publishing Co. Ltd., 2007.

191GES201T	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Common to Auto., ME, CE, CSE & IT)	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the Basic Fundamentals in Electrical Circuits.
2.	To study the construction, Principle of operation and performance of DC and AC Machines
3.	To understand the principles of PN Junction diode and BJT
4.	To Study the protection and safety measures in Electricity

UNIT	TITLE	PERIODS
I	FUNDAMENTALS OF ELECTRICITY AND CIRCUITS	9
Evolution of Electricity and Inventions- Electrical Quantities—Charge- Electric Potential, Voltage, Current, Power Energy, DC, AC, time period, Frequency, Phase, Flux density, RMS, Average, Peak, Phasor and Vector diagram. Electric circuit elements – Sources - Ohm‘s Law - Kirchhoff‘s Laws, Faradays Law, Lenz‘s Law- Wiring- House wiring and Industrial Wiring systems.		
UNIT	TITLE	PERIODS
II	MEASURING INSTRUMENTS	9
Principle of Operation Moving Coil and Moving Iron Types of Voltmeters and Ammeters - Multimeters –Measurements of resistance, inductance & capacitance-Power and Energy Measurements- Energy Efficient Equipment‘s and sample load (Domestic load) calculations.		
UNIT	TITLE	PERIODS
III	ELECTRICAL MACHINES	9
Construction - Principle of Operation - EMF Equation –Application of DC Generator, DC Motor – types and Characteristics Applications – Transformer-AC Machines – Construction, Operation and types of Single phase and three Phase Induction Motors.		
UNIT	TITLE	PERIODS
IV	BASIC ELECTRONICS AND COMMUNICATION	9
PN Junction Diode, Zener Diode – V-I Characteristics – Applications – Rectifier – Half Wave – Full Wave and Rectifiers – Transistors types – Transistor as an Amplifier —- Junction Field Effect Transistor (JFET) operation and characteristics, SCR - characteristics and its applications- CRO-Principle of Cathode Ray Tube-regulated power Supply- Function Generators. Communication systems- types- Analog, Digital and Wireless.		
UNIT	TITLE	PERIODS
V	PROTECTION, SAFETY AND INDIAN ELECTRICITY SCENARIO	9
Hazards of Electricity-Shock, Burns, arc- blast, Thermal Radiation, Explosives, fires, effect of electricity on the human Body. Electrical safety practices, Protection devices. Electrical power- Generation resources- transmission and Distribution. Regulatory authorities- role of MNRE, MNRE, NTPC, TEDA, TANGEDCO.		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply principles of electric and electronic circuits to solve engineering problems.
CO2:	Explain the operating principles of measuring instruments.
CO3:	Explain the working principle and applications of electrical machines
CO4:	Analyze the characteristics of analog electronic devices
CO5:	Carry out proper maintenance of electrical equipment by understanding various standards, and use relevant electric/electronic protective devices safely.

TEXT BOOKS:	
1.	S.Hasan Saeed, D.K.Sharma, Non-Conventional Energy Resources, Katson Books, 3rd Edition, 2013
2.	John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield,_Electrical Safety Handbook‘, McGraw-Hill Education, 4thEdition, 2012.
3.	D.P.Kothari and I.J. Nagarath –—Basic Electrical & Electronics Engineering‖, Mc.Grawhill publications, 1st Edition, 2014.
4.	Leonard S Bobrow, —Foundations of Electrical Engineering‖, Oxford University Press, 2013
5.	Vincent Del Toro, Electrical Engineering Fundamentals, Prentice Hall, 2006.

REFERENCE BOOKS:	
1.	Del Toro, —Electrical Engineering Fundamentals‖, Pearson Education, New Delhi, 2007 2. John Bird, —Electrical Circuit Theory and Technology‖, Elsevier, First Indian Edition, 2006.
2.	Maxwell Adams.J, _Electrical Safety- a guide to the causes and prevention of electric hazards‘, The Institution of Electric Engineers, IET 1994. 2. Ray A. Jones, Jane G. Jones, _Electrical Safety in the Workplace‘, Jones & Bartlett Learning, 2000.
3.	V.K.Mehta&Rohit Mehta, Principles of Electrical Engineering, S.Chand publications, 2nd Edition, 2003.
4.	Lawmans, Electricity act 2003, Act No. 36 of 2003, Kamal Publishers, New Delhi.

191GES204T	PROGRAMMING IN C	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Learn to think logically and write pseudo code or draw flow charts for problems.
2.	Be exposed to the syntax of C.
3.	To develop C Programs using basic programming constructs.
4.	Learn to use arrays and strings in C.
5.	To develop applications in C using functions , pointers and structures
6.	To do input/output and file handling in C

UNIT	TITLE	PERIODS
I	C PROGRAMMING BASICS	9
Introduction- Algorithm – Flow Charts – Pseudo Code - Structure of a C program – compilation and linking processes – Character set - Constants, Variables – Data Types – Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements.		
UNIT	TITLE	PERIODS
II	ARRAYS AND STRINGS	9
Arrays: Initialization – Declaration – Accessing the array elements – Operations on array- One dimensional array - two dimensional arrays – Strings: String operations – String Arrays - Simple programs: sorting- searching – matrix operations.		
UNIT	TITLE	PERIODS
III	FUNCTIONS AND POINTERS	9
Functions: Introduction - Function prototype - function definition - function call – Return statement - Recursion. Parameter passing: Pass by value - Pass by reference. Pointers: Pointer operators – Declaring the pointer variable - Pointer arithmetic Null pointer- Arrays and pointers – Array of pointers.		
UNIT	TITLE	PERIODS
IV	STRUCTURES AND UNIONS	9
Structures: Introduction - Need for structure data type –definition and declaration – Structure within structure – Structures and functions – Union: Definition and Declaration – Accessing the members of union - Programs using Structures and Unions – Scope of variables - Storage classes - Preprocessor directives.		
UNIT	TITLE	PERIODS
V	FILE HANDLING	9
Introduction – Using files in C - File operation: Read data from files, writing data to files, detecting the end of file, Functions for selecting a record randomly – File pointer – Error handling - Types of file processing: Sequential access, Random access- Dynamic memory allocation.		

TOTAL PERIODS:	**45**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Compile simple programs using basic C programming concepts.
CO2:	Apply arrays and strings for application development.
CO3:	Solve complex problems using functions and pointers.
CO4:	Organize heterogeneous data with structures and unions.
CO5:	Choose suitable file manipulation techniques for data processing.

TEXT BOOKS:	
1.	ReemaThareja, —Programming in C, Oxford University Press, Second Edition, 2016.
2.	Ajay Mittal — Programming in C, A practical Approach, Ltd., Pearson Education in South Asia, 2011.
3.	Balagurusamy E — Programming in ANSI C, McGraw Hill Publication, Eighth Edition, 2019.

REFERENCE BOOKS:	
1.	Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
2.	PradipDey, Manas Ghosh, —Fundamentals of Computing and Programming in C, First Edition, Oxford University Press, 2009.
3.	Paul Deitel and Harvey Deitel, —C How to Program, Seventh edition, Pearson Publication
4.	Juneja, B. L and Anita Seth, —Programming in C, CENGAGE Learning India pvt. Ltd., 2011.
5.	Kernighan, B.W and Ritchie, D.M, —The C Programming language, Second Edition, Pearson Education, 2006.

191GES211L	ENGINEERING PRACTICES LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	**0**	**4**	**0**	**2**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To provide exposure to the students with the concepts involved in product realization by carrying out manufacturing shop exercises. Hands-on practice with manufacturing shop exercises and assembly leading to realization of a new product in a group.

GROUP A (CIVIL & MECHANICAL)	
CIVIL & MECHANICAL ENGINEERING PRACTICE	
I. CIVIL ENGINEERING PRACTICE	
A. **Plumbing Works:**	
	Pipeline joints, its location and functions: Valves, Taps, Couplings, Unions, Reducers, Elbows in household fittings.
	Connection of two Galvanized Iron pipes
	Connection of PVC pipes
	Basic pipe connections involving the fitting like Valves, Taps and Bends
B. **Carpentry works:**	
	Joints in Roofs, Doors, Windows and Furniture.
	Cross Lap joint
	Mortise and Tenant joint
II	**MECHANICAL ENGINEERING PRACTICE**
A	**Welding**
	Arc welding of Butt joints, Tap joints and Tee joints.
	Gas welding practice
B	**Basic machining**
	Simple Turning and Taper turning
	Drilling practice
C	**Sheet metal work:**
	Rectangular tray making
	Funnel making

TOTAL PERIODS:	**30**

GROUP B (ELECTRICAL & ELECTRONICS)	
ELECTRICAL ENGINEERING PRACTICE	
	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
	Fluorescent lamp wiring.
	Stair case wiring
	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
	Measurement of energy using single phase energy meter.
	Measurement of resistance to earth of electrical equipment.
III	**ELECTRONICS ENGINEERING PRACTICE**
	Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak- peak, RMS period, frequency) using CR.
	Logic gates AND, OR, EX-OR and NOT.
	Generation of Clock Signal.
	Soldering practice – Components Devices and Circuits – Using general purpose PCB.
	Measurement of ripple factor of HWR and FWR.

TOTAL PERIODS:	**30**

COURSE OUTCOMES:	
On successful completion of this course, the student will be able to:	
CO1:	Fabricate carpentry components and pipe connections including plumbing works.
CO2:	Use welding equipments to join the structures.
CO3:	Carry out the basic machining operations
CO4:	Make the models using sheet metal works
CO5:	Carry out basic home electrical works and Understand works of Home Appliances Measure the electrical quantities
CO6:	Elaborate on the Electronic components, Logic gates and soldering practice.

191GES213L	C PROGRAMMING LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	0	3	1	2

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To develop programs in C using basic constructs.
2.	To develop applications in C using strings, pointers, functions, structures.
3.	To develop applications in C using file processing.

LIST OF EXPERIMENTS	
1.	Programs using only I/O functions.
2.	Programs to study operators and data types.
3.	Programs based on control structures (IF, SWITCH CASE).
4.	Programs using FOR and WHILE loops.
5.	Programs using single dimensional arrays.
6.	Programs using multi dimensional arrays.
7.	Programs on Sorting and Searching using arrays.
8.	Programs based on String manipulations.
9.	Programs based on User Defined Functions.
10.	Programs using Functions with Parameters.
11.	Programs using Storage Classes.
12.	Programs to introduce Pointers.
13.	Programs using Structures and Union.
14.	Programs using Array of Structures.
15.	Programs based on Files.

MINI PROJECT:		
1.	Create a —Railway reservation system / Airline reservation system with the following modules	
	Booking	
	Availability checking	
	Cancellation	
	Prepare chart	

TOTAL PERIODS:	60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Develop simple programs using basic constructs in C programming.
CO2:	Develop C programs for simple applications making use of arrays and strings.
CO3:	Implement modular programming with functions.
CO4:	Build programs with storage classes and pointers for memory management.
CO5:	Construct programs with user defined data types.
CO6:	Design applications using file processing techniques.

191CYM201T	ENVIRONMENTAL SCIENCE	Periods per week				Credits
		L	T	P	R	
		3	**0**	**0**	**0**	**3**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To appreciate and acquire knowledge about nature, environmental education and biodiversity.
2.	To understand the interrelationship between living organism and environment, environment functions and its value.
3.	To assess the environmental pollution and its impact on the human world.
4.	To find and implement scientific, economic and political solutions to environmental problems.
5.	To gain knowledge about waste management and resource recovery for protecting the environment.

UNIT	**TITLE**	**PERIODS**
I	**ENVIRONMENT AND BIODIVERSITY**	**9**
Definition and scope of an environment – structure of an ecosystem –biotic and abiotic components– ecological succession – food chain, food web – Introduction to biodiversity definition, types – bio-geographical classification of India, India as a mega-diversity nation – values of biodiversity– endangered and endemic species of India hot-spots of biodiversity – threats to biodiversity – conservation of biodiversity		
UNIT	**TITLE**	**PERIODS**
II	**NATURAL RESOURCES AND ITS CONSERVATION**	**9**
Forest resources - Uses and over exploitation, Deforestation, causes and its effects - Water Resources – Uses and over utilization - Water conservation- Dams, benefits and their effects, Rain Water Harvesting, Watershed Management – Mineral resources - Uses and exploitation, Food resources- World food problems - Effects of modern agriculture – Energy resources - Ocean energy, Geothermal energy, Biomass energy		
UNIT	**TITLE**	**PERIODS**
III	**ENVIRONMENTAL DEGRADATION**	**9**
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Noise pollution (e) Thermal pollution – role of an individual in prevention of pollution – pollution case studies – disaster management: cyclone, flood, drought, earthquake and landslides - case studies		
UNIT	**TITLE**	**PERIODS**
IV	**SOCIAL ISSUES**	**9**
Population and Sustainability: Population explosion - Sustainable development – Equitable use of resources for sustainable lifestyles-urban problems related to energy - Role of information technology in environment and human health. Industrial effluent treatment: Removal of organic constituents-Biological oxidation process-Removal of inorganic constituents-Metal and radioactive wastes, zero liquid discharge solutions from textile industries		

UNIT	TITLE	PERIODS
V	**WASTE MANAGEMENT AND RESOURCE RECOVERY**	9
Introduction –Biodegradable, non-biodegradable waste, Municipal solid waste and its management - Special waste – E- waste and Scrap tires - Definition, causes, effects and its management - Resource recovery: a) Waste land reclamation b) Sewage treatment c) Recycling of Plastic, Glass and Paper wastes.		

TOTAL PERIODS:	**45**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Analyze various threat to biodiversity for its conservation
CO2:	Select a suitable method to conserve natural resources for sustainable development.
CO3:	Apply necessary steps for pollution prevention and disaster management..
CO4:	Plan for a sustainable lifestyle to protect the environment
CO5:	Apply the technique to recover resources from the waste.

TEXT BOOKS:	
1.	Benny Joseph, ‗Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2.	Handbook of Solid Waste Management (McGraw-Hill Handbooks), George Tchobanoglous, Frank Kreith, Publisher: McGraw-Hill Education; 2 edition July, 2002

REFERENCE BOOKS:	
1.	R.K. Trivedi, ‗Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2.	Dharmendra S. Sengar, ‗Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
3.	Rajagopalan, R, ‗Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
4.	*Waste Management and Resource Recovery,* Charles R. Rhyner, Leander J.Schwartz, Robert B. Wenger, Mary G. Kohrell, CRC Press Published August 31, 1995.
5.	Industrial wastewater management, treatment and disposal, Water managementll Federation Alexandria Virgiia, Third Edition, 2008.

SYLLABUS OF

SEMESTER – III

COURSES

191MAB302T	DISCRETE MATHEMATICS	Periods per week				Credits
		L	T	P	R	
		3	2	0	0	4

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To extend student‘s logical and mathematical maturity and ability to deal with abstraction.
2.	To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
3.	To understand the basic concepts of Combinatorics and graph theory.
4.	To familiarize the applications of algebraic structures.
5.	To understand the concepts and significance of lattices and Boolean algebra which are widely used in computer science and engineering.

UNIT	TITLE	PERIODS
I	MATHEMATICAL LOGIC	L - 9, T – 3
Statements and Notations – Connectives – Normal forms – Theory of inference for the statement calculus– Predicate calculus – Inference theory of the predicate calculus		
UNIT	TITLE	PERIODS
II	COMBINATORICS	L - 9, T – 3
Mathematical induction – Strong induction – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications.		
UNIT	TITLE	PERIODS
III	GRAPHS	L - 9, T – 3
Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.		
UNIT	TITLE	PERIODS
IV	ALGEBRAIC STRUCTURES	L - 9, T – 3
Algebraic systems – Semi groups and Monoids (Definitions and examples) - Groups – Subgroups – Homomorphism‘s – Normal subgroup and cosets – Lagrange‘s theorem – Definitions and examples of Rings, Integral domains and Fields.		
UNIT	TITLE	PERIODS
V	LATTICES AND BOOLEAN ALGEBRA	L - 9, T – 3
Partial ordering – Posets – Lattices as posets – Properties of lattices - Some special lattices – Boolean algebra.		

TOTAL PERIODS:	60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Identify the consistency of the given propositions
CO2:	Use basic terminologies of counting principles to solve practical problems in CSE and IT
CO3:	Apply Graph theoretical ideas which are highly useful in networking and data structures.
CO4:	Recall the concepts of groups and fields which are used in coding theory.
CO5:	Produce results in Lattices and Boolean algebras analogues to results in group theory.

TEXT BOOKS:	
1.	Rosen, K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011. **Unit-II:** Sections: 4.1, 4.2, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 6.5, 6.6 **Unit-III:** Sections: 8.1, 8.2, 8.3, 8.4, 8.5 **Unit-IV:** Sections: 11.1, 11.2, 11.3, 11.4, 11.5
2.	Tremblay, J.P. and Manohar.R, “Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011. **Unit-I:** Sections: 1-1, 1-2.1 to 1-2.4, 1-2.6, 1-2.8 to 1-2.12, 1-3.1 to 1-3.4, 1- 4.1 to 1-4.3, 1-5, 1-6 **Unit-V:** Sections: 4-1.1, 4-1.2, 4-1.5, 4-2.1

REFERENCE BOOKS:	
1.	Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2.	Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum‘s Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3.	Koshy, T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.

191ECS321T	DIGITAL PRINCIPLES AND SYSTEM DESIGN	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To design digital circuits using simplified Boolean functions
2.	To analyze and design combinational circuits
3.	To analyze and design synchronous and asynchronous sequential circuits
4.	To understand Programmable Logic Devices
5.	To write HDL code for combinational and sequential circuits

UNIT	TITLE	PERIODS
I	BOOLEAN ALGEBRA AND LOGIC GATES	9
Number Systems - Arithmetic Operations - Binary Codes- Boolean Algebra and Logic Gates - Theorems and Properties of Boolean Algebra - Boolean Functions - Canonical and Standard Forms - Simplification of Boolean Functions using Karnaugh Map - Logic Gates – NAND and NOR Implementations.		
UNIT	TITLE	PERIODS
II	COMBINATIONAL LOGIC	9
Combinational Circuits – Analysis and Design Procedures - Binary Adder-Subtractor - Decimal Adder - Binary Multiplier - Magnitude Comparator - Decoders – Encoders – Multiplexers - Introduction to HDL – HDL Models of Combinational circuits.		
UNIT	TITLE	PERIODS
III	SYNCHRONOUS SEQUENTIAL LOGIC	9
Sequential Circuits - Storage Elements: Latches , Flip-Flops - Analysis of Clocked Sequential Circuits - State Reduction and Assignment - Design Procedure - Registers and Counters - HDL Models of Sequential Circuits.		
UNIT	TITLE	PERIODS
IV	ASYNCHRONOUS SEQUENTIAL LOGIC	9
Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables –Race-free State Assignment – Hazards.		
UNIT	TITLE	PERIODS
V	MEMORY AND PROGRAMMABLE LOGIC	9
RAM – Memory Decoding – Error Detection and Correction - ROM - Programmable Logic Array –Programmable Array Logic		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Simplify the Boolean expressions using different methods.
CO2:	Design and analyse the combinational logic circuits.
CO3:	Apply the fundamental knowledge of digital principles to design and implement synchronous and asynchronous sequential circuits.
CO4:	Write simple HDL codes for the combinational and sequential digital circuits using Verilog.
CO5:	Assess the nomenclature and technology in the area of memory devices and apply the concepts in real time applications.

TEXT BOOKS:	
1.	M. Morris R. Mano, Michael D. Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog”, 6th Edition, Pearson Education, 2017.

REFERENCE BOOKS:	
1.	Charles H. Roth Jr, Larry L. Kinney, Fundamentals of Logic Design, Sixth Edition, CENGAGE Learning, 2013
2.	Donald D. Givone, Digital Principles and Design‖, Tata Mc Graw Hill, 2003
3.	John F. Wakerly, Digital Design Principles and Practices, Fifth Edition, Pearson Education, 2017
4.	Kharate G. K., Digital Electronics, Oxford University Press, 2010

191CSC301T	SOFTWARE ENGINEERING	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the phases in a software project
2.	To understand fundamental concepts of requirements engineering and Analysis Modeling.
3.	To understand the various software design methodologies
4.	To learn various testing and maintenance measures

UNIT	TITLE	PERIODS
I	SOFTWARE PROCESS AND AGILE DEVELOPMENT	9
Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Introduction to Agility-Agile process-Extreme programming-XP Process.		
UNIT	TITLE	PERIODS
II	REQUIREMENTS ANALYSIS AND SPECIFICATION	9
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.		
UNIT	TITLE	PERIODS
III	SOFTWARE DESIGN	9
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.		
UNIT	TITLE	PERIODS
IV	TESTING AND MAINTENANCE	9
Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering - BPR model - Reengineering process model-Reverse and Forward Engineering.		
UNIT	TITLE	PERIODS
V	PROJECT MANAGEMENT	9
Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management - Risk Identification-RMMM Plan-CASE TOOLS		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Choose the appropriate process model for software development
CO2:	Classify the requirements of the project development, as functional and non-functional
CO3:	Integrate the architectural styles for software design
CO4:	Apply the appropriate testing strategies for software verification and validation
CO5:	Estimate the risk and cost for effective project management

TEXT BOOKS:	
1.	Ian Sommerville, —Software Engineering‖, 9th Edition, Pearson Education Asia, 2011.
2.	Roger S. Pressman, —Software Engineering – A Practitioner's Approach‖, Seventh Edition, Mc Graw-Hill International Edition, 2010.

REFERENCE BOOKS:	
1.	Kelkar S.A., —Software Engineering‖, Prentice Hall of India Pvt Ltd, 2007.
2.	Pankaj Jalote, —Software Engineering, A Precise Approach‖, Wiley India, 2010.
3.	Rajib Mall, —Fundamentals of Software Engineering‖, Third Edition, PHI Learning Private Limited, 2009
4.	Stephen R.Schach, —Software Engineering‖, Tata McGraw-Hill Publishing Company Limited, 2007.

191CSC302T	OBJECT ORIENTED PROGRAMMING WITH C++	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To comprehend the fundamentals of object oriented programming in C++.
2.	To use object oriented programming to Develop Generic programming skills
3.	Apply appropriate data structures and solve complex problems
4.	Design problem into classes and develop a full working code
5.	Develop programs using files, templates and handle exceptions

UNIT	TITLE	PERIODS
I	INTRODUCTION TO C++	9
Object oriented programming concepts: Class – Object - Abstraction - Encapsulation – Polymorphism- inheritance- Data Hiding, Introduction to C++:Structure of C++ program, Data types, Operators and control statements, Input and output operators, Dynamic initialization, Reference variables, Classes and Objects: Class specification - Member function definition		
UNIT	TITLE	PERIODS
II	FUNCTIONS,CONSTRUCTORS AND DESTRUCTORS	10
Function prototype, Default arguments, Call by reference-Static data members and Static member functions - Function return type as objects - Friend function –Constructors and destructors: Basic concepts - Parameterized constructor - Copy constructor - Dynamic constructors.		
UNIT	TITLE	PERIODS
III	INHERITANCE AND POLYMORPHISM	9
Defining derived classes, Types of inheritance: Single inheritance- Multilevel inheritance- Multiple inheritance – Hierarchical inheritance – Hybrid inheritance- Constructors in derived and base class, Abstract classes, Virtual function.		
UNIT	TITLE	PERIODS
IV	OPERATOR OVERLOADING	8
Defining operator overloading, overloading unary and binary operators, Operator overloading using friend function, Rules for Overloading operators - Type conversion.		
UNIT	TITLE	PERIODS
V	FILES,TEMPLATES AND EXCEPTION HANDLING	9
File pointer and file processing, Sequential and random file access -Template function, Template classes - Exception handling mechanism – Case Study: online Reservation system		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply the concepts of object oriented programming using C++.
CO2:	Make use of functions and constructors for complex problems.
CO3:	Construct programs with inheritance and polymorphism.
CO4:	Implement operator overloading concept with type conversion.
CO5:	Develop programs using files, templates and exception handling
CO6:	Build real world applications using Object Oriented Concepts.

TEXT BOOKS:	
1.	Balaguruswamy E. “Object Oriented Programming with C++”, 6th edition, Tata McGraw Hill Education, 2015
2.	Bjarne Stroustrup ,”The C++ Programming Language”, 4th Edition, Addison Wesley, 2015
3.	Robert Lafore, “Object-Oriented Programming in C++”, Fourth Edition, Sams Publication, 2002

REFERENCE BOOKS:	
1.	Deitel, - C++ How to Program, 6th edition, PHI publication, 2008
2.	Herbert Schildt, —C++: The Complete Referencell, Tata McGraw Hill, New Delhi, 2009.
3.	Stanley B., Lippman, JoseeLajoie and Barbara E. Moo, —C++ Primer, Pearson Education, New Delhi, 2010.
4.	YashwantKanetkar, —Object Oriented Programming with C++, BPB Publications, New Delhi, 2004.

191CSC303T	DATA STRUCTURES	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the concepts of ADTs
2.	To Learn linear data structures – lists, stacks, and queues
3.	To Learn Non-linear data structures - Trees, BST and B Trees
4.	To Learn and apply Graphs structures
5.	To understand sorting, searching and hashing algorithms

UNIT	TITLE	PERIODS
I	LINEAR DATA STRUCTURES – LIST	9
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation —- singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal)		
UNIT	TITLE	PERIODS
II	LINEAR DATA STRUCTURES – STACKS, QUEUES	8
Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression –Evaluation of Postfix expression-Queue ADT – Operations - Circular Queue - deQueue – applications of queues		
UNIT	TITLE	PERIODS
III	NON LINEAR DATA STRUCTURES – TREES	9
Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT – AVL Trees - B Tree - Heap – Min Heap and Max Heap.		
UNIT	TITLE	PERIODS
IV	NON LINEAR DATA STRUCTURES – GRAPHS	10
Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sorting – Shortest-Path algorithm - Dijkstra's algorithm - Minimum spanning tree – Prim's and Kruskal's Algorithms – Bi-connectivity – Cut Vertex – Applications of graphs.		
UNIT	TITLE	PERIODS
V	SEARCHING, SORTING AND HASHING TECHNIQUES	9
Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort - Quick Sort. Hashing- Hash Functions – Collision Resolution - Open Addressing– Chaining – Extendible Hashing.		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Implement the abstract data types of Linear and Non Linear data structures
CO2:	Choose the appropriate linear data structures for real world applications
CO3:	Organize the data using suitable tree data structures.
CO4:	Solve the real world problems using graph data structures.
CO5:	Analyze sorting, searching and hashing algorithms for data access

TEXT BOOKS:	
1.	Mark Allen Weiss, —Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education,2018.
2.	ReemaThareja, —Data Structures Using C, Second Edition , Oxford University Press, 2018

REFERENCE BOOKS:	
1.	Aho, Hopcroft and Ullman, —Data Structures and Algorithms‖, Pearson Education,1983
2.	Ellis Horowitz, SartajSahni, Susan Anderson-Freed, Fundamentals of Data
3.	Stephen G. Kochan, —Programming in C, 3rd edition, Pearson Education.
4.	Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein -- Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.

191CSC304T	COMPUTER ARCHITECTURE	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn the basic structure and operations of a computer.
2.	To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
3.	To learn the basics of pipelined execution.
4.	To understand parallelism and multi-core processors.
5.	To understand the memory hierarchies, cache memories and virtual memories.
6.	To learn the different ways of communication with I/O devices.

UNIT	TITLE	PERIODS
I	BASIC STRUCTURE OF A COMPUTER SYSTEM	9
Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing		
UNIT	TITLE	PERIODS
II	ARITHMETIC FOR COMPUTERS	9
Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Sub word Parallelism		
UNIT	TITLE	PERIODS
III	PROCESSOR AND CONTROL UNIT	9
A Basic MIPS implementation – Building a Data path – Control Implementation Scheme – Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards.		
UNIT	TITLE	PERIODS
IV	PARALLELISIM	9
Parallel processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures – Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors – Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.		
UNIT	TITLE	PERIODS
V	MEMORY & I/O SYSTEMS	9
Memory Hierarchy – memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB‘s – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – USB.		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Utilize various instruction formats for computer operations.
CO2:	Design of arithmetic and logic unit
CO3:	Build the data path with pipelining techniques
CO4:	Apply various parallel processing architectures for computational problems.
CO5:	Analyze the performance of various memory systems and I/O communication

TEXT BOOKS:	
1.	Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.
2.	David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.

REFERENCE BOOKS:	
1.	John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.
2.	John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
3.	William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.

191CSC311L	DATA STRUCTURES LABORATORY IN C	Periods per week				Credits
		L	T	P	R	
		0	0	4	0	2

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand and implement Linear data structures using C
2.	To implement Non Linear data structures using C
3.	To Implement of Graph and Traversal algorithms
4.	To implement Searching and Sorting algorithms
5.	To implement Hashing techniques

LIST OF EXPERIMENTS:	
1.	Array implementation of List ADT
2.	Array implementation of Stacks
3.	Array implementation of Queues
4.	Linked list implementation of List ADT
5.	Linked list implementation of Stacks
6.	Linked list implementation of Queues
7.	Application of Stacks and Queues
8.	Implementation of Binary Search Trees and Traversal
9.	Implementation of AVL Trees
10.	Implementation of Heaps using Priority Queues
11.	Implementation of Graph and Traversal algorithms
12.	Implementation of Sorting Algorithms : Bubble sort & Quick sort
13.	Implementation of Linear search and Binary search
14.	Implementation of Hashing - any one collision resolution techniques

TOTAL PERIODS:	60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Write functions to implement linear data structure operations using C
CO2:	Solve problems using non-linear data structures
CO3:	Implement Graph and Traversal algorithms
CO4:	Develop searching and sorting algorithms.
CO5:	Develop programs using Hashing techniques

191CSC312L	OBJECT ORIENTED PROGRAMMING LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	**0**	**3**	**1**	**2**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To use object oriented programming to Develop Generic programming skills
2.	Apply appropriate data structures and solve complex problems
3.	Design problem into classes and develop a full working code
4.	Develop programs using files, templates and handle exceptions

LIST OF EXPERIMENTS:	
1.	Design C++ classes with static members, methods with default arguments, friend functions. (For example, design matrix and vector classes with static allocation, and a friend function to do matrix-vector multiplication)
2.	Implement complex number class with necessary operator overloadings and type conversions such as integer to complex, double to complex, complex to double etc.
3.	Implement Matrix class with dynamic memory allocation and necessary methods. Give proper constructor, destructor, copy constructor, and overloading of assignment operator.
4.	Overload the new and delete operators to provide custom dynamic allocation of memory.
5.	Develop a template of linked-list class and its methods.
6.	Develop templates of standard sorting algorithms such as bubble sort, insertion sort, merge sort, and quick sort.
7.	Design stack and queue classes with necessary exception handling.
8.	Define Point class and an Arc class. Define a Graph class which represents graph as a collection of Point objects and Arc objects. Write a method to find a minimum cost spanning tree in a graph.
9.	Develop with suitable hierarchy, classes for Point, Shape, Rectangle, Square, Circle, Ellipse, Triangle, Polygon, etc. Design a simple test application to demonstrate dynamic polymorphism and RTTI.
10.	Write a C++ program that randomly generates complex numbers (use previously designed Complex class) and writes them two per line in a file along with an operator (+, -, *, or /). The numbers are written to file in the format (a + ib). Write another program to read one line at a time from this file, perform the corresponding operation on the two complex numbers read, and write the result to another file (one per line).
11.	MINI PROJECT: Create a —Railway reservation system / Airline reservation system with the following modules – Booking – Availability checking – Cancellation

	TOTAL PERIODS:	**60**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Develop programs using functions and constructors in C++.
CO2:	Write programs using inheritance and polymorphism.
CO3:	Implement the concepts of operator overloading in C++.
CO4:	Develop programs using template for searching and sorting algorithms.
CO5:	Design applications for file manipulation and exception handling.
CO6:	Create an application program using the concepts implicated in C++.

SYLLABUS OF

SEMESTER – IV

COURSES

191MAB403T	PROBABILITY AND NUMBER THEORY	Periods per week				Credits
		L	T	P	R	
		3	2	0	0	4

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
2.	To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
3.	To understand the basic concepts in number theory .
4.	To examine the key questions in the Theory of Numbers.
5.	To give an integrated approach to number theory and provide a firm basis for further reading and study in the subject.

UNIT	TITLE	PERIODS
I	PROBABILITY AND RANDOM VARIABLES	L - 8, T - 4
Probability review – Baye's theorem,Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		
UNIT	TITLE	PERIODS
II	TWO - DIMENSIONAL RANDOM VARIABLES	L - 8, T - 4
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables.		
UNIT	TITLE	PERIODS
III	DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS	L - 8, T - 4
Division algorithm – Base - b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.		
UNIT	TITLE	PERIODS
IV	DIOPHANTINE EQUATIONS AND CONGRUENCES	L - 8, T - 4
Linear Diophantine equations – Congruence's – Linear Congruence's - Applications: Divisibility tests - Modular exponentiation-Chinese remainder theorem – 2 x 2 linear systems.		
UNIT	TITLE	PERIODS
V	CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS	L - 8, T - 4
Wilson's theorem - Fermat's little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.		

TOTAL PERIODS:	60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Recall the concepts of probability to study discrete and continuous distribution.
CO2:	Compose the joint probability density function (PDF) of two new random variables by using the PDF of two given random variables and given transformation.
CO3:	Apply division algorithm and Euclidean algorithm to find the GCD of any two positive integers.
CO4:	Analyze linear congruence's to solve a system of linear congruence's.
CO5:	Revise classical theorems on number theory which help to solve linear congruence's.

TEXT BOOKS:	
1.	Koshy, T., ―Elementary Number Theory with Applications‖, Elsevier Publications, New Delhi, 2002.
2.	Ibe. O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.

REFERENCE BOOKS:	
1.	Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2.	Niven, I., Zuckerman.H.S., and Montgomery, H.L., ―An Introduction to Theory of Numbers‖, John Wiley and Sons , Singapore, 2004.
3.	San Ling and Chaoping Xing, ―Coding Theory – A first Course‖, Cambridge Publications, Cambridge, 2004..

191CSC401T	DESIGN AND ANALYSIS OF ALGORITHMS	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the concepts of algorithms and its efficiency
2.	To understand and apply the algorithm analysis techniques
3.	To critically analyze the efficiency of alternative algorithmic solutions for the same problem
4.	To understand different algorithm design techniques
5.	To understand the limitations of Algorithmic power

UNIT	TITLE	PERIODS
I	INTRODUCTION	9
Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties. Analysis Framework - Mathematical analysis for Recursive and Non-recursive algorithms – Visualization		
UNIT	TITLE	PERIODS
II	BRUTE FORCE AND DIVIDE-AND-CONQUER	9
Brute Force – Computing a^n – String Matching - Closest-Pair and Convex-Hull Problems - Exhaustive Search - Travelling Salesman Problem - Knapsack Problem - Assignment problem. Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort - Multiplication of Large Integers.		
UNIT	TITLE	PERIODS
III	DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE	9
Dynamic programming – Principle of optimality - Coin changing problem, Computing a Binomial Coefficient – Floyd‘s algorithm – Multi stage graph - Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique – Container loading problem - Prim‘s algorithm and Kruskal's Algorithm – 0/1 Knapsack problem, Huffman Trees.		
UNIT	TITLE	PERIODS
IV	ITERATIVE IMPROVEMENT	9
The Simplex Method - The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem.		
UNIT	TITLE	PERIODS
V	COPING WITH THE LIMITATIONS OF ALGORITHM POWER	9
Lower - Bound Arguments - P, NP NP-Complete and NP Hard Problems. Backtracking – n-Queen’s problem - Hamiltonian Circuit Problem – Subset Sum Problem Branch and Bound – Assignment problem – Knapsack Problem – Travelling Salesman Problem - Approximation Algorithms for NP- Hard Problems – Travelling Salesman problem – Knapsack problem.		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Analyze the algorithms by time and space complexity.
CO2:	Solve the problems using Brute force and Divide-and-Conquer method.
CO3:	Solve the problems using Dynamic Programming And Greedy technique.
CO4:	Build the solution for the problem using Iterative algorithmic design techniques.
CO5:	Design algorithms for the real-world problems.

TEXT BOOKS:	
1.	Anany Levitin, ”Introduction to the Design and Analysis of Algorithms”, Third Edition, Pearson Education,2012.
2.	Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, Computer Algoritms / C++,Second Edition, University Press,2007.

REFERENCE BOOKS:	
1.	Alfred V. Aho, John E.Hopcroft and Jeffrey D.Ullman, ”Data Structures and Algorithms”, Pearson Education, Reprint 2006.
2.	Harsh Bhasin, ”Algorithms Design and Analysis”,Oxford university press,2016.
3.	Sridhar S ,”Design and Analysis of Algorithms”,Oxford university press,2014.
4.	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, ”Introduction to Algorithms”, Third Edition,PHI Learning Private Limited,2012

WEBSITES:	
1.	http://nptel.ac.in/

191CSC402T	OPERATING SYSTEMS	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Study the basic concepts and functions of operating systems.
2.	Understand the structure and functions of OS.
3.	Learn about Processes, Threads and Scheduling algorithms.
4.	Understand the principles of concurrency and Deadlocks.
5.	Learn various memory management schemes.
6.	Study I/O management and File systems.
7.	Learn the basics of Linux system and perform administrative tasks on Linux Servers.

UNIT	TITLE	PERIODS
I	OPERATING SYSTEMS OVERVIEW	9
Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System - Computer System Organization - Operating System Structure and Operations - System Calls, System Programs, OS Generation and System Boot.		
UNIT	TITLE	PERIODS
II	PROCESS MANAGEMENT	9
Processes-Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; Threads-Overview, Multicore Programming, Multithreading Models; Windows 7 – Thread and SMP Management. Process Synchronization – Critical Section Problem, Mutex Locks, Semaphores, Monitors; CPU Scheduling and Deadlocks.		
UNIT	TITLE	PERIODS
III	STORAGE MANAGEMENT	9
Main Memory-Contiguous Memory Allocation, Segmentation, Paging, 32 and 64 bit architecture Examples; Virtual Memory - Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.		
UNIT	TITLE	PERIODS
IV	I/O SYSTEMS	9
Mass Storage Structure- Overview, Disk Scheduling and Management; File System Storage-File Concepts, Directory and Disk Structure, Sharing and Protection; File System Implementation - File System Structure, Directory Structure, Allocation Methods, Free Space Management, I/O Systems.		

UNIT	TITLE	PERIODS
V	**CASE STUDY**	9
Linux System - Basic Concepts; System Administration - Requirements for Linux System Administrator, Setting up a LINUX Multifunction Server, Domain Name System, Setting Up Local Network Services; Virtualization - Basic Concepts, VMware on Linux Host OS.		

TOTAL PERIODS:	**45**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Interpret the basics of operating systems
CO2:	Apply scheduling, synchronization, threading and deadlock concepts for process management
CO3:	Analyze various management scheme for memory allocation
CO4:	Implement file system management concepts.
CO5:	Build LINUX Multifunction Server

TEXT BOOKS:	
1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, 9th Edition, John Wiley and Sons Inc., 2012.

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

WEBSITES:	
1.	http://nptel.ac.in/

191CSC403T	DATABASE MANAGEMENT SYSTEMS	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn the fundamentals of data models and to represent a database system using ER diagrams
2.	To study SQL and relational database design
3.	To understand the internal storage structures using different file and indexing techniques which will help in physical DB design
4.	To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures
5.	To have an introductory knowledge about the Storage and Query processing Techniques

UNIT	TITLE	PERIODS
I	RELATIONAL DATABASES	10
Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL		
UNIT	TITLE	PERIODS
II	DATABASE DESIGN	8
Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form		
UNIT	TITLE	PERIODS
III	TRANSACTIONS	9
Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery		
UNIT	TITLE	PERIODS
IV	IMPLEMENTATION TECHNIQUES	9
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.		

UNIT	TITLE	PERIODS
V	**ADVANCED TOPICS**	9
Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL – XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems		

TOTAL PERIODS:	**45**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Design relational database model for real world applications
CO2:	Develop ER model into Relational model for real world scenario
CO3:	Apply normalization for effective database design
CO4:	Apply Transaction management strategies to achieve Consistency
CO5:	Analyse indexing strategies for File organisation and Query Optimization
CO6:	Appraise advanced databases over traditional databases

TEXT BOOKS:	
1.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, —Database System Concepts‖, Sixth Edition, Tata McGraw Hill, 2011
2.	RamezElmasri, Shamkant B. Navathe, —Fundamentals of Database Systems‖, Sixth Edition, Pearson Education, 2011

REFERENCE BOOKS:	
1.	Gupta G.K.,"Database Management Systems‖, Tata McGraw Hill, 2011
2.	Date C.J., Kannan A., Swamynathan S., —An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006
3.	Raghu Ramakrishnan, —Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015

191CSC404T	PROGRAMMING IN JAVA	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand Object Oriented Programming concepts and basic characteristics of Java
2.	To know the principles of packages, inheritance and interfaces
3.	To define exceptions and use I/O streams
4.	To develop a java application with threads and generics classes
5.	To design and build simple Graphical User Interfaces

UNIT	TITLE	PERIODS
I	INTRODUCTION TO OOP AND JAVA FUNDAMENTALS	9
Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- Characteristics of Java – The Java Environment - Java Source File - Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods - Access specifiers - static members - Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - JavaDoc comments.		
UNIT	TITLE	PERIODS
II	INHERITANCE AND INTERFACES	9
Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, extending interfaces - Differences between classes and interfaces - Object cloning - Inner classes, Array Lists – Strings		
UNIT	TITLE	PERIODS
III	EXCEPTION HANDLING AND I/O	9
Exceptions - exception hierarchy - throwing and catching exceptions – Built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files		
UNIT	TITLE	PERIODS
IV	MULTITHREADING AND GENERIC PROGRAMMING	9
Differences between multi-threading and multitasking -Thread life cycle - Creating threads - Synchronizing threads - Inter-thread communication - Daemon threads - Thread groups. Generic Programming – Generic classes – Generic methods – Bounded Types – Restrictions and Limitations.		
UNIT	TITLE	PERIODS
V	EVENT DRIVEN PROGRAMMING	9
Graphics programming - Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.		

TOTAL PERIODS:	**45**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Develop Simple Java programs using Object Oriented Programming principles
CO2:	Develop Java programs with the concepts inheritance and interfaces.
CO3:	Build Java applications using exceptions and I/O streams.
CO4:	Develop Java applications with threads and generics classes.
CO5:	Develop interactive Java programs using swings.

TEXT BOOKS:	
1.	Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9th Edition, Prentice Hall, 2013.
2.	Herbert Schildt, “Java The complete reference”, 8th Edition, McGraw Hill Education, 2011.

REFERENCE BOOKS:	
1.	Danny Poo, Derek Kiong, Swarnalatha Ashok, “Object-Oriented Programming and Java”, 2nd Edition, Springer Publication, 2008.
2.	Paul Deitel, Harvey Deitel, “Java SE 8 for programmers”, 3rd Edition, Pearson, 2015.
3.	Steven Holzner, “Java 2 Black book”, Dreamtech press, 2011.
4.	Timothy Budd, “Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000.

191CSC411L	OPERATING SYSTEMS LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	0	4	0	2

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn Unix commands and shell programming
2.	To implement various CPU Scheduling Algorithms
3.	To implement Process Creation and Inter Process Communication.
4.	To implement Deadlock Avoidance and Deadlock Detection Algorithms
5.	To implement Page Replacement Algorithms
6.	To implement File Organization and File Allocation Strategies

LIST OF EXPERIMENTS	
1.	Basics of UNIX commands
2.	Write programs using the following system calls of UNIX operating system fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3.	Write C programs to simulate UNIX commands like cp, ls, grep, etc.
4.	Shell Programming
5.	Write C programs to implement the various CPU Scheduling Algorithms
6.	Implementation of Semaphores
7.	Implementation of Shared memory and IPC
8.	Bankers Algorithm for Deadlock Avoidance
9.	Implementation of Deadlock Detection Algorithm
10.	Write C program to implement Threading & Synchronization Applications
11.	Implementation of the following Memory Allocation Methods for fixed partition
	a. First Fit
	b. Worst Fit
	c. Best Fit
12.	Implementation of Paging Technique of Memory Management
13.	Implementation of the following Page Replacement Algorithms
	a. FIFO
	b. LRU
	c. LFU
14.	Implementation of the various File Organization Techniques
15.	Implementation of the following File Allocation Strategies

	a. Sequential
	b. Indexed
	c. Linked

TOTAL PERIODS:	**60**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Create shell program for simple applications
CO2:	Develop programs for various CPU Scheduling Algorithms
CO3:	Implement Deadlock avoidance and Detection techniques
CO4:	Implement the concepts of Semaphore, Inter Process Communications and threads to solve real time applications
CO5:	Analyze the performance of various Page Replacement Algorithms
CO6:	Create File Organization and File Allocation Strategies in Operating Systems

191CSC412L	DATABASE MANAGEMENT SYSTEMS LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	**0**	**3**	**1**	**2**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand data definitions and data manipulation commands
2.	To learn the use of nested and join queries
3.	To understand functions, procedures and procedural extensions of data bases
4.	To be familiar with the use of a front end tool
5.	To understand design and implementation of typical database applications

LIST OF EXPERIMENTS	
1.	Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements
2.	Database Querying – Simple queries, Nested queries, Sub queries and Joins
3.	Views, Sequences, Synonyms
4.	Database Programming: Implicit and Explicit Cursors
5.	Procedures and Functions
6.	Triggers
7.	Exception Handling
8.	Database Design using ER modelling, normalization and Implementation for any application
9.	Database Connectivity with Front End Tools
10.	Case Study using real life database applications

TOTAL PERIODS:	**60**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply data definitions and manipulation commands
CO2:	Create Nested and Join Queries for given real world scenario
CO3:	Create Views, Sequences and Synonyms for tables
CO4:	Develop simple programs with Cursors, Functions, Procedures, Exception handling and triggers .
CO5:	Construct real time applications using Front end Tools with database connectivity

WEBSITES:	
1.	spoken-tutorial.org

191CSC413L	JAVA PROGRAMMING LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	0	4	0	2

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand Object Oriented Programming concepts and basics of JAVA.
2.	To build software development skills using java programming for real-world applications.
3.	To understand and apply the concepts of classes, packages, interfaces, array list, exception handling and file processing.
4.	To develop applications using generic programming and event handling.
5.	To design and build simple Graphical User Interfaces.

LIST OF EXPERIMENTS	
1.	Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff. If the type of the EB connection is domestic, calculate the amount to be paid as follows:
	• First 100 units - Rs. 1 per unit
	• 101-200 units - Rs. 2.50 per unit
	• 201-500 units - Rs. 4 per unit
	• >501 units - Rs. 6 per unit
	If the type of the EB connection is commercial, calculate the amount to be paid as follows:
	• First 100 units - Rs. 2 per unit
	• 101-200 units - Rs. 4.50 per unit
	• 201 -500 units - Rs. 6 per unit
	• >501 units - Rs. 7 per unit
2.	Develop a Java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.
3.	Develop a Java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile no. as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
4.	Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.
5.	Write a program to perform string operations using Array List. Write functions for the following
	a. Append - add at end
	b. Insert - add at particular index

	c. Search
	d. List all string starts with given letter
6.	Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle. such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
7.	Write a Java program to implement user defined exception handling.
8.	Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.
9.	Write a Java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
10.	Write a Java program to find the maximum value from the given type of elements using a generic function.
11.	Design a calculator using event-driven programming paradigm of Java with the following options.
	a. Decimal manipulations
	b. Scientific manipulations
12.	Develop a mini project for any application using Java concepts.

TOTAL PERIODS:	**60**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Develop Simple application using Classes and Objects.
CO2:	Develop Java applications using Packages, Inheritance, Abstract Classes and Interfaces.
CO3:	Build Java application using Array list and Exception handling.
CO4:	Develop Java programs using Multithreading and I/O Streams.
CO5:	Develop Java application using generic functions and event handling.
CO6:	Create a real time application using Java concepts

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SEMESTER – V

COURSES

191CSC501T	COMPUTER NETWORKS	Periods per week				Credits
		L	T	P	R	
		3	2	0	0	4

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the protocol layering and physical level communication.
2.	To analyze the performance of a network.
3.	To understand the various components required to build different networks.
4.	To learn the functions of network layer and the various routing protocols.
5.	To familiarize the functions and protocols of the Transport layer.

UNIT		PERIODS
I	FUNDAMENDALS AND PHYSICAL LAYER	L - 9, T - 3
Networks – Network Types – Internet Architecture - Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.		
UNIT		PERIODS
II	DATA-LINK LAYER & MEDIA ACCESS	L - 9, T - 3
Link layer Addressing - Services – Framing – Error Detection – Flow control – HDLC - Media access control – Ethernet (802.3) – Wireless LANs – IEEE 802.11 – Bluetooth.		
UNIT		PERIODS
III	NETWORK LAYER	L - 9, T - 3
Network Layer Services – Switch basics – Basic Internetworking (IP, CIDR, ARP, DHCP and ICMP) - IPV4 Addressing – IPV6 Protocol - Routing (RIP, OSPF, metrics) – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM).		
UNIT		PERIODS
IV	TRANSPORT LAYER	L - 9, T - 3
Overview of Transport layer – UDP – Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements.		
UNIT		PERIODS
V	APPLICATION LAYER	L - 9, T - 3
WWW and HTTP – FTP – Electronic Mail (SMTP, POP3, IMAP, MIME) –Telnet –SSH – DNS – SNMP.		
	TOTAL PERIODS:	60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Assess the required functionality at each layer
CO2:	Analyze the flow of information in the network
CO3:	Apply the various routing algorithms.
CO4:	Appraise QoS principles based on Congestion Control methods.
CO5:	Analyze the working of various application layer protocols

TEXT BOOKS:	
1.	Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
2.	Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.

REFERENCE BOOKS:	
1.	Andrew S. Tanenbaum, “Computer Networks”, Fifth Edition, Pearson Education, 2011.
2.	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.
3.	Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4.	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
5.	Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011.

191CCC501T	CYBER SECURITY ESSENTIALS	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn the challenges and impacts of threats.
2.	To understand information assurance and supporting networks.
3.	To understand cyber attacks and tools for mitigating them.
4.	To learn how to detect a cyber attack.
5.	To learn how to prevent a cyber attack.

UNIT		PERIODS
I	CYBER SECURITY FUNDAMENTALS	9
Introduction to Cyber Security - Security challenges - Essentials of Security - Impacts due to lack of security - Challenges of Security - Security Model Work - Confidentiality, Integrity, and Availability (CIA) Triad - Types of Security Threats - Hackers - Types of hackers		
UNIT		PERIODS
II	NETWORK AND SECURITY CONCEPTS	9
Information Assurance Fundamentals - Basic Cryptography - Symmetric Encryption - Public Key Encryption - The Domain Name System (DNS) - Firewalls - Virtualization - Radio-Frequency Identification - Case Study: Microsoft Windows Security Principles.		
UNIT		PERIODS
III	ATTACKER TECHNIQUES AND EXPLOITATION	9
Anti Forensics - Proxies - Tunneling Techniques - Fraud Techniques: Phishing, Smishing, Vishing, and Mobile Malicious Code, Rogue Antivirus, Click Fraud - Exploitation: Techniques to Gain a Foothold - DoS Conditions - Brute Force and Dictionary Attacks - Misdirection, Reconnaissance, and Disruption Methods.		
UNIT		PERIODS
IV	DETECTION AND PREVENTION OF MALICIOUS CODES	9
Self-Replicating Malicious Code - Evading Detection and Elevating Privileges - Rootkits - Spyware - Attacks against Privileged User Accounts and Escalation of Privileges - Token Kidnapping - Virtual Machine Detection - Stealing Information and Exploitation.		
UNIT		PERIODS
V	DEFENSE AND ANALYSIS TECHNIQUES	9
Memory Forensics - Capabilities of Memory Forensics - Memory Analysis Frameworks - Dumping Physical Memory - Installing and Using Volatility - Finding Hidden Processes - Volatility Analyst Pack.		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the basics of cyber security, cyber threats.
CO2:	Apply network security solutions to prevent the users and systems connecting tounknown locations.
CO3:	Classify various types of attacks and learn the tools to launch the attacks
CO4:	Apply intrusion techniques to detect intrusion
CO5:	Apply intrusion prevention techniques to prevent intrusion

TEXT BOOKS:	
1.	Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short - Cybersecurity Essentials, October 2018, Sybex publications, ISBN: 9781119362395
2.	James Graham, Ryan Olson, Rick Howard - Cyber Security Essentials Paperback, Auerbach Publications (O'reilly), 1st edition (15 December 2010), ISBN-10 : 1439851239, ISBN-13 : 978-1439851234, eBook

REFERENCE BOOKS:	
1.	AnandShinde,"IntroductiontoCyberSecurityGuidetotheWorldofCyberSecurity", Notion Press, 2021
2.	NinaGodbole,SunitBelapure,"CyberSecurity:UnderstandingCyberCrimes,ComputerForensicsandLegal Perspectives",WileyPublishers,2011

191CCC502T	CRYPTOGRAPHY	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Learn to analyze the security of in-built cryptosystems.
2.	Know the fundamental mathematical concepts related to security.
3.	Develop cryptographic algorithms for information security.
4.	Comprehend the various types of data integrity and authentication schemes
5.	Understand cyber crimes and cyber security.

UNIT		PERIODS
I	INTRODUCTION TO SECURITY	9

IComputer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques:Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

UNIT		PERIODS
II	SYMMETRIC CIPHERS	9

Number theory – Algebraic Structures – Modular Arithmetic - Euclid‘s algorithm – Congruence andmatrices – Group, Rings, Fields, Finite Fields

SYMMETRIC KEY CIPHERS: SDES – Block Ciphers – DES, Strength of DES – Differential andlinear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluationcriteria for AES – Pseudorandom Number Generators – RC4 – Key distribution.

UNIT		PERIODS
III	ASYMMETRIC CRYPTOGRAPHY	9

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing –Factorization – Euler’s totient function, Fermat’s and Euler’s Theorem – Chinese RemainderTheorem – Exponentiation and logarithm

ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – DiffieHellman key exchange -– Elliptic curve arithmetic – Elliptic curve cryptography.

UNIT		PERIODS
IV	INTEGRITY AND AUTHENTICATION ALGORITHMS	9

Authentication requirement – Authentication function – MAC – Hash function – Security of hashfunction: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr

Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords,Challenge Response protocols – Authentication applications – Kerberos

MUTUAL TRUST: Key management and distribution – Symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates.

UNIT		PERIODS
V	CYBER CRIMES AND CYBER SECURITY	9
Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods –Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the fundamentals of networks security, security architecture, threats and vulnerabilities
CO2:	Apply the different cryptographic operations of symmetric cryptographic algorithms
CO3:	Apply the different cryptographic operations of public key cryptography
CO4:	Apply the various Authentication schemes to simulate different applications.
CO5:	Understand various cyber crimes and cyber security.

TEXT BOOKS:	
1.	William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.
2.	Nina Godbole, SunitBelapure, “Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives”, First Edition, Wiley India, 2011.

REFERENCE BOOKS:	
1.	Behrouz A. Ferouzan, DebdeepMukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata Mc Graw Hill, 2015.
2.	Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

191CSC511L	COMPUTER NETWORKS LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	0	3	1	2

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn and use network commands.
2.	To learn socket programming.
3.	To implement and analyze various network protocols.
4.	To learn and use simulation tools.
5.	To use simulation tools to analyze the performance of various network protocols.

LIST OF EXPERIMENTS	
1.	Learn to use various networking commands and examine.
2.	Write a program to implement socket programming.
3.	Write a HTTP web client program to download a web page using TCP / UDP sockets.
4.	Write a program to implement DNS using TCP / UDP sockets.
5.	Write a program to implement Echo client and echo server and chat application using Transport layer protocol.
6.	Implementation of File Transfer using TCP / UDP.
7.	Study of Network simulator (NS)
8.	Simulation of Congestion / flow control Algorithms using NS.
9.	Performance of TCP and UDP using Simulation tool.
10.	Simulation of Distance Vector and Link state Routing algorithm.
11.	Implementation of IPv4 and IPv6
12.	Implementation of SMTP
13.	Implementation of error correction code (like CRC).
	TOTAL PERIODS: 60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply networking commands for various operating systems.
CO2:	Implement various protocols using TCP / UDP sockets.
CO3:	Implement Cyclic Redundancy Check for error detection and correction.
CO4:	Analyze the performance of various network protocols using simulation tools.
CO5:	Evaluate the various routing algorithms for finding optimal path

191CCC511L	CRYPTOGRAPHY AND CYBER SECURITY LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	**0**	**2**	**0**	**1**

PREREQUISITES:	
NIL	
COURSE OBJECTIVES:	
1.	Learn different cipher techniques.
2.	Implement the algorithms DES, AES.
3.	Implement the algorithms RSA and Diffie-Hellman.
4.	Implement hashing techniques such as SHA-1, MD-5.
5.	Develop a digital signature scheme.

LIST OF EXPERIMENTS	
1.	Write a program to implement the following cipher techniques to perform encryption and decryption Caesar Cipher Playfair Cipher Hill Cipher
2.	Write a program to implement the following transposition techniques (i) Rail fence technique –Row major transformation (ii) Rail fence technique - Column major transformation
3.	Write a program to implement DES algorithm
4.	Write a program to implement RSA Encryption algorithm
5.	Write a program to implement AES algorithm
6.	Write a program to implement the Diffie-Hellman Key Exchange mechanism. Consider one of the parties as Alice and the other party as bob.
7.	Write a program to calculate the message digest of a text using the SHA-1 algorithm.
8.	Write a program to calculate the message digest of a text using the MD-5 algorithm.
9.	Write a program to implement digital signature standard.
	TOTAL PERIODS: **30**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Develop a code for classical encryption techniques.
CO2:	Build the symmetric algorithms.
CO3:	Build the asymmetric algorithms.
CO4:	Construct a code for various Authentication schemes.
CO5:	Apply the principles of digital signature.

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SEMESTER – VI

COURSES

191CCC601T	CYBER THREAT INTELLIGENCE	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:

NIL

COURSE OBJECTIVES:

1.	Leaders can guide organizations in accurately accessing threats, Risks, and vulnerabilities
2.	To minimize the potential for incidents and, when necessary, provide more thoughtful responses
3.	To analyze Cyber Threat Intelligence
4.	To Providers of threat indicators

UNIT	TITLE	PERIODS
I	DEFINING CYBER THREAT INTELLIGENCE	9

The Need for Cyber Threat Intelligence: The menace of targeted attacks, The monitor– and–respond strategy, Why the strategy is failing, Cyber Threat Intelligence Defined, Key Characteristics: Adversary based, Risk focused, Process oriented, Tailored for diverse consumers, The Benefits of Cyber Threat Intelligence

UNIT	TITLE	PERIODS
II	DEVELOPING CYBER THREAT INTELLIGENCE REQUIREMENTS	9

Assets That Must Be Prioritized: Personal information, Intellectual property, Confidential business information, Credentials and IT systems information, Operational systems. Adversaries: Cybercriminals, Competitors and cyber espionage agents, Hack activists. Intelligence Consumers: Tactical users, Operational users, Strategic users

UNIT	TITLE	PERIODS
III	COLLECTING CYBER THREAT INFORMATION	9

Threat Indicators, File hashes and reputation data, Technical sources: honey pots and scanners, Industry sources: malware and reputation feeds. Level 2: Threat Data Feeds, Cyber threat statistics, reports, and surveys, Malware analysis. Level 3: Strategic Cyber Threat Intelligence, Monitoring the underground, Motivation and intentions, Tactics, techniques, and procedures

UNIT	TITLE	PERIODS
IV	ANALYZING AND DISSEMINATING CYBER THREAT INTELLIGENCE	9

Information versus Intelligence, Validation and Prioritization: Risk scores, Tags for context, Human assessment. Interpretation and Analysis: Reports, Analyst skills, Intelligence platform, Customization. Dissemination: Automated feeds and APIs, Searchable knowledge base, Tailored reports

UNIT	TITLE	PERIODS
V	OPEN SOURCE SOFTWARE DEVELOPMENT	9

Types of Partners: Providers of threat indicators, Providers of threat data feeds, Providers of comprehensive cyber threat intelligence. Important Selection Criteria: Global and cultural reach, Historical data and knowledge, Range of intelligence deliverables, APIs and integrations, Intelligence platform, knowledge base, and portal, Client services, Access to experts. Intelligence–driven Security

TOTAL PERIODS:	45

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1:	Study of different Cyber Threat.
CO2:	Study the technique to Develop Cyber Threat Intelligence Requirements.

CO3:	Can Collect Cyber Threat Information.
CO4:	Help in Analyzing and Disseminating Cyber Threat Intelligence.
CO5:	Study of Open Source Software Development.
TEXT BOOKS:	
1.	Jon Friedman. Mark Bouchard, CISSP. Foreword by John P. Watters, Cyber Threat Intelligence, Definitive Guide TM, 2015.
2.	Scott J. Roberts, Rebekah Brown, Intelligence– Driven Incident Response: Outwitting the Adversary, O'Reilly Media, 2017.
REFERENCE BOOKS:	
1.	Henry Dalziel, How to Define and Build an Effective Cyber Threat Intelligence Capability Elsevier Science & Technology, 2014.
2.	John Robertson, Ahmad Diab, Ericsson Marin, Eric Nunes, VivinPaliath, Jana Shakarian,PauloShakarian, DarkWeb Cyber Threat Intelligence Mining Cambridge University Press, 2017
3.	Bob Gourley, The Cyber Threat, Createspace Independent Pub, 2014.

191CCC602T	NETWORK SECURITY	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the basic concepts of security
2.	To understand the IP and web security
3.	To understand the concept of authentication protocols and digital signatures.
4.	To learn various methods and protocols to understand the cryptography.
5.	To learn various network security attacks.

UNIT	TITLE	PERIODS
I	FUNDAMENTALS OF NETWORKING SECURITY	9
Overview of networking security- Security Services -Confidentiality, Authentication, Integrity, Non-repudiation, access Control - Availability and Mechanisms- Security Attacks -Interruption,Interception ,Modification and Fabrication.		
UNIT	TITLE	PERIODS
II	AUTHENTICATION AND SECURITY	9
Authentication overview - Authentication protocols - Authentication and key establishment – keyexchange - mediated key exchange - User Authentication –password based authentication -password security - Certificate Authority and key management - digital signatures – digitalCertificates.		
UNIT	TITLE	PERIODS
III	PUBLIC-KEY CRYPTOGRAPHY AND MESSAGE AUTHENTICATION	9
Basics of cryptography -cryptographic hash functions - symmetric and public-key encryption -public key cryptography principles & algorithms - cipher block modes of operation - Secure HashFunctions – HMAC		
UNIT	TITLE	PERIODS
IV	SECURITY ATTACKS	9
Buffer overflow attacks & format string vulnerabilities - Denial-of-Service Attacks -Hijacking attacks: exploits and defenses - Internet worms – viruses – spyware –phishing – botnets - TCP sessionhijacking - ARP attacks - route table modification - UDP hijacking - man-in-the-middle attacks.		
UNIT	TITLE	PERIODS
V	IP SECURITY AND WEB SECURITY	9
Network defense tools: Firewalls,VPNs, Intrusion Detection, and filters –Ecybercrimecymail privacy: PrettyGood Privacy (PGP) and S/MIME - Network security protocols in practice- Introduction toWireshark – SSL - IPsec, and IKE -DNS security- Secure Socket Layer (SSL) and Transport LayerSecurity (TLS) - Secure Electronic Transaction (SET)		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Describe computer and network security fundamental concepts and principles.
CO2:	Acquire the knowledge of various authentication protocols, key exchange mechanism, and digital certificates.
CO3:	To get better knowledge on fundamental concepts of cryptography, encryption and hashing techniques.
CO4:	Identify and assess different types of threats and attacks such as social engineering, rootkit, and botnets,etc.
CO5:	Acquire Demonstrate the ability to select among available network security technology and protocols such as IDS, firewalls, SSL , TLS, etc.

TEXT BOOKS:	
1.	Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.

REFERENCE BOOKS:	
1.	Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe
2.	Grand, David Ahmad, Hal
3.	Flynn IdoDubrawsky, Steve W.Manzuik and Ryan Permeh, Wiley Dreamtech

191CSC603T	COMPILER DESIGN	Periods per week				Credits
		L	T	P	R	
		3	2	0	0	4

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn the various phases of compiler.
2.	To learn the various parsing techniques.
3.	To understand intermediate code generation and run-time environment.
4.	To learn to implement front-end of the compiler.
5.	To learn to implement code generator.

UNIT	TITLE	PERIODS
I	INTRODUCTION TO COMPILERS	L - 9, T - 3
Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata – Minimizing DFA.		
UNIT	TITLE	PERIODS
II	SYNTAX ANALYSIS	L - 12, T - 3
Role of Parser – Grammars – Error Handling – Context-free grammars – Writing a grammar – Top Down Parsing - General Strategies Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser-LR (0)Item Construction of SLR Parsing Table -Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC.		
UNIT	TITLE	PERIODS
III	INTERMEDIATE CODE GENERATION	L - 8, T - 3
Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.		
UNIT	TITLE	PERIODS
IV	RUN-TIME ENVIRONMENT AND CODE GENERATION	L - 8, T - 3
Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack and Heap allocation Issues in the Design of a code generator – Code generation for Runtime storage Management: Static and Stack allocation - Basic Blocks and Flow graphs - Design of a simple Code Generator.		
UNIT	TITLE	PERIODS
V	CODE OPTIMIZATION	L - 8, T - 3
Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks - Global Data Flow Analysis. Recent trends in Compiler Design.		

TOTAL PERIODS:	60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Make use of regular expressions to perform lexical analysis.
CO2:	Develop parsers using parsing algorithms.
CO3:	Generate intermediate code for the source program.
CO4:	Analyze the various storage allocation strategies for generation of target code
CO5:	Apply appropriate code optimization techniques for the given intermediate code.

TEXT BOOKS:	
1.	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools‖, Second Edition, Pearson Education, 2009

REFERENCE BOOKS:	
1.	Allen I. Holub, Compiler Design in C‖, Prentice-Hall Software Series, 1993.
2.	Keith D Cooper and Linda Torczon, Engineering a Compiler‖, Morgan Kaufmann Publishers Elsevier Science, 2004
3.	Raghavan V, Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, 2010
4.	Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002
5.	Steven S. Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.

191LEH611L	INTERPERSONAL SKILLS / LISTENING AND SPEAKING	Periods per week				Credits
		L	T	P	R	
		0	0	2	0	1

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Equip students with the English language skills required for the successful undertaking
2.	Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
3.	Improve general and academic listening skills
4.	Make effective presentations.

UNIT	TITLE	PERIODS
I		6
Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.		
UNIT	TITLE	PERIODS
II		6
Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.		
UNIT	TITLE	PERIODS
III		6
Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail		
UNIT	TITLE	PERIODS
IV		6
Being an active listener - Giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures - conversational speech- listening to and participating in conversations - persuade.		
UNIT	TITLE	PERIODS
V		6
Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.		

TOTAL PERIODS:	30

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Listen and respond appropriately.
CO2:	Participate in group discussions
CO3:	Make effective presentations
CO4:	Participate confidently and appropriately in conversations both formal and informal

TEXT BOOKS:	
1.	Brooks, Margret. Skills for Success. Listening and Speaking. Level 4, Oxford University Press, Oxford: 2011.
2.	Richards, C. Jack. & David Bholke. Speak Now Level 3, Oxford University Press, Oxford: 2010

REFERENCE BOOKS:	
1.	Bhatnagar, Nitin and MamtaBhatnagar, Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2.	Hughes, Glyn and Josephine Moate, Practical English Classroom. Oxford University Press: Oxford, 2014.
3.	Ladousse, Gillian Porter, Role Play. Oxford University Press: Oxford, 2014
4.	Richards C. Jack, Person to Person (Starter). Oxford University Press: Oxford, 2006
5.	Vargo, Mari, Speak Now Level 4. Oxford University Press: Oxford, 2013.

191CSC611L	SECURITY AND PENETRATION TESTING LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	**0**	**3**	**1**	**2**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn about the Foot printing
2.	To learn about the Port scanning
3.	To know about the Windows and Linux Enumerations
4.	To know about the Antivirus Programming
5.	To know about the Password cracking

LIST OF EXPERIMENTS	
1.	To perform the Foot printing
2.	Demonstrate Port scanning
3.	Implement Windows and Linux Enumerations
4.	Simulate Hacking web applications
5.	Simulate Hacking web servers
6.	Simulate Network hacking
7.	Perform Database hacking
8.	Study Sniffer tools
9.	Simulate Antivirus Programming
10.	Perform Password cracking

TOTAL PERIODS:	**60**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Learn about the Foot printing
CO2:	Learn about the Port scanning
CO3:	Know about the Windows and Linux Enumerations
CO4:	Know about the Antivirus Programming
CO5:	Know about the Password cracking

SYLLABUS OF

SEMESTER – VII

COURSES

191MBH721T	PROFESSIONAL ETHICS	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To exposure the aspects of professional ethics and Human Values
2.	To enable the students to create an awareness on Professional ethics and Rights
3.	To become aware of Social Experimentation and Engineering Standards
4.	To enable the students to learn safety, Responsibilities and Rights
5.	To gain knowledge about Global Issues related to Engineering.

UNIT	TITLE	PERIODS
I	HUMAN VALUES	9
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.		
UNIT	TITLE	PERIODS
II	PROFESSIONALISM	9
Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory Professional Rights – Employee Rights – Intellectual Property Rights (IPR)- Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime		
UNIT	TITLE	PERIODS
III	SOCIAL EXPERIMENTATION AND RESPONSIBILITIES	9
Engineers as responsible Experimenters: Challenger, Chernobyl, Three Mile Island - Multinational Corporations- Computer Ethics – Corporate Social Responsibility-Customs and Religion		
UNIT	TITLE	PERIODS
IV	SAFETY, RESPONSIBILITIES AND RIGHTS	9
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination		
UNIT	TITLE	PERIODS
V	GLOBAL ISSUES	9
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility		

TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply Human values, skills, and attitudes to become more aware of themselves and their surroundings
CO2:	Apply moral rights and values in the Society
CO3:	Analyze the role of professional engineer as responsible social experimenter
CO4:	Apply the fundamentals of safety, Responsibilities and Rights in real life
CO5:	Analyze the global issues related to Engineers

TEXT BOOKS:	
1.	Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2.	Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOKS:	
1.	Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2.	Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009
3.	John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4.	Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001
5.	Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6.	World Community Service Centre, ” Value Education”, Vethathiri publications, Erode, 2011

191CCC701T	CYBER FORENSICS	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Be exposed to security issues of the application layer
2.	Learn computer forensics
3.	Be familiar with forensics tools
4.	Learn to analyze and validate forensics data
5.	Learn the security issues network layer and transport layer

UNIT	TITLE	PERIODS
I	NETWORK LAYER SECURITY &TRANSPORT LAYER SECURITY	9
IPSec Protocol - IP Authentication Header - IP ESP - Key Management Protocol for IPSec. Transport layer Security: SSL protocol, Cryptographic Computations – TLS Protocol.		
UNIT	TITLE	PERIODS
II	E-MAIL SECURITY & FIREWALLS	9
PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions.		
UNIT	TITLE	PERIODS
III	INTRODUCTION TO COMPUTER FORENSICS	9
Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.		
UNIT	TITLE	PERIODS
IV	EVIDENCE COLLECTION AND FORENSICS TOOLS	9
Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.		
UNIT	TITLE	PERIODS
V	ANALYSIS AND VALIDATION	9
Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics.		

	TOTAL PERIODS:	45

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply IP sec protocols in network layer and transport layer.
CO2:	Design firewalls for trusted system.
CO3:	Investigate cyber crimes using computer forensics techniques.
CO4:	Use forensics tools for evidence collection.
CO5:	Analyze forensics data for data validation.

TEXT BOOKS:	
1.	Man Young Rhee, —Internet Security: Cryptographic Principles‖, —Algorithms and Protocols, Wiley Publications, 2003.
2.	Nelson, Phillips, Enfinger, Steuart, —Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2008.

REFERENCE BOOKS:	
1.	John R.Vacca, “Computer Forensics”, Cengage Learning, 2005
2.	MarjieT.Britz, “Computer Forensics and Cyber Crime”: An Introduction”, 3 rd Edition, Prentice Hall, 2013
3.	Richard E.Smith, “Internet Cryptography”, 3 rd Edition Pearson Education, 2008..

191CCC711L	CYBER FORENSICS LABORATORY	Periods per week				Credits
		L	T	P	R	
		0	0	3	1	2

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn different HEX editors
2.	To Study Encase Forensics.
3.	To implement and install HEX Editor.
4.	To Use Encase Forensics.

LIST OF EXPERIMENTS	
1.	Introduction to HEX Editor 18.5
2.	Introduction to Encase Forensics 4.20
3.	Installation of HEX Editor and Encase Forensics.
4.	Comparison of Files using HEX Editor 18.5 and FC Command
5.	Imaging using Encase Forensics 4.20
6.	Imaging using FTK Imager 3.2.0.0
7.	Extracting Browser Artifacts
8.	File Carving using Testdisk and Photorec
9.	Microsoft Sys internalsi. Microsoft Sys internals – Networking Utilitiesii. Microsoft Sys internals – Process Utilitiesiii. Microsoft Sys internals – Security Utilitiesiv. Microsoft Sys internals – System Information Utilitiesv. Microsoft Sys internals – Miscellaneous Utilitiesvi. Microsoft Sys internals – File and Disk Utilities

TOTAL PERIODS:	60

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Learn different HEX editors
CO2:	Study Encase Forensics.
CO3:	Implement and install HEX Editor.
CO4:	Use Encase Forensics.
CO5:	Extracting Browser Artifacts

PROFESSIONAL ELECTIVE

BE- CSE (Cyber security)

ACADEMIC SYLLABUS

(REGULATIONS 2019- V21)

CHOICE BASED CREDIT SYSTEM

(Applicable to the students from the Academic Year 2021-22)

EASWARI ENGINEERING COLLEGE
(Autonomous Institution)
Bharathi Salai, Ramapuram, Chennai - 600 089

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CONTENTS

EASWARI ENGINERING COLLEGE

(Autonomous)

Bharathi Salai, Ramapuram, Chennai-89

Common verticals for BE- CSE, CSE (Cyber security), CSE(AI&ML) and B. Tech – IT, AI & DS (R2019 v21)

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI	Vertical VII	Vertical VIII
AI&DS	**CSE**	**IT**	**AI&ML**	**CS**	**CSE**	**IT**	**AI&DS**
DATA SCIENCE	**FULL STACK DEVELOPMENT**	**CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES**	**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**	**CYBER SECURITY AND DATA PRIVACY**	**EMERGING TECHNOLOGIES I**	**EMERGING TECHNOLOGIES II**	**CREATIVE MEDIA**
191AIE011T: Exploratory Data Analysis	**191CSE012T:** Web Technologies	**191ITE013T:** Cloud Computing	**191CAE014T:** Fundamentals of Software Engineering	**191CCE015T:** Ethical Hacking	**191CSE016J:** Augmented Reality/Virtual Reality	**191CCE015T:** Ethical Hacking	**191CSE016J:** Augmented Reality/Virtual Reality
191AIE021J: Recommender Systems	**191CSE022J:** App Development	**191ITE023J:** Virtualization	**191CAE024J:** Soft Computing	**191CCE025J:** Digital and Mobile Forensics	**191CSE026J:** Robotic Process Automation	**191ITE027J:** Multimedia and Animation	**191ITE027J:** Multimedia and Animation
191AIE031J: Neural Networks and Deep Learning	**191CSE032J:** Cloud Services Management	**191CSE032J:** Cloud Services Management	**191AIE031J:** Neural Networks and Deep Learning	**191CCE035J:** Social Network Security	**191AIE031J:** Neural Networks and Deep Learning	**191CSE042J:** UI and UX Design	**191AIE038J:** Video Creation and Editing
191AIE041J: Text and Speech Analysis	**191CSE042J:** UI and UX Design	**191ITE043J:** Data Engineering in Cloud	**191AIE041J:** Text and Speech Analysis	**191CCE045J:** Modern Cryptography	**191CSE046J:** Cyber Security	**191ITE047J:** Digital Marketing	**191CSE042J:** UI and UX Design
191AIE051J: Business Analytics	**191CSE052J:** Software Testing and Automation	**191ITE053T:** Storage Technologies	**191CAE054T:** Resource Management Techniques	**191CCE055J:** Engineering Secure Software Systems	**191CSE056J:** Quantum Computing	**191CAE084J:** Ethics and AI	**191ITE047J:** Digital marketing
191AIE061J: Image and Video Analytics	**191CSE062J:** Web Application Security	**191ITE063J:** Software Defined Networks	**191CAE064J:** Knowledge Engineering	**191CCE065J:** Cryptocurrency and Block chain Technologies	**191CCE065J:** Cryptocurrency and Block chain Technologies	**191AIE061J:** Image and Video Analytics	**191AIE068J:** Multimedia Data Compression and Storage
191AIE071J: Computer Vision	**191CSE072J:** DevOps	**191ITE073J:** Stream Processing	**191CAE074J:** Cognitive Science	**191CCE075J:** Malware Analysis	**191CSE076J:** Game Development	**191AIE071J:** Computer Vision	**191CSE076J:** Game Development
191AIE081T: Fundamentals of Big Data Analytics	**191CSE082T:** Principles of Programming Languages	**191ITE083J:** Security and Privacy in Cloud	**191CAE084J:** Ethics and AI	**191ITE083J:** Security and Privacy in Cloud	**191CSE086J:** 3D Printing and Design	**191ITE083J:** Security and Privacy in Cloud	**191AIE088J:** Game Theory
191AIE091T : Introduction To Nosql Databases	**191CSE092J:** Internet Technology						

SYLLABUS OF

Vertical I – DATA SCIENCE

COURSES

Course Code	Course Title	Periods per week				Credits
		L	T	P	R	
191AIE011T	EXPLORATORY DATA ANALYSIS	3	0	0	0	3

PRE REQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To outline an overview of exploratory data analysis.
2.	To implement data visualization using Matplotlib.
3.	To perform univariate data exploration and analysis.
4.	To apply bivariate data exploration and analysis.
5.	To use Data exploration and visualization techniques for multivariate and time series data.

UNIT	TITLE	PERIODS
1	EXPLORATORY DATA ANALYSIS	9
EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques		
UNIT	TITLE	PERIODS
2	EDA USING PYTHON	9
Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.		
UNIT	TITLE	PERIODS
3	UNIVARIATE ANALYSIS	9
Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality- quantiles and QQ plots-residuals and transforms-Functions of one variable, splines and cross-validation.		
UNIT	TITLE	PERIODS
4	BIVARIATE ANALYSIS	9
Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines- Types of Bivariate Analysis-Scatterplots-Correlation-Regression, Chi -Square test-test-ANOVA (Analysis of Variance).		
UNIT	TITLE	PERIODS
5	MULTIVARIATE AND TIME SERIES ANALYSIS	9

Introducing a Third Variable - Interactions and multivariate models-Causal Explanations - Three-Variable Contingency Tables andBeyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-basedindexing– Visualizing–Grouping–Resampling.	
TOTALPERIODS:	**45**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to	
CO1:	Understand the fundamentals of exploratory data analysis.
CO2:	Implement the data visualization using Matplotlib.
CO3:	Perform univariate data exploration and analysis.
CO4:	Apply bivariate data exploration and analysis.
CO5:	Use Data exploration and visualization techniques for multivariate and time series data.

TEXTBOOKS:	
1.	Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020. (Unit 1)
2.	Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data",First Edition, O Reilly, 2017. (Unit 2)
3.	Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for SocialScientists”, Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)

REFERENCEBOOKS:	
1.	Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2.	Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.
3.	Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

Course Code	Course Title	Periods per week				Credits
		L	T	P	R	
191AIE021J	RECOMMENDER SYSTEMS	2	0	2	0	3

PREREQUISITES:
NIL

COURSEOBJECTIVES:	
1.	To understand the foundations of the recommender system.
2.	To learn the significance of machine learning and data mining algorithms for Recommender systems.
3.	To learn about collaborative filtering.
4.	To make students design and implement a recommender system.
5.	To learn collaborative filtering.

UNIT	TITLE	PERIODS
1	INTRODUCTION	6

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD) .

Suggested Activities:

- Practical learning – Implement Data similarity measures.
- External Learning – Singular Value Decomposition (SVD) applications

Suggested Evaluation Methods:

- Quiz on Recommender systems.
- Quiz of python tools available for implementing Recommender systems

UNIT	TITLE	PERIODS
2	CONTENT-BASED RECOMMENDATION SYSTEMS	6

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

Suggested Activities:

- Assignment on content-based recommendation systems
- Assignment of learning user profiles

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.
- Quiz of content-based filtering.

UNIT	TITLE	PERIODS
3	COLLABORATIVE FILTERING	6

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection.

Suggested Activities:

- Practical learning – Implement collaborative filtering concepts
- Assignment of security aspects of recommender systems

Suggested Evaluation Methods:

- Quiz on collaborative filtering
- Seminar on security measures of recommender systems.

UNIT	TITLE	PERIODS
4	ATTACK-RESISTANT RECOMMENDER SYSTEMS	6

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

Suggested Activities:

- Group Discussion on attacks and their mitigation

  Study of the impact of group attacks.
- External Learning – Use of CAPTCHAs

Suggested Evaluation Methods:

- Quiz on attacks on recommender systems
- Seminar on preventing attacks using the CAPTCHAs.

UNIT	TITLE	PERIODS
5	EVALUATING RECOMMENDER SYSTEMS	6

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design

Design Issues – Accuracy metrics – Limitations of Evaluation measures.

Suggested Activities:

- Group Discussion on goals of evaluation design
- Study of accuracy metrics

Suggested Evaluation Methods:

- Quiz on evaluation design
- Problems on accuracy measures.

TOTALPERIODS:	**30**
PRACTICAL PERIODS :	**30**

1. Implement Data similarity measures using Python
2. Implement dimension reduction techniques for recommender systems
3. Implement user profile learning
4. Implement content-based recommendation systems
5. Implement collaborative filter techniques
6. Create an attack for tampering with recommender systems
7. Implement accuracy metrics like Receiver Operated Characteristic curves.

COURSE OUTCOMES:	
Upon completion of this course, student will be able	
CO1:	Understand the basic concepts of recommender systems.
CO2:	Implement machine-learning and data-mining algorithms in recommender systems data sets.
CO3:	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
CO4:	Design and implement a simple recommender system.
CO5:	Learn about advanced topics of recommender systems.
CO6:	Learn about advanced topics of recommender systems applications

TEXTBOOKS:	
1.	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2.	Dietmar Jannach , Markus Zanker , Alexander Felfernigand Gerhard Friedrich Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3.	Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011)
4.	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rdedition, Cambridge University Press, 2020.

191AIE031J	NEURAL NETWORKS AND DEEP LEARNING	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

COURSE OBJECTIVES:	
1.	To understand the basics in deep neural networks
2.	To understand the basics of associative memory and unsupervised learning networks
3.	To apply CNN architectures of deep neural networks
4.	To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks
5.	To apply auto encoders and generative models for suitable applications

UNIT	TITLE	PERIODS
I	**INTRODUCTION**	**6**
Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction- Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.		
UNIT	**TITLE**	**PERIODS**
II	**ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS**	**6**
Training Algorithms for Pattern Association-Auto Associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.		
UNIT	**TITLE**	**PERIODS**
III	**THIRD-GENERATION NEURAL NETWORKS**	**6**
Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.		
UNIT	**TITLE**	**PERIODS**
IV	**DEEP FEEDFORWARD NETWORKS**	**6**
History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.		

UNIT	TITLE	PERIODS
V	**RECURRENT NEURAL NETWORKS**	6
Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Auto encoder, Stochastic Encoders and Decoders, Contractive Encoders.		
		30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Implement simple vector addition in TensorFlow.	
2.	Implement a regression model in Keras.	
3.	Implement a perceptron in TensorFlow/Keras Environment.	
4.	Implement a Feed-Forward Network in TensorFlow/Keras.	
5.	Implement an Image Classifier using CNN in TensorFlow/Keras.	
6.	Improve the Deep learning model by fine tuning hyper parameters.	
7.	Implement a Transfer Learning concept in Image Classification.	
8.	Using a pre trained model on Keras for Transfer Learning	
9.	Perform Sentiment Analysis using RNN	
10.	Implement an LSTM based Auto encoder in TensorFlow / Keras.	
11.	Image generation using GAN	
Additional Experiments		
12.	Train a Deep learning model to classify a given image using pre trained model	
13.	Recommendation system from sales data using Deep Learning	
14.	Implement Object Detection using CNN	
15.	Implement any simple Reinforcement Algorithm for an NLP problem	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply Convolution Neural Network for image processing.
CO2:	Understand the basics of associative memory and unsupervised learning networks.
CO3:	Apply CNN and its variants for suitable applications.
CO4:	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
CO5:	Apply auto encoders and generative models for suitable applications.

TEXT BOOKS:	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2.	Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.

REFERENCE BOOKS:	
1.	Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly, 2018.
2.	Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
3.	Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4.	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5.	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6.	Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017.
7.	S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
8.	Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9.	James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

Course Code	Course Title	Periods per week				Credits
		L	T	P	R	
191AIE041J	TEXT AND SPEECH ANALYSIS	2	0	2	0	3

PRE REQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Understand natural language processing basics
2.	Apply classification algorithms to text documents
3.	Build question-answering and dialogue systems
4.	Develop a speech recognition system
5.	Develop a speech synthesizer

UNIT	TITLE	PERIODS
1	NATURAL LANGUAGE BASICS	6

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs.

UNIT	TITLE	PERIODS
2	TEXT CLASSIFICATION	6

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

Assignment on above topics

Quiz on RNN, Transformers

Implementing NLP with RNN and Transformers.

UNIT	TITLE	PERIODS
3	QUESTION ANSWERING AND DIALOGUE SYSTEMS	6

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems

Suggested Activities:

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

UNIT	TITLE	PERIODS
4	TEXT-TO-SPEECH SYNTHESIS	6

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.

Suggested Activities:

Flipped classroom on Speech signal processing
Exploring Text normalization
Data collection
Implementation of TTS systems

Suggested Evaluation Methods

Assignment on the above topics
Quiz on wavenet, deep learning-based TTS systems
Finding accuracy with different TTS systems

UNIT	TITLE	PERIODS
5	AUTOMATIC SPEECH RECOGNITION	6

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems.

Suggested Activities:

Flipped classroom on Speech recognition.
Exploring Feature extraction

Suggested Evaluation Methods

Assignment on the above topics
Quiz on acoustic modelling

TOTAL PERIODS:	**30**
PRACTICAL PERIODS :	**30**
Create Regular expressions in Python for detecting word patterns and tokenizing text	
Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams	
Accessing Text Corpora using NLTK in Python	
Write a function that finds the 50 most frequently occurring words of a text that are not stop words.	
Implement the Word2Vec model	
Use a transformer for implementing classification	
Design a chatbot with a simple dialog system	
Convert text to speech and find accuracy	
Design a speech recognition system and find the error rate	

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Explain existing and emerging deep learning architectures for text and speech processing
CO2:	Apply deep learning techniques for NLP tasks, language modelling and machine translation
CO3:	Explain coreference and coherence for text processing
CO4:	Build question-answering systems, chatbots and dialogue systems
CO5:	Apply deep learning models for building speech recognition and text-to-speech systems

TEXT BOOKS:	
1.	Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022

REFERENCE BOOKS:	
1.	Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018.
2.	Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008
3.	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
4.	Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY.

191AIE051J	BUSINESS ANALYTICS	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the Analytics Life Cycle.
2.	To comprehend the process of acquiring Business Intelligence.
3.	To understand various types of analytics for Business Forecasting.
4.	To model the supply chain management for Analytics.
5.	To apply analytics for different functions of a business.

UNIT	TITLE	PERIODS
I	INTRODUCTION TO BUSINESS ANALYTICS	6
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration.		
UNIT	TITLE	PERIODS
II	BUSINESS INTELLIGENCE	6
Data Warehouses and Data Mart – Knowledge Management –Types of Decisions – Decision MakingProcess – Decision Support Systems – Business Intelligence –OLAP – Analytic function.		
UNIT	TITLE	PERIODS
III	BUSINESS FORECASTING	6
Introduction to Business Forecasting and Predictive analytics – Logic and Data Driven Models –DataMining and Predictive Analysis Modelling –Machine Learning for Predictive analytics		
UNIT	TITLE	PERIODS
IV	HR & SUPPLY CHAIN ANALYTICS	6
Human Resources – Planning and Recruitment – Training and Development – Supply chain network Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year		
UNIT	TITLE	PERIODS
V	MARKETING & SALES ANALYTICS	6
Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales – predictive analytics for customers behavior in marketing and sales.		
		30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Explore the features of Ms-Excel.	
2.	(i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) ii) Perform data import/export operations for different file formats.	
3.	Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis	
4.	Perform Z-test, T-test & ANOVA	
5.	Perform data pre-processing operations i) Handling Missing data ii) Normalization	
6.	Perform dimensionality reduction operation using PCA, KPCA & SVD	
7.	Perform bivariate and multivariate analysis on the dataset.	
8.	Apply and explore various plotting functions on the data set.	
II Cycle – Power BI Desktop		
9.	Explore the features of Power BI Desktop	
10.	Prepare & Load data	
11.	Develop the data model	
12.	Perform DAX calculations	
13.	Design a report	
14.	Create a dashboard and perform data analysis	
15.	Presentation of a case study	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Explain the real world business problems and model with analytical solutions
CO2:	Identify the business processes for extracting Business Intelligence.
CO3:	Apply predictive analytics for business fore-casting.
CO4:	Apply analytics for supply chain and logistics management
CO5:	Use analytics for marketing and sales

TEXT BOOKS:	
1.	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017 .
2.	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3.	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4.	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010
5.	Mahadevan B, “Operations Management -Theory and Practice”,3rd Edition,Pearson Education,2018

191AIE061J	IMAGE AND VIDEO ANALYTICS	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the basics of image processing techniques for computer vision.
2.	To learn the techniques used for image pre-processing
3.	To discuss the various object detection techniques.
4.	To understand the various Object recognition mechanisms.
5.	To elaborate on the video analytics techniques.

UNIT	TITLE	PERIODS
I	INTRODUCTION	6

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures

UNIT	TITLE	PERIODS
II	IMAGE PRE-PROCESSING	6

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models – Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration

UNIT	TITLE	PERIODS
III	OBJECT DETECTION USING MACHINE LEARNING	6

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN- Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT	TITLE	PERIODS
IV	FACE RECOGNITION AND GESTURE RECOGNITION	6

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition- DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet- Gesture Recognition

UNIT	TITLE	PERIODS
V	VIDEO ANALYTICS	6

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3.

	30 PERIODS

LAB EXCERCISE		30 PERIODS
1.	Write a program that computes the T-pyramid of an image	
2.	Write a program that derives the quad tree representation of an image using thehomogeneity criterion of equal intensity	
3.	Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale (c) Skewing (d) Affine transform calculated from three pairs of corresponding points(e)Bilinear transform calculated from four pairs of corresponding points.	
4.	Develop a program to implement Object Detection and Recognition	
5.	Develop a program for motion analysis using moving edges, and apply it to your image sequences	
6.	Develop a program for Facial Detection and Recognition	
7.	Write a program for event detection in video surveillance system	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the basics of image processing techniques for computer vision and videoanalysis.
CO2:	Explain the techniques used for image pre-processing.
CO3:	Develop various object detection techniques
CO4:	Understand the various face recognition mechanisms
CO5:	Elaborate on deep learning-based video analytics.

TEXT BOOKS:	
1.	Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and MachineVision”, 4nd edition, Thomson Learning, 2013.
2.	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)

REFERENCE BOOKS:	
1.	Richard Szeliski, “Computer Vision: Algorithms and Applications”,Springer Verlag London Limited,2011.
2.	Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “VideoAnalytics for Business Intelligence”, Springer, 2012.
3.	A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education,2003.
4.	E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press.

191AIE071J	COMPUTER VISION	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the fundamental concepts related to Image formation and processing
2.	To learn feature detection, matching and detection
3.	To become familiar with feature based alignment and motion estimation
4.	To develop skills on 3D reconstruction
5.	To understand image based rendering and recognition

UNIT	TITLE	PERIODS
I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	6
Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization		
UNIT	TITLE	PERIODS
II	FEATURE DETECTION, MATCHING AND SEGMENTATION	6
Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge -Meanshift and mode finding - Normalized cuts - Graph cuts and energy-based methods.		
UNIT	TITLE	PERIODS
III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	5
2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment – Constrained structure and motion - Translational alignment - Parametric motion - Spline-basedmotion - Optical flow - Layered motion.		
UNIT	TITLE	PERIODS
IV	3D RECONSTRUCTION	7
Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps andalbedosos.		
UNIT	TITLE	PERIODS
V	IMAGE-BASED RENDERING AND RECOGNITION	6
View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes -Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets		
		30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
Software needed: OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent		
1.	OpenCV Installation and working with Python	
2.	Basic Image Processing - loading images, Cropping, Resizing, Thresholding,Contour analysis, Bolb detection.	
3.	Image Annotation – Drawing lines, text circle, rectangle, ellipse on images	
4.	Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection	
5.	Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment	
6.	Image segmentation using Graphcut / Grabcut	
7.	Camera Calibration with circular grid	
8.	Pose Estimation	
9.	3D Reconstruction – Creating Depth map from stereo images	
10.	Object Detection and Tracking using Kalman Filter, Camshift	
1. docs.opencv.org 2. https://opencv.org/opencv-free-course/		
	TOTAL:	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand basic knowledge, theories and methods in image processing and computervision
CO2:	Implement basic and some advanced image processing techniques inOpenCV.
CO3:	Apply 2D a feature-based based image alignment, segmentation and motionestimations
CO4:	Apply 3D image reconstruction techniques
CO5:	Design and develop innovative image processing and computer visionapplications.

TEXT BOOKS:	
1.	Richard Szeliski, “Computer Vision: Algorithms and Applications”,Springer- Texts inComputer Science, Second Edition, 2022.
2.	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education,Second Edition, 2015.

REFERENCE BOOKS:	
1.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision,Second Edition, Cambridge University Press,March 2004.
2.	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer,2006
3.	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press,2012.

191AIE081T	FUNDAMENTALS OF BIG DATA ANALYTICS	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

COURSE OBJECTIVES:	
1.	To understand big data.
2.	To learn and use NoSQL big data management.
3.	To learn mapreduce analytics using Hadoop and related tools.
4.	To work with map reduce applications
5.	To understand the usage of Hadoop related tools for Big Data Analytics

UNIT	TITLE	PERIODS
I	UNDERSTANDING BIG DATA	9

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies - introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics - inter and trans firewall analytics.

UNIT	TITLE	PERIODS
II	NOSQL DATA MANAGEMENT	9

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients

UNIT	TITLE	PERIODS
III	MAP REDUCE APPLICATIONS	9

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReducejob run – classic Map-reduce – YARN – FAILURES IN CLASSIC Map-reduce and YARN – job scheduling – shuffle and sort – task execution- Map reduce types – input formats – output formats

UNIT	TITLE	PERIODS
IV	BASICS OF HADOOP	9

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration

UNIT	TITLE	PERIODS
V	**HADOOP RELATED TOOLS**	9
Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQLqueries.		
		45 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Describe big data and use cases from selected business domains.
CO2:	Explain NoSQL big data management.
CO3:	Install, configure, and run Hadoop and HDFS
CO4:	Perform map-reduce analytics using Hadoop.
CO5:	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

TEXT BOOKS:	
1.	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2.	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3.	Sadalage, Pramod J. “NoSQL distilled”, 2013

REFERENCE BOOKS:	
1.	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2.	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3.	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4.	Alan Gates, "Programming Pig", O'Reilley, 2011.

191AIE091T	INTRODUCTION TO NOSQL DATABASES	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

COURSE OBJECTIVES:	
1.	To Explore the emergence, requirements, and benefits of a NoSQL database
2.	To Understand the basic architecture and data models of a NoSQL database
3.	To distinguish the different types of NoSQL databases
4.	To learn the functions Document database and functionalities of transactions.
5.	Design the real time applications using NoSQL concepts.

UNIT	TITLE	PERIODS
I	INTRODUCTION	9

Overview and History of NoSQL Databases - Features of NoSQL-Definition of the Four Types of NoSQL Database – The Value of Relational Databases - Managing Transactions and Data Integrity, ACID and BASE for reliable database transactions - Brewers CAP theorem - Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL.

UNIT	TITLE	PERIODS
II	NOSQL BASICS	9

NoSQL Data model: Aggregate Models- Document Data Model- Key-Value Data Model Columnar Data Model Graph Based Data Model Graph Data Model, NOSQL Storage Architecture- NoSQL system ways to handle big data problems - Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication to scale reads, Database distributed queries to Data nodes - Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm - Page Rank- Markov chain, page rank computation

UNIT	TITLE	PERIODS
III	ADVANCED NOSQL	9

NoSQL – CAP Theorem – Sharding - Document based – MongoDB Operation: Insert, Update, Delete, Query, Indexing, Application, Replication, Sharding–Cassandra: Data Model, Key Space, Table Operations, CRUD Operations, CQL Types – HIVE: Data types, Database Operations, Partitioning – HiveQL – OrientDB Graph database – OrientDB Features.

UNIT	TITLE	PERIODS
IV	**WORKING WITH NOSQL**	9

NOSQL in CLOUD- Parallel Processing with Map Reduce, Big Data with Hive - Google App Engine Data Store - GAE Python SDK: Installation, Setup, and Getting Started - Essentials of Data Modeling for GAE in Python- Queries and Indexes - Allowed Filters and Result Ordering - Tersely Exploring the Java App Engine SDK - Amazon Simple DB.

UNIT	TITLE	PERIODS
V	**NO SQL APPLICATIONS**	9

Understanding MapReduce : Finding the Highest Stock Price for Each Stock - Uploading Historical NYSE Market Data in to Couch DB – Map Reduce with HBase –Map Reduce Possibilities and Apache Mahout – Hive Basics – JOIN(s) in HiveQL.

45 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Explain and compare different types of NoSQL Databases.
CO2:	Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL Databases.
CO3:	Design Schema and implement CRUD operations, distributed data operations.
CO4:	Develop NoSQL desktop and cloud database solutions.
CO5:	Differentiate and identify right database models for real time applications.

TEXT BOOKS:	
1.	"Professional NOSQL" by Shashank Tiwari,2016,WROXPress
2.	The Definitive guide to MongoDB, The NoSQL Database for Cloud and Desktop Computing, Apress 2014

REFERENCE BOOKS:	
1.	Dan Sullivan, "NoSQL for Mere Mortals" Addison-Wesley Professional 2015
2.	Christopher D manning, Prabhakar Raghavan, Hinrich Schutze " An Introduction to Information Retrieval, Cambridge University Press.
3.	Daniel Abadi, Peter Boncz and Stavros Harizopoulas, "The Design and Implementation of Modern Column-oriented Database Systems, Now Publishers.
4.	Guy Harrison, Next Generation Database: NoSQL and Bigdata , Apress.

SYLLABUS OF

Vertical II – FULL STACK DEVELOPMENT

COURSES

191CSE012T	WEB TECHNOLOGIES	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

COURSE OBJECTIVES:	
1.	To understand different Internet Technologies
2.	To learn java-specific web services architecture
3.	To Develop web applications using frameworks

UNIT	TITLE	PERIODS
I	**WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0**	9
Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations. Bootstrap Framework.		
UNIT	**TITLE**	**PERIODS**
II	**CLIENT SIDE PROGRAMMING**	9
Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation- Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.		
UNIT	**TITLE**	**PERIODS**
III	**SERVER SIDE PROGRAMMING**	9
Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.		
UNIT	**TITLE**	**PERIODS**
IV	**PHP and XML**	9
An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL ,		
UNIT	**TITLE**	**PERIODS**
V	**INTRODUCTION TO ANGULAR and WEB APPLICATIONS FRAMEWORKS**	9
Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- Django- UI & UX.		
		45 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Construct a basic website using HTML and Cascading Style Sheets
CO2:	Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO3:	Develop server side programs using Servlets and JSP.
CO4:	Construct simple web pages in PHP and to represent data in XML format.
CO5:	Develop interactive web applications.

TEXT BOOKS:	
1.	Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5th Edition, 2011.
2.	Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011.
3.	Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing

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

191CSE022J	APP DEVELOPMENT	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To learn development of native applications with basic GUI Components
2.	To develop cross-platform applications with event handling
3.	To develop applications with location and data storage capabilities
4.	To develop web applications with database access

UNIT	TITLE	PERIODS
I	FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT	6
Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design,		
UNIT	TITLE	PERIODS
II	NATIVE APP DEVELOPMENT USING JAVA	6
Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Development Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props		
UNIT	TITLE	PERIODS
III	HYBRID APP DEVELOPMENT	6
Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova,		
UNIT	TITLE	PERIODS
IV	CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE	6
What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross-platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props		
UNIT	TITLE	PERIODS
V	NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS	6
Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Using react native, build a cross platform application for a BMI calculator.	
2.	Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense.	
3.	Develop a cross platform application to convert units from imperial system to metric system (km to miles, kg to pounds etc.,)	
4.	Design and develop a cross platform application for day to day task (to-do) management.	
5.	Design an android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers.	
6.	Design and develop an android application using Apache Cordova to find and display the current location of the user.	
7.	Write programs using Java to create Android application having Databases ● For a simple library application. ● For displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.	
		TOTAL 60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Develop Native applications with GUI Components.
CO2:	Develop hybrid applications with basic event handling.
CO3:	Implement cross-platform applications with location and data storage capabilities.
CO4:	Implement cross platform applications with basic GUI and event handling.
CO5:	Develop web applications with cloud database access.

TEXT BOOKS:	
1.	Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2.	Apache Cordova in Action, Raymond K. Camden, Manning. 2015
3.	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing

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

191CSE032J	CLOUD SERVICES MANAGEMENT	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

COURSE OBJECTIVES:	
1.	Introduce Cloud Service Management terminology, definition & concepts
2.	Compare and contrast cloud service management with traditional IT service management
3.	Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
4.	Select appropriate structures for designing, deploying and running cloud-based services in a business environment
5.	Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT	**TITLE**	**PERIODS**
I	**CLOUD SERVICE MANAGEMENT FUNDAMENTALS**	**6**
Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models,Cloud Service Deployment Models		
UNIT	**TITLE**	**PERIODS**
II	**CLOUD SERVICES STRATEGY**	**6**
Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacitymatching, Demand Queueing, Change Management, Cloud Service Architecture		
UNIT	**TITLE**	**PERIODS**
III	**CLOUD SERVICE MANAGEMENT**	**6**
Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, CloudService Operations Management.		
UNIT	**TITLE**	**PERIODS**
IV	**CLOUD SERVICE ECONOMICS**	**6**
Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift,Cloud service Charging, Cloud Cost Models		

UNIT	TITLE	PERIODS
V	CLOUD SERVICE GOVERNANCE & VALUE	6
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, CloudGovernance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud software's like Open stack, Eucalyptus, Open Nebula with Role-based access control	
2.	Create a Cost-model for a web application using various services and do Cost-Benefit analysis	
3.	Create alerts for usage of Cloud resources	
4.	Create Billing alerts for your Cloud Organization	
5.	Compare Cloud cost for a simple web application across AWS, Azure andGCP and suggest the best one	
	TOTAL:	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.
CO2:	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services
CO3:	Solve the real world problems using Cloud services and technologies

TEXT BOOKS:	
1.	Cloud Service Management and Governance: Smart Service Management inCloud Era by Enamul Haque, Enel Publications
2.	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl,Ricardo Puttini, Zaigham Mohammad 2013
3.	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour.

REFERENCE BOOKS:	
1.	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2.	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya,Christian Vechhiola, S. Thamarai Selvi

191CSE042J	UI AND UX DESIGN	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To provide a sound knowledge in UI & UX
2.	To understand the need for UI and UX
3.	To understand the various Research Methods used in Design
4.	To explore the various Tools used in UI & UX
5.	Creating a wireframe and prototype

UNIT	**TITLE**	**PERIODS**
I	**FOUNDATIONS OF DESIGN**	**6**
UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy		
UNIT	**TITLE**	**PERIODS**
II	**FOUNDATIONS OF UI DESIGN**	**6**
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles —Branding - Style Guides		
UNIT	**TITLE**	**PERIODS**
III	**FOUNDATIONS OF UX DESIGN**	**5**
Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals		
UNIT	**TITLE**	**PERIODS**
IV	**WIREFRAMING, PROTOTYPING AND TESTING**	**7**
Sketching Principles - Sketching Red Routes - Responsive Design — Wire framing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools- Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration		

UNIT	TITLE	PERIODS
V	RESEARCH, DESIGNING, IDEATING, & INFORMATIONARCHITECTURE	6
Identifying and Writing Problem Statements - Identifying Appropriate ResearchMethods – Creating Personas - Solution Ideation - Creating User Stories – Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture		
		30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Designing a Responsive layout for an societal application	
2.	Exploring various UI Interaction Patterns	
3.	Developing an interface with proper UI Style Guides	
4.	Developing Wireflow diagram for application using open source software	
5.	Exploring various open source collaborative interface Platform	
6.	Hands on Design Thinking Process for a new product	
7.	Brainstorming feature for proposed product	
8.	Defining the Look and Feel of the new Project	
9.	Create a Sample Pattern Library for that product (Mood board, Fonts,Colors based on UI principles)	
10.	Identify a customer problem to solve	
11.	Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping	
12.	Sketch, design with popular tool and build a prototype and performusability testing and identify improvements	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Build UI for user Applications
CO2:	Evaluate UX design of any product or application
CO3:	Demonstrate UX Skills in product development
CO4:	Implement Sketching principles
CO5:	Create Wireframe and Prototype

TEXT BOOKS:	
1.	Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2.	Jon Yablonski, “Laws of UX using Psychology to Design BetterProduct & Services” O’Reilly2021

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

191CSE052J	SOFTWARE TESTING AND AUTOMATION	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the basics of software testing
2.	To learn how to do the testing and planning effectively
3.	To build test cases and execute them
4.	To focus on wide aspects of testing and understanding multiple facets of testing
5.	To get an insight about test automation and the tools used for test automation

UNIT	TITLE	PERIODS
1	FOUNDATIONS OF SOFTWARE TESTING	6

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing.

UNIT	TITLE	PERIODS
2	TEST PLANNING	6

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT	TITLE	PERIODS
3	TEST DESIGN AND EXECUTION	6

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT	TITLE	PERIODS
4	ADVANCED TESTING CONCEPTS	6

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT	TITLE	PERIODS
5	TEST AUTOMATION AND TOOLS	6

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

LAB EXCERCISE		30 PERIODS
1.	Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).	
2.	Design the test cases for testing the e-commerce application	
3.	Test the e-commerce application and report the defects in it.	
4.	Develop the test plan and design the test cases for an inventory control system.	
5.	Execute the test cases against a client server or desktop application and identify the defects.	
6.	Test the performance of the e-commerce application.	
7.	Automate the testing of e-commerce applications using Selenium.	
8.	Integrate TestNG with the above test automation.	
9.	Mini Project: a) Build a data-driven framework using Selenium and TestNG b) Build Page object Model using Selenium and TestNG c) Build BDD framework with Selenium, TestNG and Cucumber	
		TOTAL: 60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the basic concepts of software testing and the need for software testing
CO2:	Design Test planning and different activities involved in test planning
CO3:	Design effective test cases that can uncover critical defects in the application
CO4:	Carry out advanced types of testing
CO5:	Automate the software testing using Selenium and TestNG

TEXT BOOKS:	
1.	Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2.	Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018.

REFERENCE BOOKS:	
1.	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.
2.	Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3.	Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Fourth Edition, 2014, Taylor & Francis Group.
4.	Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
5.	Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc.
6.	Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing.
7.	Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.

191CSE062J	WEB APPLICATION SECURITY	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

COURSE OBJECTIVES:	
1.	To understand the fundamentals of web application security
2.	To focus on wide aspects of secure development and deployment of web applications
3.	To learn how to build secure APIs
4.	To learn the basics of vulnerability assessment and penetration testing
5.	To get an insight about Hacking techniques and Tools

UNIT	TITLE	PERIODS
I	**FUNDAMENTALS OF WEB APPLICATION SECURITY**	**6**
The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation.		
UNIT	**TITLE**	**PERIODS**
II	**SECURE DEVELOPMENT AND DEPLOYMENT**	**5**
Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM).		
UNIT	**TITLE**	**PERIODS**
III	**SECURE API DEVELOPMENT**	**6**
API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.		

UNIT	TITLE	PERIODS
IV	VULNERABILITY ASSESSMENT AND PENETRATION TESTING	6
Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.		
UNIT	TITLE	PERIODS
V	HACKING TECHNIQUES AND TOOLS	7
Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.		

TOTAL:	30PERIODS

PRACTICAL EXERCISES:	30 PERIODS
1.	Install wireshark and explore the various protocols a) Analyze the difference between HTTP vs HTTPS b) Analyze the various security mechanisms embedded with different protocols.
2.	Identify the vulnerabilities using OWASP ZAP tool
3.	Create simple REST API using python for following operation . a) GET b) PUSH c) POST d) DELETE
4.	Install Burp Suite to do following vulnerabilities: a) SQL injection b) cross-site scripting (XSS)
5.	Attack the website using Social Engineering method
TOTAL:	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understanding the basic concepts of web application security and the need for it.
CO2:	Be acquainted with the process for secure development and deployment of web applications
CO3:	Acquire the skill to design and develop Secure Web Applications that use Secure APIs
CO4:	Be able to get the importance of carrying out vulnerability assessment and penetration testing
CO5:	Acquire the skill to think like a hacker and to use hackers tool sets

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

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

191CSE072J	DEVOPS	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To introduce DevOps terminology, definition & concepts.
2.	To understand the different Version control tools like Git, Mercuria
3.	To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4.	To understand Configuration management using Ansible
5.	Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT	TITLE	PERIODS
I	INTRODUCTION TO DEVOPS	6
Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.		
UNIT	TITLE	PERIODS
II	COMPILE AND BUILD USING MAVEN & GRADLE	6
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle.		
UNIT	TITLE	PERIODS
III	CONTINUOUS INTEGRATION USING JENKINS	6
Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.		
UNIT	TITLE	PERIODS
IV	CONFIGURATION MANAGEMENT USING ANSIBLE	6
Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible		
UNIT	TITLE	PERIODS
V	BUILDING DEVOPS PIPELINES USING AZURE	6
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		
		30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Create Maven Build pipeline in Azure	
2.	Run regression tests using Maven Build pipeline in Azure	
3.	Install Jenkins in Cloud	
4.	Create CI pipeline using Jenkins	
5.	Create a CD pipeline in Jenkins and deploy in Cloud	
6.	Create an Ansible playbook for a simple web application infrastructure	
7.	Build a simple application using Gradle	
8.	Install Ansible and configure ansible roles and to write playbooks	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand different actions performed through Version control tools like Git
CO2:	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
CO3:	Ability to Perform Automated Continuous Deployment
CO4:	Ability to do configuration management using Ansible
CO5:	Understand to leverage Cloud-based DevOps tools using Azure DevOps

TEXT BOOKS:	
1.	Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2.	Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014

REFERENCE BOOKS:	
1.	Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni.
2.	Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
3.	David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
4.	Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.
5.	https://www.jenkins.io/user-handbook.pdf
6.	https://maven.apache.org/guides/getting-started/

191CSE082T	PRINCIPLES OF PROGRAMMING LANGUAGES	Periods perweek				Credits
		L	T	P	R	
		3	**0**	**0**	**0**	**3**

COURSE OBJECTIVES:	
1.	To understand and describe syntax and semantics of programming languages
2.	To understand data, data types, and basic statements
3.	To understand call-return architecture and ways of implementing them
4.	To understand object-orientation, concurrency, and event handling in programming languages
5.	To develop programs in non-procedural programming paradigms

UNIT	TITLE	PERIODS
I	**SYNTAX AND SEMANTICS**	**9**
Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing.		
UNIT	**TITLE**	**PERIODS**
II	**DATA, DATA TYPES, AND BASIC STATEMENTS**	**9**
Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements.		
UNIT	**TITLE**	**PERIODS**
III	**SUBPROGRAMS AND IMPLEMENTATIONS**	**9**
Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping		
UNIT	**TITLE**	**PERIODS**
IV	**OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING**	**9**
Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling		

UNIT	TITLE	PERIODS
V	**FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES**	9
Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages.		
		45 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Describe syntax and semantics of programming languages.
CO2:	Explain data, data types, and basic statements of programming languages.
CO3:	Design and implement subprogram constructs.
CO4:	Apply object-oriented, concurrency, and event handling programming constructs and Develop programs in Scheme, ML, and Prolog.
CO5:	Understand and adopt new programming languages.

TEXT BOOKS:	
1.	Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.
2.	Michael L. Scott, “Programming Language Pragmatics”, Fourth Edition, Elsevier, 2018.
3.	R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, Prentice Hall, 2011.
4.	Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Pearson, 1997.
5.	W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003.

191CSE092J	INTERNET TECHNOLOGY	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the various components of full stack development
2.	To learn Node.js features and applications
3.	To develop applications with MongoDB
4.	To understand the role of Angular and Express in web applications
5.	To develop simple web applications with React

UNIT	TITLE	PERIODS
I	**BASICS OF FULL STACK**	6
Understanding the Basic Web Development Framework - Webserver - Backend Services – MVC Architecture - Understanding the different stacks –The role of Express – Angular – Node – Mongo DB– React		
UNIT	**TITLE**	**PERIODS**
II	**NODE JS**	6
Basics of Node JS – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers - Callbacks – Implementing HTTP services in Node.js		
UNIT	**TITLE**	**PERIODS**
III	**MONGO DB**	6
Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Connecting to MongoDB from Node.js		
UNIT	**TITLE**	**PERIODS**
IV	**EXPRESS AND ANGULAR**	6
Implementing Express in Node.js - Configuring routes - Using Request and Response objects - Angular - Typescript - Angular Components - Expressions - Data binding - Built-in directives		
UNIT	**TITLE**	**PERIODS**
V	**REACT**	6
MERN STACK – Basic React applications – React Components – React State – Routing with React Router –Server-side rendering.		
		30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Develop a portfolio website for yourself which gives details about yourself for a potential recruiter.	
2.	Create a web application to manage the TO-DO list of users, where users can login and manage their to-do items	
3.	Create a food delivery website where users can order food from a particular restaurant listed in the website.	
4.	Develop a classifieds web application to buy and sell used products.	
5.	Develop an online survey application where a collection of questions is available and users are asked to answer any random 5 questions.	
	TOTAL:	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the various stacks available for web application development
CO2:	Use Node.js for application development
CO3:	Develop applications with MongoDB
CO4:	Use the features of Angular and Express
CO5:	Develop React applications

TEXT BOOKS:	
1.	Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018
2.	Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019

REFERENCE BOOKS:	
1.	Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
2.	Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018
3.	https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
4.	https://www.coursera.org/specializations/full-stack-react
5.	https://www.udemy.com/course/the-full-stack-web-development/

SYLLABUS OF

Vertical III – Cloud Computing and Data Center Technologies

COURSES

191ITE013T	CLOUD COMPUTING	Periods per week				Credits
		L	T	P	R	
		3	**0**	**0**	**0**	**3**

COURSE OBJECTIVES:	
1.	To understand the principles of cloud architecture, models and infrastructure
2.	To understand the concepts of virtualization and virtual machines.
3.	To gain knowledge about virtualization Infrastructure.
4.	To explore and experiment with various Cloud deployment environments
5.	To learn about the security issues in the cloud environment.

UNIT	TITLE	PERIODS
I	**CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE**	**9**

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges-Elasticity in Cloud – On-demand Provisioning.

UNIT	TITLE	PERIODS
II	**CLOUD ENABLING TECHNOLOGIES**	**9**

Service Oriented Architecture – REST and Systems of Systems- Web Services – Basics of Virtualization- Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization**.**

UNIT	TITLE	PERIODS
III	**VIRTUALIZATION INFRASTRUCTURE AND DOCKER**	**9**

Virtualization of CPU, Memory and I/O devices, Desktop Virtualization – Network Virtualization – Storage Virtualization– Application Virtualization – Virtual clusters -Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

UNIT	TITLE	PERIODS
IV	**RESOURCE MANAGEMENT & DEPLOYMENT ENVIRONMENT**	**9**

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods Hadoop – MapReduce -Google App Engine – Amazon AWS; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT	TITLE	PERIODS

V	CLOUD SECURITY	9
Cloud Security Challenges-Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyper jacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice-Federation in the Cloud – Four Levels of Federation- Federated Services and Applications.		

	45 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the Cloud Architecture and design challenges in the cloud.
CO2:	Apply the concept of virtualization and its types.
CO3:	Experiment with virtualization of hardware resources and Docker.
CO4:	Develop and deploy services on the cloud and set up a cloud environment
CO5:	Explain security challenges in the cloud environment.

TEXT BOOKS:	
1.	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012
2.	James Turnbull, “The Docker Book”, O’Reilly Publishers, 2014.
3.	Krutz, R. L., Vines, R. D, “Cloud security. A Comprehensive Guide to SecureCloud Computing”, Wiley Publishing, 2010.

REFERENCE BOOKS:	
1.	James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systemsand Processes”, Elsevier/Morgan Kaufmann, 2005.
2.	Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy: anenterprise perspective on risks and compliance”, O’Reilly Media, Inc.,2009.

191ITE023J	VIRTUALIZATION	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To Learn the basics and types of Virtualization
2.	To understand the Hypervisors and its types
3.	To Explore the Virtualization Solutions
4.	To Experiment the virtualization platforms

UNIT	TITLE	PERIODS
I	INTRODUCTION TO VIRTUALIZATION	6
Virtualization and cloud computing - Need of virtualization — cost, administration, fast deployment, reduce infrastructure cost — limitations- Types of hardware virtualization: Fullvirtualization - partial virtualization - Paravirtualization-Types of Hypervisors.		
UNIT	TITLE	PERIODS
II	SERVER AND DESKTOP VIRTUALIZATION	6
Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- typesof server virtualization- Business Cases for Server Virtualization — Uses of Virtual Server Consolidation — Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization		
UNIT	TITLE	PERIODS
III	NETWORK VIRTUALIZATION	6
Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization-VLAN-WAN Architecture-WAN Virtualization		
UNIT	TITLE	PERIODS
IV	STORAGE VIRTUALIZATION	6
Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risksof Storage Virtualization-SAN-NAS-RAID		
UNIT	TITLE	PERIODS
V	VIRTUALIZATION TOOLS	6
VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization-Case study.		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on that VMWAR	
2.	a. Shrink and extend virtual disk b. Create, Manage, Configure and schedule snapshots c. Create Spanned, Mirrored and Striped volume d. Create RAID 5 volume	
3.	a. Desktop Virtualization using VNC b. Desktop Virtualization using Chrome Remote Desktop	
4.	Create type 2 virtualization on ESXI 6.5 server	
5.	Create a VLAN in CISCO packet tracer	
6.	Install KVM in Linux	
7.	Create Nested Virtual Machine(VM under another VM)	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Analyse the virtualization concepts and Hypervisor
CO2:	Apply the Virtualization for real-world applications
CO3:	Install & Configure the different VM platforms
CO4:	Experiment with the VM with various software

TEXT BOOKS:	
1.	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter,TATA McGraw- Hill , New Delhi – 2010
2.	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3.	David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
4.	Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress,2005.
5.	James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
6.	David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware andMicrosoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

191CSE032J	CLOUD SERVICES MANAGEMENT	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

COURSE OBJECTIVES:	
1.	Introduce Cloud Service Management terminology, definition & concepts
2.	Compare and contrast cloud service management with traditional IT service management
3.	Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
4.	Select appropriate structures for designing, deploying and running cloud-based services in a business environment
5.	Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT	**TITLE**	**PERIODS**
I	**CLOUD SERVICE MANAGEMENT FUNDAMENTALS**	**6**
Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models,Cloud Service Deployment Models		
UNIT	**TITLE**	**PERIODS**
II	**CLOUD SERVICES STRATEGY**	**6**
Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacitymatching, Demand Queueing, Change Management, Cloud Service Architecture		
UNIT	**TITLE**	**PERIODS**
III	**CLOUD SERVICE MANAGEMENT**	**6**
Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, CloudService Operations Management.		
UNIT	**TITLE**	**PERIODS**
IV	**CLOUD SERVICE ECONOMICS**	**6**
Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift,Cloud service Charging, Cloud Cost Models		

UNIT	TITLE	PERIODS
V	CLOUD SERVICE GOVERNANCE & VALUE	6
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, CloudGovernance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud software's like Open stack, Eucalyptus, Open Nebula with Role-based access control	
2.	Create a Cost-model for a web application using various services and do Cost-Benefit analysis	
3.	Create alerts for usage of Cloud resources	
4.	Create Billing alerts for your Cloud Organization	
5.	Compare Cloud cost for a simple web application across AWS, Azure andGCP and suggest the best one	
	TOTAL:	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.
CO2:	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services
CO3:	Solve the real world problems using Cloud services and technologies

TEXT BOOKS:	
1.	Cloud Service Management and Governance: Smart Service Management inCloud Era by Enamul Haque, Enel Publications
2.	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl,Ricardo Puttini, Zaigham Mohammad 2013
3.	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour.

REFERENCE BOOKS:	
1.	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2.	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya,Christian Vechhiola, S. Thamarai Selvi

191ITE043J	DATA ENGINEERING IN CLOUD	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	Understand the foundation of a database and its architecture.
2.	Learn about the undercurrents of the data engineering lifecycle, which are key foundations that support all data engineering efforts.
3.	Understand Operational source system patterns and the significant types of source systems.
4.	Knowing the use case of the data and the way to retrieve it in the future.
5.	Understand Google cloud platform and working of cloud composer.

UNIT	TITLE	PERIODS
1	FOUNDATION OF DATA ENGINEERING	6
What Is Data Engineering- Life Cycle-Evolution-Data engineering skill and activities-Data Maturity-Business Responsibility-Technical Roles		
UNIT	TITLE	PERIODS
2	THE DATA ENGINEERING LIFECYCLE	6
Stages of Life Cycle-Major Undercurrents Across the Data Engineering Lifecycle-Data architecture definitions-Principles-Major architecture Concepts-Distributed Systems, Scalability, and Designing for Failure		
UNIT	TITLE	PERIODS
3	DATA GENERATION IN SOURCE SYSTEMS	6
Source of Data-Source systems-Files and unstructured data-API-Application Data base-OLAP-Major considerations for understanding database technologies-Data Sharing-Third Party Data Source-Message Queues and Event		
UNIT	TITLE	PERIODS
4	BIG DATA CAPABILITY IN CLOUD	6
ELT Concept-process multiple files using map reduce-On Demand nature of cloud-introduction to GCP console-GCP cloud shell-GCP services –GCP server less services-service mapping and prioritization- IAM tool		
UNIT	TITLE	PERIODS
5	BUILDING A DATAWAREHOUSE IN BIG QUERY	6
Introduction to Google cloud storage and big query-big query console-pre requisites-developing a data warehouse-cloud composer-working of airflow.		

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply the data engineering lifecycle to design and build a robust architecture
CO2:	Assess a wide range of requirements and apply relevant database techniques to create a robust architecture
CO3:	Apply the proper storage solutions for data architecture in real time.
CO4:	Analyze data engineering problems using an end-to-end framework of best practices
CO5:	Build data warehouse in big query for real time applications.

LAB EXCERCISE		30 PERIODS
1.	Installing and configuring Apache NiFi & Air flow	
2.	Installing and configuring Elasticsearch & Kibana	
3.	Installing and configuring PostgreSQL & Installing pgAdmin	
4.	Reading and writing CSVs using pandas DataFrames	
5.	Inserting and extracting relational data in Python	
6.	Inserting data into PostgreSQL	
7.	Inserting and extracting NoSQL database data in Python	
8.	Inserting data into Elasticsearch	
9.	Build data pipeline orchestration using cloud composer	
10.	Building a data lake on dataproc cluster.	
	TOTAL:	**60 PERIODS**

TEXT BOOKS:	
1.	Joe Reis and Matt Housley ,"Fundamentals of Data Engineering Plan and Build Robust Data Systems "O'Reilly Media Inc, 2022,First Edition.
2.	Adi Wijaya,"Data Engineering with Google Cloud Platform" Packet publicating Ltd ,2022,First edition.

REFERENCE BOOKS:	
1.	Paul Crickard" Data Engineering with Python" O'Reilly Media Inc, 2020.

191ITE053T	STORAGE TECHNOLOGIES	Periods perweek				Credits
		L	T	P	R	
		3	**0**	**0**	**0**	**3**

COURSE OBJECTIVES:	
1.	Characterize the functionalities of logical and physical components of storage
2.	Describe various storage networking technologies
3.	Identify different storage virtualization technologies
4.	Discuss the different backup and recovery strategies
5.	Understand common storage management activities and solutions

UNIT	TITLE	PERIODS
I	**STORAGE SYSTEMS**	**9**

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT	TITLE	PERIODS
II	**INTELLIGENT STORAGE SYSTEMS AND RAID**	**5**

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale- out storage Architecture.

UNIT	TITLE	PERIODS
III	**STORAGE NETWORKING TECHNOLOGIESAND VIRTUALIZATION**	**13**

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage.Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switchaggregation, and VLAN, FCIP protocol,

connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN,FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT	TITLE	PERIODS
IV	**BACKUP, ARCHIVE AND REPLICATION**	12

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, NDisaster Recovery as a Service (DRaaS).

UNIT	TITLE	PERIODS
V	**SECURING STORAGE INFRASTRUCTURE**	6

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

TOTAL:	**45 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Demonstrate the fundamentals of information storage management and variousmodels of Cloud infrastructure services and deployment
CO2:	Illustrate the usage of advanced intelligent storage systems and RAID
CO3:	Interpret various storage networking architectures - SAN, including storagesubsystems and virtualization
CO4:	Examine the different role in providing disaster recovery and remote replicationtechnologies
CO5:	Infer the security needs and security measures to be employed in informationstorage management

TEXT BOOKS:	
1.	EMC Corporation, Information Storage and Management, Wiley, India
2.	Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas,Introduction to Storage Area Networks,Ninth Edition, IBM - Redbooks, December 2017
3.	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, NilsHaustein ,Storage Networks Explained, Second Edition, Wiley, 2009.

191ITE063J	SOFTWARE DEFINED NETWORKS	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the need for SDN and its data plane operations
2.	To understand the functions of control plane
3.	To comprehend the migration of networking functions to SDN environment
4.	To explore various techniques of network function virtualization
5.	To comprehend the concepts behind network virtualization

UNIT	TITLE	PERIODS
I	**SDN: INTRODUCTION**	6
Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane ,Control plane and Application Plane		
UNIT	**TITLE**	**PERIODS**
II	**SDN DATA PLANE AND CONTROL PLANE**	6
Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface — SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers		
UNIT	**TITLE**	**PERIODS**
III	**SDN APPLICATIONS**	6
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking		
UNIT	**TITLE**	**PERIODS**
IV	**NETWORK FUNCTION VIRTUALIZATION**	6
Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefitsand Requirements – Reference Architecture		
UNIT	**TITLE**	**PERIODS**
V	**NFV FUNCTIONALITY**	6
NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration –		

NFV Use cases – SDN and NFV

	30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Setup your own virtual SDN lab I. Virtualbox/Mininet Environment for SDN - http://mininet.org II. https://www.kathara.org III. GNS3	
2.	Create a simple mininet topology with SDN controller and use Wireshark to captureand visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.	
3.	Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc	
4.	Create a simple end-to-end network service with two VNFs using vim-emu	
5.	Install OSM and onboard and orchestrate network service.	
	TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Describe the motivation behind SDN
CO2:	Identify the functions of the data plane and control plane
CO3:	Design and develop network applications using SDN
CO4:	Orchestrate network services using NFV
CO5:	Explain various use cases of SDN and NFV

TEXT BOOKS:	
1.	William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”,Pearson Education, 1st Edition, 2015.

REFERENCE BOOKS:	
1.	Ken Gray, Thomas D. Nadeau, “Network Function Virtualization”, Morgan Kauffman, 2016.
2.	Thomas D Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.
3.	Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1stEdition, CRC Press, 2014
4.	Paul Goransson, Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2nd Edition, Morgan Kaufmann Press, 2016.
5.	Oswald Coker, Siamak Azodolmolky, “Software-Defined Networking with OpenFlow”, 2ndEdition, O’Reilly Media, 2017.

191ITE073J	STREAM PROCESSING	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

COURSE OBJECTIVES:	
1.	Introduce Data Processing terminology, definition & concepts
2.	Define different types of Data Processing
3.	Explain the concepts of Real-time Data processing
4.	Select appropriate structures for designing and running real-time data services in abusiness environment
5.	Illustrate the benefits and drive the adoption of real-time data services to solve real worldproblems

UNIT	**TITLE**	**PERIODS**
I	**FOUNDATIONS OF DATA SYSTEMS**	**6**
Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges.		
UNIT	**TITLE**	**PERIODS**
II	**REAL-TIME DATA PROCESSING**	**6**
Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing,Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage.		
UNIT	**TITLE**	**PERIODS**
III	**DATA MODELS AND QUERY LANGUAGES**	**6**
Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many- to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL.		
UNIT	**TITLE**	**PERIODS**
IV	**EVENT PROCESSING WITH APACHE KAFKA**	**6**
Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API,Kafka Connect API.		

UNIT	TITLE	PERIODS
V	REAL-TIME PROCESSING USING SPARK STREAMING	6
Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication.		

	30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Install MongoDB	
2.	Design and Implement Simple application using MongoDB	
3.	Query the designed system using MongoDB	
4.	Create a Event Stream with Apache Kafka	
5.	Create a Real-time Stream processing application using Spark Streaming	
6.	Build a Micro-batch application	
7.	Real-time Fraud and Anomaly Detection,	
8.	Real-time personalization, Marketing, Advertising	
	TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the applicability and utility of different streaming algorithms.
CO2:	Describe and apply current research trends in data-stream processing.
CO3:	Analyze the suitability of stream mining algorithms for data stream systems
CO4:	Program and build stream processing systems, services and applications.
CO5:	Solve problems in real-world applications that process data streams.

TEXT BOOKS:	
1.	Streaming Systems: The What, Where, When and How of Large-Scale Data Processingby Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2.	Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media
3.	Practical Real-time Data Processing and Analytics : Distributed Computing andEvent Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing

REFERENCE BOOKS:	
1.	https://spark.apache.org/docs/latest/streaming-programming-guide.html
2.	Kafka.apache.org

191ITE083J	SECURITY AND PRIVACY IN CLOUD	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To Introduce Cloud Computing terminology, definition & concepts
2.	To understand the security design and architectural considerations for Cloud
3.	To understand the Identity, Access control in Cloud
4.	To follow best practices for Cloud security using various design patterns
5.	To be able to monitor and audit cloud applications for security

UNIT	TITLE	PERIODS
I	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	7
Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non- repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.		
UNIT	TITLE	PERIODS
II	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	6
Security design principles for Cloud Computing - Comprehensive data protection - End-to-endaccess control - Common attack vectors and threats - Network and Storage - Secure IsolationStrategies - Virtualization strategies - Inter-tenant network segmentation strategies — Data Protection strategies: Data retention, deletion and archiving procedures for tenant data,Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key		
UNIT	TITLE	PERIODS
III	ACCESS CONTROL AND IDENTITY MANAGEMENT	6
Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot – Intruder Detection and prevention		
UNIT	TITLE	PERIODS
IV	CLOUD SECURITY DESIGN PATTERNS	6
Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, CloudResource Access Control, Secure On-Premise Internet Access, Secure External Cloud		

UNIT	TITLE	PERIODS
V	MONITORING, AUDITING AND MANAGEMENT	5
Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing — Record generation,Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management		
		30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in CloudSim	
2.	Simulate resource management using cloud sim	
3.	simulate log forensics using cloud sim	
4.	simulate a secure file sharing using a cloud sim	
5.	Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)	
6.	Implement any encryption algorithm to protect the images	
7.	Implement any image obfuscation mechanism	
8.	Implement a role-based access control mechanism in a specific scenario	
9.	implement an attribute-based access control mechanism based on a particular scenario	
10.	Develop a log monitoring system with incident management in the cloud	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the cloud concepts and fundamentals
CO2:	Explain the security challenges in the cloud.
CO3:	Define cloud policy and Identity and Access Management.
CO4:	Understand various risks and audit and monitoring mechanisms in the cloud.
CO5:	Define the various architectural and design considerations for security in the cloud.

TEXT BOOKS:	
1.	Raj Kumar Buyya , James Broberg, andrzejGoscinski, —Cloud Computing:‖, Wiley 2013
2.	Dave shackleford, —Virtualization Security‖, SYBEX a wiley Brand 2013.

REFERENCE BOOKS:	
1.	Mark C. Chu-Carroll —Code in the Cloud‖,CRC Press, 2011
2.	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya,Christian Vechhiola, S. ThamaraiSelvi

SYLLABUS OF

Vertical IV – ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

COURSES

191CAE014T	FUNDAMENTALS OF SOFTWARE ENGINEERING	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:

NIL

COURSEOBJECTIVES:

1.	To understand Software Engineering Lifecycle Models.
2.	To gain knowledge of the System Analysis and Design concepts.
3.	To be familiar with the basic UML diagrams.
4.	To Architect and design using various architectural styles and design patterns.
5.	To understand software testing approaches.

UNIT	TITLE	PERIODS
I	INTRODUCTION	9

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall – Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation –Scheduling–Risk management–Software configuration management.

UNIT	TITLE	PERIODS
II	SOFTWARE REQUIREMENT SPECIFICATION	9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model–Class diagrams – Interaction diagrams–Activity diagrams–State chart diagrams – Functional modelling–Data Flow Diagram.

UNIT	TITLE	PERIODS
III	SOFTWARE DESIGN	9

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.

UNIT	TITLE	PERIODS
IV	TESTING AND MAINTENANCE	9

Software testing Fundamentals-Internal and external views of Testing-white box testing — basis path testing-control structure testing-black box testing-Regression Testing—Unit Testing —Integration Testing—Validation Testing —System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring- Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering

UNIT	TITLE	PERIODS
V	PROJECT MANAGEMENT	9
Software Project Management: Estimation — LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model — Project Scheduling — Scheduling, Earned Value Analysis Planning — Project Plan, Planning Process, RFP Risk Management—Identification, Projection — Risk Management-Risk Identification-RMMM Plan.		

	45 PERIODS

COURSEOUTCOMES:	
Upon completion of this course ,student will be able to:	
CO1:	Understand the advantages of various Software Development Life cycle Models
CO2:	Strategies Perform formal analysis on specifications
CO3:	Use UML diagrams for analysis and design
CO4:	Understand software testing approaches
CO5:	Gain knowledge on project management approaches as well as cost and schedule estimation

TEXTBOOKS:	
1.	Dutoit, Allen H., and Bruegge, Bernd. Object-oriented Software Engineering Using UML, Patterns, And Java.United Kingdom, Pearson Education Limited,2013.
2.	Carlo Ghezzi,Mehdi Jazayeri,Dino Mandrioli, Fundamentals of Software Engineering,2nd edition, PHI Learning Pvt.Ltd.,2010.

REFERENCEBOOKS:	
1.	Larman, Craig. Applying UML and Patterns: An Introduction to Object-oriented Analysis and Design and Iterative Development.India,Pearson,2016
2.	Len Bass ,Ingo Weber and Liming Zhu,"DevOps: A Software Architect's Perspective", Pearson Education,2016
3.	Mall, Rajib .FUNDAMENTALS OF SOFTWARE ENGINEERING, FIFTH EDITION. India, PHI Learning Private Limited,2018.

191CAE024J	SOFT COMPUTING	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
2.	To provide the mathematical background for carrying out the optimization associated with neural network learning
3.	To learn various evolutionary Algorithms.
4.	To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
5.	To introduce case studies utilizing the above and illustrate the Intelligent behavior of programs based on soft computing

UNIT	TITLE	PERIODS
I	INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC	6
Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems.		
UNIT	TITLE	PERIODS
II	NEURAL NETWORKS	6
Supervised Learning Neural Networks – Perceptrons - Backpropagation -Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks		
UNIT	TITLE	PERIODS
III	GENETIC ALGORITHMS	6
Chromosome Encoding Schemes -Population initialization and selection methods - Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function.		
UNIT	TITLE	PERIODS
IV	NEURO FUZZY MODELING	6
ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum - Analysis of Adaptive Learning Capability.		
UNIT	TITLE	PERIODS
V	APPLICATIONS	6
Modeling a two input sine function - Printed Character Recognition – Fuzzy filtered neural networks Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction		
		30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Implementation of fuzzy control/ inference system	
2.	Programming exercise on classification with a discrete perceptron	
3.	Implementation of XOR with backpropagation algorithm	
4.	Implementation of self organizing maps for a specific application	
5.	Programming exercises on maximizing a function using Genetic algorithm	
6.	Implementation of two input sine function	
7.	Implementation of three input non linear function	
	TOTAL	60 PERIODS

COURSEOUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the fundamentals of fuzzy logic operators and inference mechanisms
CO2:	Understand neural network architecture for AI applications such as classification and clustering
CO3:	Learn the functionality of Genetic Algorithms in Optimization problems CO4: Use hybrid techniques involving Neural networks and Fuzzy logic CO5: Apply soft computing techniques in real world applications
CO4:	Use hybrid techniques involving Neural networks and Fuzzy logic
CO5:	Apply soft computing techniques in real world applications

TEXT BOOKS:	
1.	SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall,1997
2.	Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python
3.	With Case Studies and Applications from the Industry, Apress, 2020

REFERENCE BOOKS:	
1.	roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2.	S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
3.	Samir Roy, Udit Chakraborthy, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
4.	S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.
5.	R.Eberhart, P.Simpson and R.Dobbins, “Computational Intelligence - PC Tools”, AP Professional, Boston, 1996

191AIE031J	NEURAL NETWORKS AND DEEP LEARNING	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the basics in deep neural networks
2.	To understand the basics of associative memory and unsupervised learning networks
3.	To apply CNN architectures of deep neural networks
4.	To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks
5.	To apply auto encoders and generative models for suitable applications

UNIT	TITLE	PERIODS
I	INTRODUCTION	6

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction- Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT	TITLE	PERIODS
II	ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS	6

Training Algorithms for Pattern Association-Auto Associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT	TITLE	PERIODS
III	THIRD-GENERATION NEURAL NETWORKS	6

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT	TITLE	PERIODS
IV	DEEP FEEDFORWARD NETWORKS	6

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT	TITLE	PERIODS
V	**RECURRENT NEURAL NETWORKS**	6
Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Auto encoder, Stochastic Encoders and Decoders, Contractive Encoders.		
		30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Implement simple vector addition in TensorFlow.	
2.	Implement a regression model in Keras.	
3.	Implement a perceptron in TensorFlow/Keras Environment.	
4.	Implement a Feed-Forward Network in TensorFlow/Keras.	
5.	Implement an Image Classifier using CNN in TensorFlow/Keras.	
6.	Improve the Deep learning model by fine tuning hyper parameters.	
7.	Implement a Transfer Learning concept in Image Classification.	
8.	Using a pre trained model on Keras for Transfer Learning	
9.	Perform Sentiment Analysis using RNN	
10.	Implement an LSTM based Auto encoder in TensorFlow / Keras.	
11.	Image generation using GAN	
Additional Experiments		
12.	Train a Deep learning model to classify a given image using pre trained model	
13.	Recommendation system from sales data using Deep Learning	
14.	Implement Object Detection using CNN	
15.	Implement any simple Reinforcement Algorithm for an NLP problem	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply Convolution Neural Network for image processing.
CO2:	Understand the basics of associative memory and unsupervised learning networks.
CO3:	Apply CNN and its variants for suitable applications.
CO4:	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
CO5:	Apply auto encoders and generative models for suitable applications.

TEXT BOOKS:	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2.	Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.

REFERENCE BOOKS:	
1.	Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly, 2018.
2.	Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
3.	Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4.	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5.	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6.	Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017.
7.	S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
8.	Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9.	James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

Course Code	Course Title	Periods per week				Credits
		L	T	P	R	
191AIE041J	TEXT AND SPEECH ANALYSIS	2	0	2	0	3

PRE REQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Understand natural language processing basics
2.	Apply classification algorithms to text documents
3.	Build question-answering and dialogue systems
4.	Develop a speech recognition system
5.	Develop a speech synthesizer

UNIT	TITLE	PERIODS
1	NATURAL LANGUAGE BASICS	6

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs.

UNIT	TITLE	PERIODS
2	TEXT CLASSIFICATION	6

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

Assignment on above topics

Quiz on RNN, Transformers

Implementing NLP with RNN and Transformers.

UNIT	TITLE	PERIODS
3	QUESTION ANSWERING AND DIALOGUE SYSTEMS	6

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems

Suggested Activities:

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

UNIT	TITLE	PERIODS
4	TEXT-TO-SPEECH SYNTHESIS	6

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.

Suggested Activities:

Flipped classroom on Speech signal processing
Exploring Text normalization
Data collection
Implementation of TTS systems

Suggested Evaluation Methods

Assignment on the above topics
Quiz on wavenet, deep learning-based TTS systems
Finding accuracy with different TTS systems

UNIT	TITLE	PERIODS
5	AUTOMATIC SPEECH RECOGNITION	6

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems.

Suggested Activities:

Flipped classroom on Speech recognition.
Exploring Feature extraction

Suggested Evaluation Methods

Assignment on the above topics
Quiz on acoustic modelling

TOTAL PERIODS:	**30**
PRACTICAL PERIODS :	**30**
Create Regular expressions in Python for detecting word patterns and tokenizing text	
Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams	
Accessing Text Corpora using NLTK in Python	
Write a function that finds the 50 most frequently occurring words of a text that are not stop words.	
Implement the Word2Vec model	
Use a transformer for implementing classification	
Design a chatbot with a simple dialog system	
Convert text to speech and find accuracy	
Design a speech recognition system and find the error rate	

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Explain existing and emerging deep learning architectures for text and speech processing
CO2:	Apply deep learning techniques for NLP tasks, language modelling and machine translation
CO3:	Explain coreference and coherence for text processing
CO4:	Build question-answering systems, chatbots and dialogue systems
CO5:	Apply deep learning models for building speech recognition and text-to-speech systems

TEXT BOOKS:	
1.	Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022

REFERENCE BOOKS:	
1.	Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018.
2.	Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008
3.	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
4.	Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY.

Course Code	Course Title	Periods per week				Credits
		L	T	P	R	
191CAE054T	RESOURCE MANAGEMENT TECHNIQUES	3	0	0	0	3

PREREQUISITES:
NIL

COURSEOBJECTIVES:	
1.	Learn to formulate linear programming problems and solve LPP using simple algorithm.
2.	Learn to solve networking problems.
3.	Learn to formulate and solve integer programming problems.
4.	Learn to solve Non Linear programming problems.
5.	Learn to understand and solve project management problems.

UNIT	TITLE	PERIODS
1	LINEAR PROGRAMMING	9
Principal components of decision problem – Modeling phases – LP formulation and graphic solution – Resource allocation problems – simplex method – sensitivity analysis.		
UNIT	TITLE	PERIODS
2	DUALITY AND NETWORKS	9
Definition of dual problems – primal – Dual relationships – Dual simplex method –post optimality analysis – Transportation and assignment model – Shortest route problem.		
UNIT	TITLE	PERIODS
3	INTEGER PROGRAMMING	9
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.		
UNIT	TITLE	PERIODS
4	CLASSICAL OPTIMISATION THEORY	9
Unconstrained external problems, Newton – Ralphson method – Equality constraints –Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.		
UNIT	TITLE	PERIODS
5	OBJECT SCHEDULING	9
Network diagram representation – Critical path method – Time charts and resource leveling – PERT		

TOTALPERIODS:	45

COURSEOUTCOMES:	
Upon completion of this course, student will be able	
CO1:	Understand to formulate linear programming problems and solve LPP using simple algorithm.
CO2:	Understand to solve networking problems.
CO3:	Understand to formulate and solve integer programming problems.
CO4:	Understand to solve Non Linear programming problems.
CO5:	Understand to understand and solve project management problems.

TEXTBOOKS:	
1.	H.A. Taha, “Operation Research”, Prentice Hall of India, 2002.

REFERENCEBOOKS:	
1.	Paneer selvam, ‘Operations Research’ Prentice Hall of India, 2002.
2.	Anderson ‘Quantitative Methods for Business’, 8th Edition, Thomson Learning, 2002.
3.	Winston ‘Operations Research for Business’, Thomson Learning, 2003.
4.	Vohra, ’Quantitative Techniques in Management’, Tata Mc Graw Hill, 2002.
5.	Anand sarma, ‘Operation Research’ Himalaya Publishing House, 2003.

Course Code	Course Title	Periods per week				Credits
		L	T	P	R	
191CAE064J	KNOWLEDGE ENGINEERING	2	0	2	0	3

PRE REQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the basics of Knowledge Engineering.
2.	To discuss methodologies and modeling for Agent Design and Development.
3.	To design and develop ontologies.
4.	To apply reasoning with ontologies and rules.
5.	To understand learning and rule learning.

UNIT	TITLE	PERIODS
1	REASONING UNDER UNCERTAINTY	6

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering.

UNIT	TITLE	PERIODS
2	METHODOLOGY AND MODELING	6

Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.

UNIT	TITLE	PERIODS
3	ONTOLOGIES – DESIGN AND DEVELOPMENT	6

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

UNIT	TITLE	PERIODS
4	REASONIING WITH ONTOLOGIES AND RULES	6

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

UNIT	TITLE	PERIODS
5	LEARNING AND RULE LEARNING	6

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.

TOTAL PERIODS:	30

PRACTICAL EXERCISES:	**30**
1. Perform operations with Evidence Based Reasoning.	
2. Perform Evidence based Analysis.	
3. Perform operations on Probability Based Reasoning.	
4. Perform Believability Analysis.	
5. Implement Rule Learning and refinement.	
6. Perform analysis based on learned patterns.	
7. Construction of Ontology for a given domain.	

COURSE OUTCOMES:	
Upon completion of this course, student will be able to	
CO1:	Understand the basics of Knowledge Engineering.
CO2:	Apply methodologies and modelling for Agent Design and Development.
CO3:	Design and develop ontologies
CO4:	Apply reasoning with ontologies and rules.
CO5:	Understand learning and rule learning.

TEXT BOOKS:	
1.	Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 – Chapter 8, 9)

REFERENCE BOOKS:	
1.	Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2.	Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3.	John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4.	King , Knowledge Management and Organizational Learning , Springer, 2009.
5.	Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

Course Code	Course Title	Periods per week				Credits
		L	T	P	R	
191CAE074J	Cognitive Science	2	0	2	0	3

PRE REQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To know the theoretical background of cognition.
2.	To understand the link between cognition and computational intelligence.
3.	To explore probabilistic programming language.
4.	To study the computational inference models of cognition.
5.	To study the computational learning models of cognition.

UNIT	TITLE	PERIODS
1	PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE	6

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing – Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

UNIT	TITLE	PERIODS
2	COMPUTATIONAL INTELLIGENCE	6

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making –Learning – Language – Vision.

UNIT	TITLE	PERIODS
3	PROBABILISTIC PROGRAMMING LANGUAGE	6

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations – Enumeration.

UNIT	TITLE	PERIODS
4	INFERENCE MODELS OF COGNITION	6

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

UNIT	TITLE	PERIODS
5	LEARNING MODELS OF COGNITION	6

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.

TOTAL PERIODS:	30

PRACTICAL EXERCISES:	30

1. Demonstration of Mathematical functions using WebPPL.
2. Implementation of reasoning algorithms.
3. Developing an Application system using generative model.
4. Developing an Application using conditional inference learning model.
5. Application development using hierarchical model.
6. Application development using Mixture model.

COURSE OUTCOMES:	
Upon completion of this course, student will be able to	
CO1:	Understand the underlying theory behind cognition.
CO2:	Connect to the cognition elements computationally.
CO3:	Implement mathematical functions through WebPPL.
CO4:	Develop applications using cognitive inference model.
CO5:	Develop applications using cognitive learning model.

TEXTBOOKS:	
1.	Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016.
2.	Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015.
3.	Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”,The MIT Press, 1999.
4.	Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020.

REFERENCEBOOKS:	
1.	Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/.
2.	Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.

Course Code	Course Title	Periods per week				Credits
		L	T	P	R	
191CAE084J	Ethics and AI	2	0	2	0	3

PRE REQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Study the morality and ethics in AI
2.	Learn about the Ethical initiatives in the field of artificial intelligence
3.	Study about AI standards and Regulations
4.	Study about social and ethical issues of Robot Ethics
5.	Study about AI and Ethics- challenges and opportunities

UNIT	TITLE	PERIODS
1	INTRODUCTION	6
Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust.		
UNIT	TITLE	PERIODS
2	ETHICAL INITIATIVES IN AI	6
International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.		
UNIT	TITLE	PERIODS
3	AI STANDARDS AND REGULATION	6
Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations- Ontological Standard for Ethically Driven Robotics and Automation Systems.		
UNIT	TITLE	PERIODS
4	ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS	6
Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility - Roboethics Taxonomy.		
UNIT	TITLE	PERIODS
5	AI AND ETHICS- CHALLENGES AND OPPORTUNITIES	6
Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.		

TOTAL PERIODS:	30

PRACTICAL EXERCISES:		30
1.	Recent case study of ethical initiatives in healthcare, autonomous vehicles and defense.	
2.	Exploratory data analysis on a 2 variable linear regression model.	
3.	Experiment the regression model without a bias and with bias .	
4.	Classification of a dataset from UCI repository using a perceptron with and without bias.	
5.	Case study on ontology where ethics is at stake.	
6.	Identification on optimization in AI affecting ethics.	

COURSE OUTCOMES:	
Upon completion of this course, student will be able to	
CO1:	Learn about morality and ethics in AI.
CO2:	Acquire the knowledge of real time application ethics, issues and its challenges.
CO3:	IUnderstand the ethical harms and ethical initiatives in AI.
CO4:	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems.
CO5:	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.
CO6:	Learn about the societal issues in AI with National and International Strategies on AI

TEXT BOOKS:	
1.	y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2.	Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.

REFERENCE BOOKS:	
1.	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2.	Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020
3.	https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65
4.	https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen challenges-and-opportunities/
5.	https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/
6.	https://sci-hub.mksa.top/10.1159/000492428

SYLLABUS OF

Vertical V – Cyber Security and Data Privacy

COURSES

191CCE015T	ETHICAL HACKING	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:

NIL

COURSEOBJECTIVES:

1.	To understand the basics of computer based vulnerabilities.
2.	To explore different foot printing, reconnaissance and scanning methods.
3.	To expose the enumeration and vulnerability analysis methods.
4.	To understand hacking options available in Web and wireless applications.
5.	To explore the options for network protection.
6.	To practice tools to perform ethical hacking to expose the vulnerabilities.

UNIT	TITLE	PERIODS
I	INTRODUCTION	9

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security.

UNIT	TITLE	PERIODS
II	FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS	9

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall.

UNIT	TITLE	PERIODS
III	ENUMERATION AND VULNERABILITY ANALYSIS	9

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss.

UNIT	TITLE	PERIODS
IV	SYSTEM HACKING	9

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade

UNIT	TITLE	PERIODS
V	NETWORK PROTECTION SYSTEMS	9
Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - NetworkBased and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.		

	45 PERIODS

COURSEOUTCOMES:	
Upon completion of this course ,student will be able to:	
CO1:	Express knowledge on basics of computer based vulnerabilities
CO2:	Gain understanding on different foot printing, reconnaissance and scanning methods.
CO3:	Demonstrate the enumeration and vulnerability analysis methods
CO4:	Gain knowledge on hacking options available in Web and wireless applications.
CO5:	Acquire knowledge on the options for network protection.
CO6:	Use tools to perform ethical hacking to expose the vulnerabilities.

TEXTBOOKS:	
1.	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2.	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3.	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

REFERENCEBOOKS:	
1.	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz, 2014.

191CCE025J	DIGITAL AND MOBILE FORENSICS	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:

NIL

COURSE OBJECTIVES:

1.	To understand basic digital forensics and techniques.
2.	To understand digital crime and investigation.
3.	To understand how to be prepared for digital forensic readiness.
4.	To understand and use forensics tools for iOS devices.
5.	To understand and use forensics tools for Android devices.

UNIT	TITLE	PERIODS
I	INTRODUCTION TO DIGITAL FORENSICS	6

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase.

UNIT	TITLE	PERIODS
II	DIGITAL CRIME AND INVESTIGATION	6

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence.

UNIT	TITLE	PERIODS
III	DIGITAL FORENSIC READINESS	6

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics.

UNIT	TITLE	PERIODS
IV	iOS FORENSICS	6

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud.

UNIT	TITLE	PERIODS
V	ANDROID FORENSICS	6

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling.

30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.	
2.	Data extraction from call logs using Sleuth Kit.	
3.	Data extraction from SMS and contacts using Sleuth Kit.	
4.	Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups.	
5.	Process and parse records from the iOS system	
6.	Extract installed applications from Android devices.	
7.	Extract diagnostic information from Android devices through the adb protocol.	
8.	Generate a unified chronological timeline of extracted records.	
	TOTAL	60 PERIODS

COURSEOUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Classify the various phases of digital forensics
CO2:	Analyze digital crime and investigations procedures
CO3:	Examine the frameworks, standards and methodologies for digital forensics.
CO4:	Survey digital evidences and tools for iOS devices.
CO5:	Categorize digital evidences and forensic procedure for android devices.

TEXT BOOKS:	
1.	Andre Arnes, “Digital Forensics”, Wiley, 2018.
2.	Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.

REFERENCE BOOKS:	
1.	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

191CCE035J	SOCIAL NETWORK SECURITY	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:

NIL

COURSEOBJECTIVES:

1.	To develop semantic web related simple applications.
2.	To explain Privacy and Security issues in Social Networking.
3.	To explain the data extraction and mining of social networks
4.	To discuss the prediction of human behavior in social communities
5.	To describe the Access Control, Privacy and Security management of social networks.

UNIT	TITLE	PERIODS
I	FUNDAMENTALS OF SOCIAL NETWORKING	6

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security

UNIT	TITLE	PERIODS
II	SECURITY ISSUES IN SOCIAL NETWORKS	6

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world.

UNIT	TITLE	PERIODS
III	EXTRACTION AND MINING IN SOCIAL NETWORKING DATA	6

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy.

UNIT	TITLE	PERIODS
IV	PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES	6

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties.

UNIT	TITLE	PERIODS
V	ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT	6

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning.

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Design own social media application.	
2.	Create a Network model using Neo4.	
3.	Read and write Data from Graph Database.	
4.	Find “Friend of Friends” using Neo4j.	
5.	Implement secure search in social media.	
6.	Create a simple Security & Privacy detector	
	TOTAL:	60 PERIODS

COURSEOUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Develop semantic web related simple applications.
CO2:	Address Privacy and Security issues in Social Networking.
CO3:	Explain the data extraction and mining of social networks.
CO4:	Discuss the prediction of human behavior in social communities.
CO5:	Describe the applications of social networks.

TEXTBOOKS:	
1.	Peter Mika, “Social Networks and the Semantic Web, First Edition, Springer 2007.
2.	BorkoFurht, “Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3.	Learning Neo4j 3.x “Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing.
4.	David Easley, Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning about a Highly Connected Worldǁ, First Edition, Cambridge University Press, 2010.

REFERENCEBOOKS:	
1.	Easley D. Kleinberg J., “Networks, Crowds, and Markets – Reasoning about a Highly Connected World”, Cambridge University Press, 2010.
2.	Jackson, Matthew O., “Social and Economic Networks”, Princeton University Press, 2008.
3.	GuandongXu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First Edition, Springer, 2011.
4.	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, “Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling”, IGI Global Snippet, 2009.
5.	John G. Breslin, Alexander Passant and Stefan Decker, “The Social Semantic Webǁ, Springer, 2009.

1 91CCE045J	MODERN CRYPTOGRAPHY	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To learn about Modern Cryptography.
2.	To focus on how cryptographic algorithms and protocols work and how to use them.
3.	To build a Pseudorandom permutation.
4.	To construct Basic cryptanalytic techniques.
5.	To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT	TITLE	PERIODS
1	INTRODUCTION	6
Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.		
UNIT	TITLE	PERIODS
2	FORMAL NOTIONS OF ATTACKS	6
Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NM-CCA2, Inter-relations among the attack model.		
UNIT	TITLE	PERIODS
3	RANDOM ORACLES	6
Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF).		
UNIT	TITLE	PERIODS
4	BUILDING A PSEUDORANDOM PERMUTATIO	6
The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.		
UNIT	TITLE	PERIODS
5	MESSAGE AUTHENTICATION CODE	6
Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.		

LAB EXCERCISE		30 PERIODS
11.	Implement Feige-Fiat-Shamir identification protocol.	
12.	Implement GQ identification protocol.	
13.	Implement Schnorr identification protocol.	
14.	Implement Rabin one-time signature scheme.	
15.	Implement Merkle one-time signature scheme.	
16.	Implement Authentication trees and one-time signatures.	
17.	Implement GMR one-time signature scheme.	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Interpret the basic principles of cryptography and general cryptanalysis.
CO2:	Determine the concepts of symmetric encryption and authentication.
CO3:	Identify the use of public key encryption, digital signatures, and key establishment.
CO4:	Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
CO5:	Express the use of Message Authentication Codes.

TEXT BOOKS:	
1.	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2.	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)

REFERENCE BOOKS:	
1.	ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2.	OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3.	William Stallings, “Cryptography and Network Security: Principles and Practice”, PHI 3rd Edition, 2006.

191CCE055J	ENGINEERING SECURE SOFTWARE SYSTEMS	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	Know the importance and need for software security.
2.	Know about various attacks.
3.	Learn about secure software design.
4.	Understand risk management in secure software development.
5.	Know the working of tools related to software security.

UNIT	TITLE	PERIODS
I	NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACK	6
Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – MemoryBased Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks.		
UNIT	TITLE	PERIODS
II	SECURE SOFTWARE DESIGN	7
Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles.		
UNIT	TITLE	PERIODS
III	SECURITY RISK MANAGEMENT	5
Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management		
UNIT	TITLE	PERIODS
IV	SECURITY TESTING	8
Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing		

UNIT	TITLE	PERIODS
V	SECURINGSTORAGEINFRASTRUCTURE	4
Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice		

TOTAL:	30 PERIODS

LAB EXCERCISE		30 PERIODS
1.	Implement the SQL injection attack.	
2.	Implement the Buffer Overflow attack.	
3.	Implement Cross Site Scripting and Prevent XSS.	
4.	Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like Kali Linux.	
5.	Develop and test the secure test cases.	
6.	Penetration test using kali Linux.	
	TOTAL:	60 PERIODS

OURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Identify various vulnerabilities related to memory attacks.
CO2:	Apply security principles in software development.
CO3:	Evaluate the extent of risks.
CO4:	Involve selection of testing techniques related to software security in the testing phase of software development.
CO5:	Use tools for securing software.

TEXTBOOKS:	
1.	Julia H. Allen, “Software Security Engineering”, Pearson Education, 2008.
2.	Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011.
3.	Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006.

REFERENCE BOOKS:	
1.	Robert C. Seacord, “Secure Coding in C and C++ (SEI Series in Software Engineering)”, Addison-Wesley Professional, 2005.
2.	Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.

3.	Mike Shema, “Hacking Web Apps: Detecting and Preventing Web Application Security Problems”, First edition, Syngress Publishing, 2012.
4.	Bryan Sullivan and Vincent Liu, “Web Application Security, A Beginner's Guide”, Kindle Edition, McGraw Hill, 2012.
5.	Lee Allen, “Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)”, Kindle Edition, Packt Publishing,2012.
6.	Jason Grembi, “Developing Secure Software”

191CCE065J	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSEOBJECTIVES:	
1.	To understand the basics of Blockchain.
2.	To learn Different protocols and consensus algorithms in Blockchain
3.	To learn the Blockchain implementation frameworks.
4.	To understand the Blockchain Applications.
5.	To experiment the Hyperledger Fabric, Ethereum networks.

UNIT	TITLE	PERIODS
I	INTRODUCTION TO BLOCKCHAIN	7
Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, TransactionsThe Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.		
UNIT	TITLE	PERIODS
II	BITCOIN AND CRYPTOCURRENCY	6
A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.		
UNIT	TITLE	PERIODS
III	BITCOIN CONSENSUS	6
Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.		
UNIT	TITLE	PERIODS
IV	HYPERLEDGER FABRIC & ETHEREUM	5
Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.		
UNIT	TITLE	PERIODS
V	BLOCKCHAIN APPLICATIONS	6
Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.		

	30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.	
2.	Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.	
3.	Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.	
4.	Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.	
5.	Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.	
6.	Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan	
	TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand emerging abstract models for Blockchain Technology
CO2:	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
CO3:	provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable
CO4:	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.

TEXTBOOKS:	
1.	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2.	Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

REFERENCE BOOKS:	
1.	Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3.	Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015
4.	Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing
5.	Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

191CCE075J	MALWARE ANALYSIS	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To introduce the fundamentals of malware, types and its effects.
2.	To enable to identify and analyse various malware types by static analysis.
3.	To enable to identify and analyse various malware types by dynamic analysis.
4.	To deal with detection, analysis, understanding, controlling, and eradication of malware.

UNIT	TITLE	PERIODS
I	INTRODUCTIONAND BASIC ANALYSIS	6
Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots.		
UNIT	TITLE	PERIODS
II	ADVANCED STATIC ANALYSIS	7
The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism.		
UNIT	TITLE	PERIODS
III	ADVANCED DYNAMIC ANALYSIS	7
Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, api calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching		
UNIT	TITLE	PERIODS
IV	MALWARE FUNCTIONALITY	5
Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection.		

UNIT	TITLE	PERIODS
V	ANDROID MALWARE ANALYSIS	5
Android Malware Analysis: Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis, Case studies.		
		30 PERIODS

PRACTICAL EXCERCISE	30 PERIODS
1.	Experimentation on Initial Infection Vectors and Malware Discovery.
2.	Implementation on Sandboxing Malware and Gathering Information From Runtime Analysis.
3.	Implementation on Portable Executable (PE32) File Format.
4.	Implementation on Executable Metadata and Executable Packers.
5.	Experimentation on Malware Self - Defense, Compression, and Obfuscation Techniques.
6.	Experimentation on Malware behaviour analysis.
7.	Experimentation on analyzing Malicious Microsoft Office and Adobe PDF Documents.
8.	Experimentation on Mobile malware analysis.
9.	Experimentation on Packing and Unpacking of malware.
10.	Experimentation on Rootkit AntiForensics and Covert Channels.
11.	Experimentation on Modern Rootkit Analysis
12.	Experimentation on Malware traffic analysis
	Implement of real time applications for the following malware analysis 1. Static analysis of malwares 2. Dynamic analysis of malwares. 3. Classification of malwares based on their behaviour. 4. Usage of tools to classify malware 5. Advanced malware analysis 6. Android malware analysis 7. Applying antivirus tools in various applications 8. Malware report documentation
TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the various concepts of malware analysis and their technologies used.
CO2:	:Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
CO3:	Understand the methods and techniques used by professional malware analysts.
CO4:	To be able to safely analyze, debug, and disassemble any malicious software by malware analysis.
CO5:	Understand the concept of Android malware analysis their architecture, and App development

TEXTBOOKS:	
1.	Michael Sikorski and Andrew Honig, “Practical Malware Analysis” by No Starch Press, 2012,ISBN: 9781593272906.
2.	Bill Blunden, “The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System”, Second Edition,Jones & Bartlett Publishers, 2009.

REFERENCE BOOKS:	
1.	Jamie Butler and Greg Hoglund, “Rootkits: Subverting the Windows Kernel” by 2005, Addison-Wesley Professional.
2.	Bruce Dang, Alexandre Gazet, Elias Bachaalany, SébastienJosse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.
3.	Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, O’Reilly, 2015.
4.	Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis",CRC Press, Taylor & Francis Group, 2015.
5.	Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.

191ITE083J	SECURITY AND PRIVACY IN CLOUD	Periods per week				Credits
		L	J	P	R	
		2	0	2	0	3

PRE REQUISITES:
NIL

COURSEOBJECTIVES:	
1.	To Introduce Cloud Computing terminology, definition & concepts.
2.	To understand the security design and architectural considerations for Cloud.
3.	To understand the Identity, Access control in Cloud.
4.	To follow best practices for Cloud security using various design pattern.
5.	To be able to monitor and audit cloud applications for security.

UNIT	TITLE	PERIODS
I	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	7
Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.		
UNIT	TITLE	PERIODS
II	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	6
Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.		
UNIT	TITLE	PERIODS
III	ACCESS CONTROL AND IDENTITY MANAGEMENT	6
Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention.		
UNIT	TITLE	PERIODS
IV	CLOUD SECURITY DESIGN PATTERNS	6
Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.		

UNIT	TITLE	PERIODS
V	MONITORING, AUDITING AND MANAGEMENT	5
Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting 126 and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management.		

	30 PERIODS

PRACTICAL EXCERCISE	**30 PERIODS**
1.	Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim.
2.	Simulate resource management using cloud sim.
3.	Simulate log forensics using cloud sim.
4.	Simulate a secure file sharing using a cloud sim.
5.	Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)
6.	Implement any encryption algorithm to protect the images.
7.	Implement any image obfuscation mechanism.
8.	Implement a role-based access control mechanism in a specific scenario.
9.	Implement an attribute-based access control mechanism based on a particular scenario.
10.	Develop a log monitoring system with incident management in the cloud.
TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the cloud concepts and fundamentals.
CO2:	Explain the security challenges in the cloud.
CO3:	Define cloud policy and Identity and Access Management.
CO4:	Understand various risks and audit and monitoring mechanisms in the cloud.
CO5:	Define the various architectural and design considerations for security in the cloud.

TEXT BOOKS:	
1.	Raj Kumar Buyya , James Broberg, andrzejGoscinski, “Cloud Computing:”, Wiley 2013
2.	Dave shackleford, “Virtualization Security”, SYBEX a wiley Brand 2013.
3.	Mather, Kumaraswamy and Latif, “Cloud Security and Privacy”, OREILLY 2011.

REFERENCE BOOKS:	
1.	Mark C. Chu-Carroll —Code in the Cloud‖,CRC Press, 2011.
2.	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. ThamaraiSelvi

SYLLABUS OF

Vertical VI – Emerging Technologies I

COURSES

191CSE016J	Augmented Reality/Virtual Reality	Periods per week				Credits
		L	T	P	C	
		2	**0**	**2**	**3**	**3**

COURSE OBJECTIVES:	
1.	To impart the fundamental aspects and principles of AR/VR technologies.
2.	To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
3.	To learn about the graphical processing units and their architectures.
4.	To gain knowledge about AR/VR application development.
5.	To know the technologies involved in the development of AR/VR based applications.

UNIT	TITLE	PERIODS
I	**INTRODUCTION**	**7**
Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies- Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.		
UNIT	**TITLE**	**PERIODS**
II	**VR MODELING**	**6**
Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management		
UNIT	**TITLE**	**PERIODS**
III	**VR PROGRAMMING**	**6**
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.		
UNIT	**TITLE**	**PERIODS**
IV	**APPLICATIONS**	**6**
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications - Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education		

UNIT	TITLE	PERIODS
V	AUGMENTED REALITY	5
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.	
2.	Use the primitive objects and apply various projection types by handling camera.	
3.	Download objects from asset store and apply various lighting and shading effects.	
4.	Model three dimensional objects using various modelling techniques and apply textures over them.	
5.	Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.	
6.	Add audio and text special effects to the developed application.	
7.	Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.	
8.	Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.	
9.	Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.	
10.	Develop simple MR enabled gaming applications.	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1:	Understand the basic concepts of AR and VR
CO2:	Understand the tools and technologies related to AR/VR
CO3:	Know the working principle of AR/VR related Sensor devices
CO4:	Design of various models using modeling techniques
CO5:	Develop AR/VR applications in different domains

TEXT BOOKS:	
1.	Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2.	Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016
3.	John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4.	William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003

191CSE026J	Robotic Process Automation	Periods per week				Credits
		L	T	P	C	
		2	0	2	3	3

COURSE OBJECTIVES:	
1.	To understand the basic concepts of Robotic Process Automation.
2.	To expose to the key RPA design and development strategies and methodologies
3.	To learn the fundamental RPA logic and structure
4.	To explore the Exception Handling, Debugging and Logging operations in RPA.
5.	To learn to deploy and Maintain the software bot.

UNIT	TITLE	PERIODS
I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	6
Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.		
UNIT	TITLE	PERIODS
II	AUTOMATION PROCESS ACTIVITIES	6
Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events		
UNIT	TITLE	PERIODS
III	APP INTEGRATION, RECORDING AND SCRAPING	6
App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.		
UNIT	TITLE	PERIODS
IV	EXCEPTION HANDLING AND CODE MANAGEMENT	6
Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine		
UNIT	TITLE	PERIODS
V	DEPLOYMENT AND MAINTENANCE	6
Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Create a Sequence to obtain user inputs display them using a message box	
2.	Create a Flowchart to navigate to a desired page based on a condition	
3.	Create a State Machine workflow to compare user input with a random number.	
4.	Build a process in the RPA platform using UI Automation Activities.	
5.	Create an automation process using key System Activities, Variables and Arguments	
6.	Also implement Automation using System Trigger	
7.	Automate login to (web)Email account	
8.	Recording mouse and keyboard actions.	
9.	Scraping data from website and writing to CSV	
10.	Implement Error Handling in RPA platform	
11.	Web Scraping	
12.	Email Query Processing	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
By the end of this course, the students will be able to	
CO1:	Enunciate the key distinctions between RPA and existing automation techniques and platforms.
CO2:	Use UiPath to design control flows and work flows for the target process
CO3:	Implement recording, web scraping and process mining by automation
CO4:	Use UIPath Studio to detect, and handle exceptions in automation processes
CO5:	Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.

TEXT BOOKS:	
1.	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2.	Tom Taulli , “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, Apress publications, 2020.

191AIE031J	NEURAL NETWORKS AND DEEP LEARNING	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

COURSE OBJECTIVES:	
1.	To understand the basics in deep neural networks
2.	To understand the basics of associative memory and unsupervised learning networks
3.	To apply CNN architectures of deep neural networks
4.	To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks
5.	To apply auto encoders and generative models for suitable applications

UNIT	TITLE	PERIODS
I	**INTRODUCTION**	**6**

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction- Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT	TITLE	PERIODS
II	**ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS**	**6**

Training Algorithms for Pattern Association-Auto Associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT	TITLE	PERIODS
III	**THIRD-GENERATION NEURAL NETWORKS**	**6**

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT	TITLE	PERIODS
IV	**DEEP FEEDFORWARD NETWORKS**	**6**

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT	TITLE	PERIODS
V	**RECURRENT NEURAL NETWORKS**	6
Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Auto encoder, Stochastic Encoders and Decoders, Contractive Encoders.		
		30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
16.	Implement simple vector addition in TensorFlow.	
17.	Implement a regression model in Keras.	
18.	Implement a perceptron in TensorFlow/Keras Environment.	
19.	Implement a Feed-Forward Network in TensorFlow/Keras.	
20.	Implement an Image Classifier using CNN in TensorFlow/Keras.	
21.	Improve the Deep learning model by fine tuning hyper parameters.	
22.	Implement a Transfer Learning concept in Image Classification.	
23.	Using a pre trained model on Keras for Transfer Learning	
24.	Perform Sentiment Analysis using RNN	
25.	Implement an LSTM based Auto encoder in TensorFlow / Keras.	
26.	Image generation using GAN	
Additional Experiments		
27.	Train a Deep learning model to classify a given image using pre trained model	
28.	Recommendation system from sales data using Deep Learning	
29.	Implement Object Detection using CNN	
30.	Implement any simple Reinforcement Algorithm for an NLP problem	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Apply Convolution Neural Network for image processing.
CO2:	Understand the basics of associative memory and unsupervised learning networks.
CO3:	Apply CNN and its variants for suitable applications.
CO4:	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
CO5:	Apply auto encoders and generative models for suitable applications.

TEXT BOOKS:	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2.	Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.

REFERENCE BOOKS:	
1.	Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly, 2018.
2.	Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
3.	Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4.	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5.	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6.	Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017.
7.	S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
8.	Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9.	James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

191CSE046J	CYBER SECURITY	Periods per week				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

COURSE OBJECTIVES:	
1.	To learn cybercrime and cyberlaw.
2.	To understand the cyber attacks and tools for mitigating them.
3.	To understand information gathering.
4.	To learn how to detect a cyber attack.
5.	To learn how to prevent a cyber attack.

UNIT	TITLE	PERIODS
I	**INTRODUCTION**	**6**

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT	TITLE	PERIODS
II	**ATTACKS AND COUNTERMEASURES**	**6**

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

UNIT	TITLE	PERIODS
III	**RECONNAISSANCE**	**6**

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.

UNIT	TITLE	PERIODS
IV	**INTRUSION DETECTION**	**6**

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT	TITLE	PERIODS
V	**INTRUSION PREVENTION**	**6**

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Install Kali Linux on Virtual box	
2.	Explore Kali Linux and bash scripting	
3.	Perform open source intelligence gathering using Netcraft, Whois Lookups, DNS Reconnaissance, Harvester and Maltego	
4.	Understand the nmap command d and scan a target using nmap	
5.	Install metasploitable2 on the virtual box and search for unpatched vulnerabilities	
6.	Use Metasploit to exploit an unpatched vulnerability	
7.	Install Linus server on the virtual box and install ssh	
8.	Use Fail2banto scan log files and ban Ips that show the malicious signs	
9.	Launch brute-force attacks on the Linux server using Hydra.	
10.	Perform real-time network traffic analysis and data pocket logging using Snort	
	TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Explain the basics of cyber security, cyber crime and cyber law (K2)
CO2:	Classify various types of attacks and learn the tools to launch the attacks (K2)
CO3:	Apply various tools to perform information gathering (K3)
CO4:	Apply intrusion techniques to detect intrusion (K3)
CO5:	Apply intrusion prevention techniques to prevent intrusion (K3)

TEXT BOOKS:	
1.	Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021 (Unit 1)
2.	Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011 (Unit 1)
3.	https://owasp.org/www-project-top-ten/
REFERENCE BOOKS:	
1.	David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones & Bartlett Learning Publishers, 2013 (Unit 2)
2.	Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy”, Elsevier, 2011 (Unit 3)
3.	Kimberly Graves, “CEH Official Certified Ethical hacker Review Guide”, Wiley Publishers, 2007 (Unit 3)
4.	William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015 (Units 4 and 5)
5.	Georgia Weidman, “Penetration Testing: A Hands-On Introduction to Hacking”, No Starch Press, 2014 (Lab)

5.

191CSE056J	QUANTUM COMPUTING	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To know the background of classical computing and quantum computing.
2.	To learn the fundamental concepts behind quantum computation.
3.	To study the details of quantum mechanics and its relation to Computer Science.
4.	To gain knowledge about the basic hardware and mathematical models of quantum computation.
5.	To learn the basics of quantum information and the theory behind it.

UNIT	TITLE	PERIODS
I	QUANTUM COMPUTING BASIC CONCEPTS	6
Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits - Superpositions		
UNIT	TITLE	PERIODS
II	QUANTUM GATES AND CIRCUITS	5
Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction.		
UNIT	TITLE	PERIODS
III	QUANTUM ALGORITHMS	7
Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm		
UNIT	TITLE	PERIODS
IV	QUANTUM INFORMATION THEORY	6
Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels		
UNIT	TITLE	PERIODS
V	QUANTUM CRYPTOGRAPHY	6
Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Single qubit gate simulation - Quantum Composer	
2.	Multiple qubit gate simulation - Quantum Composer	
3.	Composing simple quantum circuits with q-gates and measuring the output into classical bits.	
4.	IBM Qiskit Platform Introduction	
5.	Implementation of Shor's Algorithms	
6.	Implementation of Grover's Algorithm	
7.	Implementation of Deutsch's Algorithm	
8.	Implementation of Deutsch-Jozsa's Algorithm	
9.	Integer factorization using Shor's Algorithm	
10.	QKD Simulation	
11.	Mini Project such as implementing an API for efficient search using Grover's Algorithms.	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the basics of quantum computing.
CO2:	Understand the background of Quantum Mechanics.
CO3:	Analyze the computation models.
CO4:	Model the circuits using quantum computation, environments and frameworks.
CO5:	Understand the quantum operations such as noise and error–correction.

TEXT BOOKS:	
1.	Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).
2.	Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3.	Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".
REFERENCE BOOKS:	
1.	Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2.	N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

191CCE065J	Cryptocurrency and Block chain Technologies	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the basics of Blockchain
2.	To learn Different protocols and consensus algorithms in Blockchain
3.	To learn the Blockchain implementation frameworks
4.	To understand the Blockchain Applications
5.	To experiment the Hyperledger Fabric, Ethereum networks

UNIT	TITLE	PERIODS
I	INTRODUCTION TO BLOCKCHAIN	7

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, TransactionsThe Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT	TITLE	PERIODS
II	BITCOIN AND CRYPTOCURRENCY	6

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT	TITLE	PERIODS
III	BITCOIN CONSENSUS	6

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool- Permissioned model and use cases.

UNIT	TITLE	PERIODS
IV	HYPERLEDGER FABRIC & ETHEREUM	5

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT	TITLE	PERIODS
V	BLOCKCHAIN APPLICATIONS	6

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.	
2.	Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.	
3.	Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.	
4.	Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network	
5.	Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.	
6.	Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan	
		TOTAL: 60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand emerging abstract models for Blockchain Technology
CO2:	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
CO3:	It provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
CO4:	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.

TEXT BOOKS:	
1.	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2.	Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

REFERENCE BOOKS:	
1.	Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3.	Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015
4.	Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing
5.	Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

191CSE076J	GAME DEVELOPMENT	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To know the basics of 2D and 3D graphics for game development.
2.	To know the stages of game development.
3.	To understand the basics of a game engine.
4.	To survey the gaming development environment and tool kits.
5.	To learn and develop simple games using Pygame environment

UNIT	TITLE	PERIODS
I	**3D GRAPHICS FOR GAME DESIGN**	**6**
Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.		
UNIT	**TITLE**	**PERIODS**
II	**GAME DESIGN PRINCIPLES**	**6**
Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.		
UNIT	**TITLE**	**PERIODS**
III	**GAME ENGINE DESIGN**	**6**
Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.		
UNIT	**TITLE**	**PERIODS**
IV	**OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS**	**6**
Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.		
UNIT	**TITLE**	**PERIODS**
V	**GAME DEVELOPMENT USING PYGAME**	**6**
Developing 2D and 3D interactive games using Pygame - Avatar Creation - 2D and 3D Graphics Programming - Incorporating music and sound - Asset Creations - Game Physics algorithms Development - Device Handling in Pygame - Overview of Isometric and Tile Based arcade Games - Puzzle Games.		
		30 PERIODS

PRACTICAL EXERCISES	30 PERIODS
1. Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game.	
2. Character design, sprites, movement and character control	
3. Level design: design of the world in the form of tiles along with interactive and collectible objects.	
4. Design of interaction between the player and the world, optionally using the physics engine.	
5. Developing a 2D interactive using Pygame	
6. Developing a Puzzle game	
7. Design of menus and user interaction in mobile platforms.	
8. Developing a 3D Game using Unreal	
9. Developing a Multiplayer game using unity	
TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Explain the concepts of 2D and 3d Graphics
CO2:	Design game design documents.
CO3:	Implementation of gaming engines.
CO4:	Survey gaming environments and frameworks.
CO5:	Implement a simple game in Pygame.

REFERENCE BOOKS:	
1.	Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley,2013.
2.	Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress,2007.
3.	Paul Craven, “Python Arcade games”, Apress Publishers,2016.
4.	David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press,2006.
5.	Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.

5.

191CSE086J	3D PRINTING AND DESIGN	Periods per week				Credits
		L	T	P	R	
		3	0	0	0	3

COURSE OBJECTIVES:	
1.	To discuss on basics of 3D printing
2.	To explain the principles of 3D printing technique
3.	To explain and illustrate inkjet technology
4.	To explain and illustrate laser technology
5.	To discuss the applications of 3D printing

UNIT	TITLE	PERIODS
I	INTRODUCTION	6

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats

UNIT	TITLE	PERIODS
II	PRINCIPLE	6

Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations

UNIT	TITLE	PERIODS
III	INKJET TECHNOLOGY	6

Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continous jet, Mulitjet; Powder based fabrication – Colourjet.

UNIT	TITLE	PERIODS
IV	LASER TECHNOLOGY	6

Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow-Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures;

UNIT	TITLE	PERIODS
V	INDUSTRIAL APPLICATIONS	6

Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Future trends;

	30 PERIODS

PRACTICAL EXERCISES	30 PERIODS
1. Study the interface and basic tools in the CAD software.	
2. Study 3D printer(s) including print heads, build envelope, materials used and related support removal system(s).Character design, sprites, movement and character control	
3. Review of geometry terms of a 3D mesh.	
4. Commands for moving from 2D to 3D.	
5. Advanced CAD commands to navigate models in 3D space	
6. Design any four everyday objects Refer to web sites like Thingiverse, Shapeways and GitFab to design four everyday objects that utilize the advantages of 3D printing . Choose four models from a sharing site like Thingiverse, Shapeways or Gitfab. a. Improve upon a file and make it your own. Some ideas include: • Redesign it with a specific user in mind • Redesign it for a slightly different purpose • Improve the look of the product	
7. Use the CAM software to prepare files for 3D printing.	
8. Manipulate machine movement and material layering.	
9. Repair a 3D mesh using a) Freeware utilities: Autodesk MeshMixer (http://goo.gl/x5nhYc), MeshLab (http://goo.gl/fgztLl) or Netfabb Basic or Cloud Service (http://goo.gl/Q1P47a) b) Freeware tool tutorials: Netfabb Basic or Cloud Service (http://goo.gl/Q1P47a), Netfabb and MeshLab (http://goo.gl/WPOVec) c) Professional tools: Magics or Netfabb Equipment : one 3D printer for every 10-15 students	
TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Outline and examine the basic concepts of 3D printing technology:
CO2:	Outline 3D printing workflow`
CO3:	Explain and categorise the concepts and working principles of 3D printing using inkjet technique
CO4:	Explain and categorise the working principles of 3D printing using laser technique
CO5:	Explain various method for designing and modeling for industrial applications

TEXT BOOKS:	
1.	Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2.	Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons, 2013.

REFERENCES:	
1.	Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010
2.	Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007
3.	Joan Horvath, Mastering 3D Printing, APress, 2014

SYLLABUS OF

Vertical VII – Emerging Technologies II

COURSES

191CCE015T	ETHICAL HACKING	Periods perweek				Credits
		L	T	P	R	
		3	0	0	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To understand the basics of computer based vulnerabilities
2.	To explore different foot printing, reconnaissance and scanning methods
3.	To expose the enumeration and vulnerability analysis methods
4.	To understand hacking options available in Web and wireless applications.
5.	To explore the options for network protection
6.	To practice tools to perform ethical hacking to expose the vulnerabilities.

UNIT	TITLE	PERIODS
I	INTRODUCTION	9

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The TransportLayer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

UNIT	TITLE	PERIODS
II	FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS	9

Foot printing Concepts – Foot printing through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence – Foot printing through Social Engineering – Foot printing Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT	TITLE	PERIODS
III	ENUMERATION AND VULNERABILITY ANALYSIS	9

Enumeration Concepts - NetBIOS Enumeration — SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

UNIT	TITLE	PERIODS
IV	SYSTEM HACKING	9

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackersand Security Testers Hacking Wireless Networks - Components of a Wireless Network — Wardriving- Wireless Hacking - Tools of the Trade

UNIT	TITLE	PERIODS
V	NETWORK PROTECTION SYSTEMS	9
Access Control Lists - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network- Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.		

TOTAL	45 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Express knowledge on basics of computer based vulnerabilities
CO2:	Gain understanding on different foot printing, reconnaissance and scanningmethods.
CO3:	Demonstrate the enumeration and vulnerability analysis methods
CO4:	Gain knowledge on hacking options available in Web and wireless applications
CO5:	Acquire knowledge on the options for network protection
CO6:	To use tools to perform ethical hacking to expose the vulnerabilities

TEXT BOOKS:	
1.	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology,Delmar Cengage Learning, 2010.
2.	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS,Elsevier, 2013.
3.	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, DafyddStuttard and Marcus Pinto, 2011.

REFERENCE BOOKS:	
1.	Black Hat Python: Python Programming for Hackers and Pentesters, JustinSeitz , 2014.

191ITE027J	MULTIMEDIA AND ANIMATION	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To grasp the fundamental knowledge of Multimedia elements and systems
2.	To get familiar with Multimedia file formats and standards
3.	To learn the process of Authoring multimedia presentations
4.	To learn the techniques of animation in 2D and 3D and for the mobile UI
5.	To explore different popular applications of multimedia

UNIT	TITLE	PERIODS
I	INTRODUCTION TO MULTIMEDIA	6
Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing.Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning		
UNIT	TITLE	PERIODS
II	MULTIMEDIA FILE FORMATS AND STANDARDS	6
File formats – Text, Image file formats, Graphic and animation file formats, Digital audio andVideo file formats, Color in image and video, Color Models. Multimedia data and file formats forthe web.		
UNIT	TITLE	PERIODS
III	MULTIMEDIA AUTHORING	6
Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon andObject Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual Learning ,simulations.		
UNIT	TITLE	PERIODS
IV	ANIMATION	7
Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D,2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.		

UNIT	TITLE	PERIODS
V	**MULTIMEDIA APPLICATIONS**	5
Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries.		

	30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Working with Image Editing tools: Install tools like GIMP/ InkScape / Krita / Pencil and perform editing operations: • Usedifferent selection and transform tools to modify or improve an image • Create logos and banners for home pages of websites	
2.	Working with Audio Editing tools: • Install tools like, Audacity / Ardour for audio editing, sound mixing and special effects like fade- in or fade-out etc., • Perform audio compression by choosing a proper codec	
3.	Working with Video Editing and conversion tools: Install tools like OpenShot / Cinelerra / HandBrake for editing video content. • Edit and mix video content, remove noise, create special effects, add captions. • Compress and convert video file format to other popular formats.	
4.	Working with web/mobile authoring tools: Adapt / KompoZer/ BlueGriffon / BlueFish / Aptana Studio/ NetBeans / WordPress /Expression Web: • Design simple Home page with banners, logos, tables quick links etc • Provide a search interface and simple navigation from the home page to the insidepages of the website. • Design Responsive web pages for use on both web and mobile interfaces	
5.	Working with Animation tools: Install tools like, Krita, Wick Editor, Blender: • Perform a simple 2D animation withsprites • Perform simple 3D animation with keyframes, kinematics • Working with Mobile UI animation tools: Origami studio / Lottie / Framer etc.,	
6.	Working with E-Learning authoring tools: Install tools like EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache, VideoLAN: • Demonstrate screen recording and further editing for e-learning content. • Create a simple E-Learning module for a topic of your choice	
7.	Creating VR and AR applications: • Any affordable VR viewer like Google Cardboard and any development platform like Openspace 3D / ARCore etc. Note: all tools listed are open source. Usage of any proprietary tools in place of open source tools is not restricted.	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Get the bigger picture of the context of Multimedia and its applications
CO2:	Use the different types of media elements of different formats on content pages
CO3:	Author 2D and 3D creative and interactive presentations for different target multimediaapplications
CO4:	Use different standard animation techniques for 2D, 21/2 D, 3D applications
CO5:	Understand the complexity of multimedia applications in the context ofcloud, security,bigdata streaming, social networking, CBIR etc.,

TEXT BOOKS:	
1.	Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)

REFERENCE BOOKS:	
1.	John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016
2.	Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press,2018.
3.	Prabhat K.Andleigh, Kiran Thakrar, "Multimedia System Design", Pearson Education, 1st Edition, 2015.
4.	Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", SpringerNature, 1st Edition, 2021.
5.	Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
6.	Rogers David, "Animation: Master – A Complete Guide (GraphicsSeries)", Charles RiverMedia, 2006.
7.	Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rd Edition, 2012.
8.	Emilio Rodriguez Martinez, Mireia Alegre Ruiz, "UI Animations with Lottie and After Effects: Create, render, and ship stunning After Effects animations natively on mobile with React Native", Packt Publishing, 2022.

191CSE042J	UI AND UX DESIGN	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To provide a sound knowledge in UI & UX
2.	To understand the need for UI and UX
3.	To understand the various Research Methods used in Design
4.	To explore the various Tools used in UI & UX
5.	Creating a wireframe and prototype

UNIT	**TITLE**	**PERIODS**
I	**FOUNDATIONS OF DESIGN**	**6**
UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy		
UNIT	**TITLE**	**PERIODS**
II	**FOUNDATIONS OF UI DESIGN**	**6**
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles —Branding - Style Guides		
UNIT	**TITLE**	**PERIODS**
III	**FOUNDATIONS OF UX DESIGN**	**5**
Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals		
UNIT	**TITLE**	**PERIODS**
IV	**WIREFRAMING, PROTOTYPING AND TESTING**	**7**
Sketching Principles - Sketching Red Routes - Responsive Design — Wire framing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools- Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration		

UNIT	TITLE	PERIODS
V	RESEARCH, DESIGNING, IDEATING, & INFORMATIONARCHITECTURE	6
Identifying and Writing Problem Statements - Identifying Appropriate ResearchMethods – Creating Personas - Solution Ideation - Creating User Stories – Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture		
		30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Designing a Responsive layout for an societal application	
2.	Exploring various UI Interaction Patterns	
3.	Developing an interface with proper UI Style Guides	
4.	Developing Wireflow diagram for application using open source software	
5.	Exploring various open source collaborative interface Platform	
6.	Hands on Design Thinking Process for a new product	
7.	Brainstorming feature for proposed product	
8.	Defining the Look and Feel of the new Project	
9.	Create a Sample Pattern Library for that product (Mood board, Fonts,Colors based on UI principles)	
10.	Identify a customer problem to solve	
11.	Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping	
12.	Sketch, design with popular tool and build a prototype and performusability testing and identify improvements	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Build UI for user Applications
CO2:	Evaluate UX design of any product or application
CO3:	Demonstrate UX Skills in product development
CO4:	Implement Sketching principles
CO5:	Create Wireframe and Prototype

TEXT BOOKS:	
1.	Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2.	Jon Yablonski, “Laws of UX using Psychology to Design BetterProduct & Services” O’Reilly2021

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

191ITE047J	DIGITAL MARKETING	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
2.	It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured

UNIT	**TITLE**	**PERIODS**
I	**INTRODUCTION TO ONLINE MARKET**	**6**
Online Market space- Digital Marketing Strategy- Components - Opportunities for buildingBrand Website - Planning and Creation - Content Marketing		
UNIT	**TITLE**	**PERIODS**
II	**SEARCH ENGINE OPTIMISATION**	**6**
Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement		
UNIT	**TITLE**	**PERIODS**
III	**E- MAIL MARKETING**	**6**
E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting		
UNIT	**TITLE**	**PERIODS**
IV	**SOCIAL MEDIA MARKETING**	**6**
Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns.EngagementMarketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing		
UNIT	**TITLE**	**PERIODS**
V	**DIGITAL TRANSFORMATION**	**6**
Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aidwith the branding of the company and how it aids its potential customer segments.	
2.	Perform keyword search for a skincare hospital website based on search volume andcompetition using Google keyword planner tool.	
3.	Demonstrate how to use the Google WebMasters Indexing API	
4.	Discuss an interesting case study regarding how an insurance company manages leads.	
5.	Discuss negative and positive impacts and ethical implications of using social media for political advertising	
6.	Discuss how Predictive analytics is impacting marketing automation	
	TOTAL:	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Examine and explore the role and importance of digital marketing in today'srapidly changing business environment..
CO2:	Focuses on how digital marketing can be utilized by organizations and how itseffectiveness can be measured
CO3:	Know the key elements of a digital marketing strategy.
CO4:	Study how the effectiveness of a digital marketing campaign can be measured
CO5:	Demonstrate advanced practical skills in common digital marketing tools such as SEO,SEM, Social media and Blogs.

TEXT BOOKS:	
1.	Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: PearsonEducation
2.	First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373
3.	Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press(April 2015). ISBN-10: 0199455449.
4.	Marketing 4.0: Moving from Traditional to Digital by Philip Kotler; Publisher: Wiley;1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930
5.	Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.
6.	Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.
7.	Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

191CAE084J	ETHICS AND AI	Periods perweek				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

COURSE OBJECTIVES:	
1.	Study the morality and ethics in AI
2.	Learn ae Ethical initiatives in the field of artificial intelligence
3.	Study about AI standards and Regulations
4.	Study about social and ethical issues of Robot Ethics
5.	Study about AI and Ethics- challenges and opportunities

UNIT	**TITLE**	**PERIODS**
I	**INTRODUCTION**	6
Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impacton the legal system-Impact on the environment and the planet-Impact on trust		
UNIT	**TITLE**	**PERIODS**
II	**ETHICAL INITIATIVES IN AI**	6
International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots,Autonomous Vehicles , Warfare and weaponization.		
UNIT	**TITLE**	**PERIODS**
III	**AI STANDARDS AND REGULATION**	6
Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems		
UNIT	**TITLE**	**PERIODS**
IV	**ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS**	6
Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and ProfessionalResponsibility- Roboethics Taxonomy**.**		
UNIT	**TITLE**	**PERIODS**
V	**AI AND ETHICS- CHALLENGES AND OPPORTUNITIES**	6
Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine - decision-making role in industries-National and International Strategies on AI.		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Recent case study of ethical initiatives in healthcare, autonomous vehicles and defense	
2.	Exploratory data analysis on a 2 variable linear regression model	
3.	Experiment the regression model without a bias and with bias	
4.	Classification of a dataset from UCI repository using a perceptron with and without bias	
5.	Case study on ontology where ethics is at stake	
6.	Identification on optimization in AI affecting ethics	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Learn about morality and ethics in AI
CO2:	Acquire the knowledge of real time application ethics, issues and its challenges.
CO3:	Understand the ethical harms and ethical initiatives in AI
CO4:	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous andSemi-Autonomous Systems
CO5:	Understand the concepts of Roboethics and Morality with professional responsibilities
CO6:	Learn about the societal issues in AI with National and International Strategies on AI

TEXT BOOKS:	
1.	y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2.	Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implicationsof Robotics", The MIT Press- January 2014

REFERENCE BOOKS:	
1.	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2.	Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020
3.	https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65
4.	https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteenchallenges-and-opportunities/
5.	https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/
6.	. https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/

191AIE061J	IMAGE AND VIDEO ANALYTICS	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the basics of image processing techniques for computer vision.
2.	To learn the techniques used for image pre-processing
3.	To discuss the various object detection techniques.
4.	To understand the various Object recognition mechanisms.
5.	To elaborate on the video analytics techniques.

UNIT	TITLE	PERIODS
I	INTRODUCTION	6

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures

UNIT	TITLE	PERIODS
II	IMAGE PRE-PROCESSING	7

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models – Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration

UNIT	TITLE	PERIODS
III	OBJECT DETECTION USING MACHINE LEARNING	5

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN- Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT	TITLE	PERIODS
IV	FACE RECOGNITION AND GESTURE RECOGNITION	6

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition- DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet- Gesture Recognition

UNIT	TITLE	PERIODS
V	VIDEO ANALYTICS	6

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3.

	30 PERIODS

LAB EXCERCISE		**30 PERIODS**
1.	Write a program that computes the T-pyramid of an image	
2.	Write a program that derives the quad tree representation of an image using thehomogeneity criterion of equal intensity	
3.	Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale (c) Skewing (d) Affine transform calculated from three pairs of corresponding points(e)Bilinear transform calculated from four pairs of corresponding points.	
4.	Develop a program to implement Object Detection and Recognition	
5.	Develop a program for motion analysis using moving edges, and apply it to your image sequences	
6.	Develop a program for Facial Detection and Recognition	
7.	Write a program for event detection in video surveillance system	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the basics of image processing techniques for computer vision and videoanalysis.
CO2:	Explain the techniques used for image pre-processing.
CO3:	Develop various object detection techniques
CO4:	Understand the various face recognition mechanisms
CO5:	Elaborate on deep learning-based video analytics.

TEXT BOOKS:	
1.	Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and MachineVision”, 4nd edition, Thomson Learning, 2013.
2.	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)

REFERENCE BOOKS:	
1.	Richard Szeliski, “Computer Vision: Algorithms and Applications”,Springer Verlag London Limited,2011.
2.	Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “VideoAnalytics for Business Intelligence”, Springer, 2012.
3.	A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education,2003.
4.	E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press.

191AIE071J	COMPUTER VISION	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the fundamental concepts related to Image formation and processing
2.	To learn feature detection, matching and detection
3.	To become familiar with feature based alignment and motion estimation
4.	To develop skills on 3D reconstruction
5.	To understand image based rendering and recognition

UNIT	TITLE	PERIODS
I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	6
Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization		
UNIT	TITLE	PERIODS
II	FEATURE DETECTION, MATCHING AND SEGMENTATION	6
Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge -Meanshift and mode finding - Normalized cuts - Graph cuts and energy-based methods.		
UNIT	TITLE	PERIODS
III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	5
2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment – Constrained structure and motion - Translational alignment - Parametric motion - Spline-basedmotion - Optical flow - Layered motion.		
UNIT	TITLE	PERIODS
IV	3D RECONSTRUCTION	7
Shape from X - Active range finding - Surface representations - Point-based representations-		
Volumetric representations - Model-based reconstruction - Recovering texture maps andalbedosos.		
UNIT	TITLE	PERIODS
V	IMAGE-BASED RENDERING AND RECOGNITION	6
View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes -Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets		

	30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
Software needed: OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent		
1.	OpenCV Installation and working with Python	
2.	Basic Image Processing - loading images, Cropping, Resizing, Thresholding,Contour analysis, Bolb detection.	
3.	Image Annotation – Drawing lines, text circle, rectangle, ellipse on images	
4.	Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection	
5.	Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment	
6.	Image segmentation using Graphcut / Grabcut	
7.	Camera Calibration with circular grid	
8.	Pose Estimation	
9.	3D Reconstruction – Creating Depth map from stereo images	
10.	Object Detection and Tracking using Kalman Filter, Camshift	
1. docs.opencv.org 2. https://opencv.org/opencv-free-course/		
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand basic knowledge, theories and methods in image processing and computervision
CO2:	Implement basic and some advanced image processing techniques inOpenCV.
CO3:	Apply 2D a feature-based based image alignment, segmentation and motionestimations
CO4:	Apply 3D image reconstruction techniques
CO5:	Design and develop innovative image processing and computer visionapplications.

TEXT BOOKS:	
1.	Richard Szeliski, “Computer Vision: Algorithms and Applications”,Springer- Texts inComputer Science, Second Edition, 2022.
2.	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education,Second Edition, 2015.

REFERENCE BOOKS:	
1.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision,Second Edition, Cambridge University Press,March 2004.
2.	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer,2006
3.	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press,2012.

191ITE083J	SECURITY AND PRIVACY IN CLOUD	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To Introduce Cloud Computing terminology, definition & concepts
2.	To understand the security design and architectural considerations for Cloud
3.	To understand the Identity, Access control in Cloud.
4.	To follow best practices for Cloud security using various design patterns
5.	To be able to monitor and audit cloud applications for security

UNIT	TITLE	PERIODS
I	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	7
Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non- repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures		
UNIT	TITLE	PERIODS
II	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	6
Security design principles for Cloud Computing - Comprehensive data protection - End-to-endaccess control - Common attack vectors and threats - Network and Storage - Secure IsolationStrategies - Virtualization strategies - Inter-tenant network segmentation strategies — Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key		
UNIT	TITLE	PERIODS
III	ACCESS CONTROL AND IDENTITY MANAGEMENT	6
Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot – Intruder Detection and prevention		
UNIT	TITLE	PERIODS
IV	CLOUD SECURITY DESIGN PATTERNS	6

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, CloudResource Access Control, Secure On-Premise Internet Access, Secure External Cloud		
UNIT	**TITLE**	**PERIODS**
V	**MONITORING, AUDITING AND MANAGEMENT**	**5**
Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing — Record generation,Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management		
		30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in CloudSim	
2.	Simulate resource management using cloud sim	
3.	simulate log forensics using cloud sim	
4.	simulate a secure file sharing using a cloud sim	
5.	Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)	
6.	Implement any encryption algorithm to protect the images	
7.	Implement any image obfuscation mechanism	
8.	Implement a role-based access control mechanism in a specific scenario	
9.	Implement an attribute-based access control mechanism based on a particular scenario	
10	Develop a log monitoring system with incident management in the cloud	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the cloud concepts and fundamentals
CO2:	Explain the security challenges in the cloud.
CO3:	Define cloud policy and Identity and Access Management.
CO4:	Understand various risks and audit and monitoring mechanisms in the cloud.
CO5:	Define the various architectural and design considerations for security in the cloud.

TEXT BOOKS:	
1.	Raj Kumar Buyya , James Broberg, and rzejGoscinski, —Cloud Computing:‖, Wiley 2013
2.	Dave shackleford, —Virtualization Security‖, SYBEX a wiley Brand 2013.
3.	Mather, Kumaraswamy and Latif, —Cloud Security and Privacy‖, OREILLY 2011

REFERENCE BOOKS:	
1.	Mark C. Chu-Carroll —Code in the Cloud‖,CRC Press, 2011
2.	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

SYLLABUS OF

Vertical VIII

CREATIVE MEDIA

COURSES

191CSE016J	Augmented Reality/Virtual Reality	Periods per week				Credits
		L	T	P	C	
		2	0	2	3	3

COURSE OBJECTIVES:	
1.	To impart the fundamental aspects and principles of AR/VR technologies.
2.	To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
3.	To learn about the graphical processing units and their architectures.
4.	To gain knowledge about AR/VR application development.
5.	To know the technologies involved in the development of AR/VR based applications.

UNIT	TITLE	PERIODS
I	INTRODUCTION	7

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies- Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT	TITLE	PERIODS
II	VR MODELING	6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management

UNIT	TITLE	PERIODS
III	VR PROGRAMMING	6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.

UNIT	TITLE	PERIODS
IV	APPLICATIONS	6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society- Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications -

Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education

UNIT	TITLE	PERIODS
V	AUGMENTED REALITY	5
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices		

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.	
2.	Use the primitive objects and apply various projection types by handling camera.	
3.	Download objects from asset store and apply various lighting and shading effects.	
4.	Model three dimensional objects using various modelling techniques and apply textures over them.	
5.	Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.	
6.	Add audio and text special effects to the developed application.	
7.	Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.	
8.	Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.	
9.	Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.	
10.	Develop simple MR enabled gaming applications.	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1:	Understand the basic concepts of AR and VR
CO2:	Understand the tools and technologies related to AR/VR
CO3:	Know the working principle of AR/VR related Sensor devices
CO4:	Design of various models using modeling techniques
CO5:	Develop AR/VR applications in different domains

TEXT BOOKS:	
1.	Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2.	Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016
3.	John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4.	William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003

191ITE027J	MULTIMEDIA AND ANIMATION	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To grasp the fundamental knowledge of Multimedia elements and systems
2.	To get familiar with Multimedia file formats and standards
3.	To learn the process of Authoring multimedia presentations
4.	To learn the techniques of animation in 2D and 3D and for the mobile UI
5.	To explore different popular applications of multimedia

UNIT	TITLE	PERIODS
I	INTRODUCTION TO MULTIMEDIA	6
Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing.Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning		
UNIT	TITLE	PERIODS
II	MULTIMEDIA FILE FORMATS AND STANDARDS	6
File formats – Text, Image file formats, Graphic and animation file formats, Digital audio andVideo file formats, Color in image and video, Color Models. Multimedia data and file formats forthe web.		
UNIT	TITLE	PERIODS
III	MULTIMEDIA AUTHORING	6
Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon andObject Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual Learning ,simulations.		
UNIT	TITLE	PERIODS
IV	ANIMATION	7
Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D,2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.		

UNIT	TITLE	PERIODS
V	**MULTIMEDIA APPLICATIONS**	5
Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries.		

	30 PERIODS

PRACTICAL EXCERCISE	**30 PERIODS**
1.	Working with Image Editing tools: Install tools like GIMP/ InkScape / Krita / Pencil and perform editing operations: • Usedifferent selection and transform tools to modify or improve an image • Create logos and banners for home pages of websites
2.	Working with Audio Editing tools: • Install tools like, Audacity / Ardour for audio editing, sound mixing and special effects like fade- in or fade-out etc., • Perform audio compression by choosing a proper codec
3.	Working with Video Editing and conversion tools: Install tools like OpenShot / Cinelerra / HandBrake for editing video content. • Edit and mix video content, remove noise, create special effects, add captions. • Compress and convert video file format to other popular formats.
4.	Working with web/mobile authoring tools: Adapt / KompoZer/ BlueGriffon / BlueFish / Aptana Studio/ NetBeans / WordPress /Expression Web: • Design simple Home page with banners, logos, tables quick links etc • Provide a search interface and simple navigation from the home page to the insidepages of the website. • Design Responsive web pages for use on both web and mobile interfaces
5.	Working with Animation tools: Install tools like, Krita, Wick Editor, Blender: • Perform a simple 2D animation withsprites • Perform simple 3D animation with keyframes, kinematics • Working with Mobile UI animation tools: Origami studio / Lottie / Framer etc.,
6.	Working with E-Learning authoring tools: Install tools like EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache, VideoLAN: • Demonstrate screen recording and further editing for e-learning content. • Create a simple E-Learning module for a topic of your choice
7.	Creating VR and AR applications: • Any affordable VR viewer like Google Cardboard and any development platform like Openspace 3D / ARCore etc. Note: all tools listed are open source. Usage of any proprietary tools in place of open source tools is not restricted.
	TOTAL: 60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Get the bigger picture of the context of Multimedia and its applications
CO2:	Use the different types of media elements of different formats on content pages
CO3:	Author 2D and 3D creative and interactive presentations for different target multimediaapplications
CO4:	Use different standard animation techniques for 2D, 21/2 D, 3D applications
CO5:	Understand the complexity of multimedia applications in the context ofcloud, security,bigdata streaming, social networking, CBIR etc.,

TEXT BOOKS:	
1.	Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)

REFERENCE BOOKS:	
1.	John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016
2.	Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press,2018.
3.	Prabhat K.Andleigh, Kiran Thakrar, "Multimedia System Design", Pearson Education, 1st Edition, 2015.
4.	Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", SpringerNature, 1st Edition, 2021.
5.	Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
6.	Rogers David, "Animation: Master – A Complete Guide (GraphicsSeries)", Charles RiverMedia, 2006.
7.	Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rd Edition, 2012.
8.	Emilio Rodriguez Martinez, Mireia Alegre Ruiz, "UI Animations with Lottie and After Effects: Create, render, and ship stunning After Effects animations natively on mobile with React Native", Packt Publishing, 2022.

191AIE038J	VIDEO CREATION AND EDITING	Periods perweek				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To introduce the broad perspective of linear and nonlinear editing concepts
2.	To understand the concept of Storytelling styles.
3.	To be familiar with audio and video recording. To apply different media tools.
4.	To learn and understand the concepts of AVID XPRESS DV 4.

UNIT	TITLE	PERIODS
I	FUNDAMENTALS	6
Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.		

UNIT	TITLE	PERIODS
II	STORYTELLING	6
Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management.		

UNIT	TITLE	PERIODS
III	USING AUDIO AND VIDEO	6
Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs.		

UNIT	TITLE	PERIODS
IV	WORKING WITH FINAL CUT PRO	6
Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio - Using Media Tools - Viewing and Setting Preferences.		

UNIT	TITLE	PERIODS
V	**WORKING WITH AVID XPRESS DV 4**	6
Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.		
		30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Write a Movie Synopsis (Individual/Team Writing)	
2.	Present team stories in class.	
3.	Script/Storyboard Writing(Individual Assignment)	
4.	Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements	
5.	Production: Single camera production personnel & equipment, Documentary Production	
6.	Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching	
7.	Write Documentary & Animation Treatment	
8.	Post-production: Editing, Sound design, Finishing	
	TOTAL:	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Compare the strengths and limitations of Nonlinear editing.
CO2:	Identify the infrastructure and significance of storytelling.
CO3:	Apply suitable methods for recording to CDs and VCDs.
CO4:	Address the core issues of advanced editing and training techniques.
CO5:	Design and develop projects using AVID XPRESS DV 4.

TEXT BOOKS:	
1.	Avid Xpress DV 4 User Guide, 2007.
2.	Final Cut Pro 6 User Manual, 2004.
3.	Keith Underdahl, “Digital Video for Dummies”, Third Edition, Dummy Series, 2001.
4.	Robert M. Goodman and Partick McGarth, “Editing Digital Video: The Complete Creative and Technical Guide”, Digital Video and Audio, McGraw – Hill 2003.

191CSE042J	UI AND UX DESIGN	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:

NIL

COURSE OBJECTIVES:

1.	To provide a sound knowledge in UI & UX
2.	To understand the need for UI and UX
3.	To understand the various Research Methods used in Design
4.	To explore the various Tools used in UI & UX
5.	Creating a wireframe and prototype

UNIT	TITLE	PERIODS
I	FOUNDATIONS OF DESIGN	6

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT	TITLE	PERIODS
II	FOUNDATIONS OF UI DESIGN	6

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles —Branding - Style Guides

UNIT	TITLE	PERIODS
III	FOUNDATIONS OF UX DESIGN	5

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT	TITLE	PERIODS
IV	WIREFRAMING, PROTOTYPING AND TESTING	7

Sketching Principles - Sketching Red Routes - Responsive Design — Wire framing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools- Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT	TITLE	PERIODS
V	RESEARCH, DESIGNING, IDEATING, & INFORMATIONARCHITECTURE	6

Identifying and Writing Problem Statements - Identifying Appropriate ResearchMethods – Creating Personas - Solution Ideation - Creating User Stories – Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.

	30 PERIODS

PRACTICAL EXCERCISE		30 PERIODS
1.	Designing a Responsive layout for an societal application	
2.	Exploring various UI Interaction Patterns	
3.	Developing an interface with proper UI Style Guides	
4.	Developing Wireflow diagram for application using open source software	
5.	Exploring various open source collaborative interface Platform	
6.	Hands on Design Thinking Process for a new product	
7.	Brainstorming feature for proposed product	
8.	Defining the Look and Feel of the new Project	
9.	Create a Sample Pattern Library for that product (Mood board, Fonts,Colors based on UI principles)	
10.	Identify a customer problem to solve	
11.	Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping	
12.	Sketch, design with popular tool and build a prototype and performusability testing and identify improvements	
	TOTAL	60 PERIODS

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Build UI for user Applications
CO2:	Evaluate UX design of any product or application
CO3:	Demonstrate UX Skills in product development
CO4:	Implement Sketching principles
CO5:	Create Wireframe and Prototype

TEXT BOOKS:	
1.	Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2.	Jon Yablonski, “Laws of UX using Psychology to Design BetterProduct & Services” O’Reilly2021

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

191ITE047J	DIGITAL MARKETING	Periods per week				Credits
		L	T	P	R	
		2	**0**	**2**	**0**	**3**

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
2.	It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

UNIT	TITLE	PERIODS
I	**INTRODUCTION TO ONLINE MARKET**	**6**
Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.		
UNIT	**TITLE**	**PERIODS**
II	**SEARCH ENGINE OPTIMISATION**	**6**
Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On- Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement.		
UNIT	**TITLE**	**PERIODS**
III	**E- MAIL MARKETING**	**6**
Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting.		
UNIT	**TITLE**	**PERIODS**
IV	**SOCIAL MEDIA MARKETING**	**6**
Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.		
UNIT	**TITLE**	**PERIODS**
V	**DIGITAL TRANSFORMATION**	**6**

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.	
	30 PERIODS

PRACTICAL EXCERCISE		**30 PERIODS**
1.	Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments.	
2.	Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool.	
3.	Demonstrate how to use the Google WebMasters Indexing API	
4.	Discuss an interesting case study regarding how an insurance company manages leads.	
5.	Discuss negative and positive impacts and ethical implications of using social media for political advertising.	
6.	Discuss how Predictive analytics is impacting marketing automation	
	TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	To examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
CO2:	To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured
CO3:	To know the key elements of a digital marketing strategy..
CO4:	To study how the effectiveness of a digital marketing campaign can be measured
CO5:	To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

TEXT BOOKS:	
1.	Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education.
2.	First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
3.	Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN- 10: 0199455449.

4.	Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
5.	Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.
6.	Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.
7.	Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education.

191AIE068J	MULTIMEDIA DATA COMPRESSION AND STORAGE	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To understand the basics of compression techniques
2.	To understand the categories of compression for text, image and video
3.	To explore the modalities of text, image and video compression algorithms
4.	To know about basics of consistency of data availability in storage devices
5.	To understand the concepts of data streaming services

UNIT	TITLE	PERIODS
I	**BASICS OF DATA COMPRESSION**	6
Introduction —Lossless and LossyCompression– Basics of Huffmann coding- Arithmetic coding- Dictionary techniques- Context based compression – Applications.		
UNIT	**TITLE**	**PERIODS**
II	**IMAGE COMPRESSION**	6
Lossless Image compression – JPEG-CALIC-JPEG LS-Prediction using conditional averages – Progressive Image Transmission – Lossless Image compression formats – Applications - Facsimile encoding.		
UNIT	**TITLE**	**PERIODS**
III	**VIDEO COMPRESSION**	6
Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1- MPEG-2- H.263.		
UNIT	**TITLE**	**PERIODS**
IV	**DATA PLACEMENT ON DISKS**	6
Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storage system – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system		
UNIT	**TITLE**	**PERIODS**
V	**DISK SCHEDULING METHODS**	6
Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams.		
		30 PERIODS

PRACTICAL EXERCISES	30 PERIODS
1. Construct Huffman codes for given symbol probabilities.	
2. Encode run lengths with fixed-length code.	
3. Lempel-Ziv algorithm for adaptive variable-length encoding	
4. Compress the given word using arithmetic coding based on the frequency of the letters.	
5. Write a shell script, which converts all images in the current directory in JPEG.	
6. Write a program to split images from a video without using any primitives.	
7. Create a photo album of a trip by applying appropriate image dimensions and format.	
8. Write the code for identifying the popularity of content retrieval from media server.	
9. Write the code for ensuring data availability in disks using strip based method.	
10. Program for scheduling requests for data streams.	
TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Understand the basics of text, Image and Video compression.
CO2:	Understand the various compression algorithms for multimedia content.
CO3:	Explore the applications of various compression techniques.
CO4:	Explore knowledge on multimedia storage on disks.
CO5:	Understand scheduling methods for request streams.

TEXT BOOKS:	
1.	Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition.
2.	Philip K.C.Tse, Multimedia Information Storage and Retrieval: Techniques and Technologies, 2008.

REFERENCE BOOKS:	
1.	David Salomon, A concise introduction to data compression, 2008.
2.	Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series, 2017.
3.	Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor& Francis,2019.
4.	Irina Bocharova, Compression for Multimedia, Cambridge University Press; 1st edition, 2009.

191CSE076J	GAME DEVELOPMENT	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

COURSE OBJECTIVES:	
1.	To know the basics of 2D and 3D graphics for game development.
2.	To know the stages of game development.
3.	To understand the basics of a game engine.
4.	To survey the gaming development environment and tool kits.
5.	To learn and develop simple games using Pygame environment

UNIT	TITLE	PERIODS
I	**3D GRAPHICS FOR GAME DESIGN**	6
Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.		
UNIT	**TITLE**	**PERIODS**
II	**GAME DESIGN PRINCIPLES**	6
Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.		
UNIT	**TITLE**	**PERIODS**
III	**GAME ENGINE DESIGN**	6
Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.		
UNIT	**TITLE**	**PERIODS**
IV	**OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS**	6
Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.		
UNIT	**TITLE**	**PERIODS**
V	**GAME DEVELOPMENT USING PYGAME**	6
Developing 2D and 3D interactive games using Pygame - Avatar Creation - 2D and 3D Graphics Programming - Incorporating music and sound - Asset Creations - Game Physics algorithms Development - Device Handling in Pygame - Overview of Isometric and Tile Based arcade Games - Puzzle Games.		
		30 PERIODS

PRACTICAL EXERCISES	30 PERIODS
1. Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game.	
2. Character design, sprites, movement and character control	
3. Level design: design of the world in the form of tiles along with interactive and collectible objects.	
4. Design of interaction between the player and the world, optionally using the physics engine.	
5. Developing a 2D interactive using Pygame	
6. Developing a Puzzle game	
7. Design of menus and user interaction in mobile platforms.	
8. Developing a 3D Game using Unreal	
9. Developing a Multiplayer game using unity	
TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Explain the concepts of 2D and 3d Graphics
CO2:	Design game design documents.
CO3:	Implementation of gaming engines.
CO4:	Survey gaming environments and frameworks.
CO5:	Implement a simple game in Pygame.

REFERENCE BOOKS:	
1.	Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley,2013.
2.	Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress,2007.
3.	Paul Craven, “Python Arcade games”, Apress Publishers,2016.
4.	David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press,2006.
5.	Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.

191AIE088J	GAME THEORY	Periods per week				Credits
		L	T	P	R	
		2	0	2	0	3

PREREQUISITES:
NIL

COURSE OBJECTIVES:	
1.	To introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets.
2.	To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in 41odeIling applications.
3.	To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.
4.	To introduce contemporary topics in the intersection of game theory, computer science, and economics.
5.	To apply game theory in searching, auctioning and trading.

UNIT	TITLE	PERIODS
I	**INTRODUCTION**	6
Introduction — Making rational choices: basics of Games — strategy — preferences — payoffs — Mathematical basics — Game theory — Rational Choice — Basic solution concepts-non- cooperative versus cooperative games — Basic computational issues — finding equilibria and learning in games- Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets)		

UNIT	TITLE	PERIODS
II	**GAMES WITH PERFECT INFORMATION**	6
Games with Perfect Information — Strategic games — prisoner's dilemma, matching pennies - Nash equilibria —mixed strategy equilibrium — zero-sum games.		

UNIT	TITLE	PERIODS
III	**GAMES WITH IMPERFECT INFORMATION**	6
Games with Imperfect Information — Bayesian Games — Motivational Examples — General Definitions — Information aspects — Illustrations — Extensive Games with Imperfect — Information— Strategies — Nash Equilibrium —Repeated Games — The Prisoner's Dilemma — Bargaining		

UNIT	TITLE	PERIODS
IV	**NON-COOPERATIVE GAME THEORY**	6

Non-cooperative Game Theory — Self-interested agents — Games in normal form — Analyzing games: from optimality to equilibrium — Computing Solution Concepts of Normal — Form Games-Computing Nash equilibria of two-player, zero-sum games —Computing Nash equilibria of two- player, general- sum games — Identifying dominated strategies

UNIT	TITLE	PERIODS
V	**MECHANISM DESIGN**	6

Aggregating Preferences — Social Choice — Formal Model — Voting — Existence of social functions- Ranking systems — Protocols for Strategic Agents: Mechanism Design — Mechanism design with unrestricted preferences.

30 PERIODS

PRACTICAL EXCERCISE	**30 PERIODS**
1.	Prisoner's dilemma
2.	Pure Strategy Nash Equilibrium
3.	Extensive Form – Graphs and Trees, Game Trees
4.	Strategic Form – Elimination of dominant strategy
5.	Minimax theorem, minimax strategies
6.	Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium,
7.	Imperfect-information games - Mixed Strategy Nash Equilibrium - Finding mixed-strategy Nash equilibria for zero sum games, mixed versus behavioral strategies.
8.	Repeated Games
9.	Bayesian Nash equilibrium
TOTAL	**60 PERIODS**

COURSE OUTCOMES:	
Upon completion of this course, student will be able to:	
CO1:	Discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.
CO2:	Discuss the use of Nash Equilibrium for other problems.
CO3:	Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.
CO4:	Identify some applications that need aspects of Bayesian Games.
CO5:	Implement a typical Virtual Business scenario using Game theory.

TEXT BOOKS:	
1.	M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.

2.	M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
3.	N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2007.
4.	A.Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.
5.	YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008.
6.	Zhu Han, DusitNiyato, WalidSaad, TamerBasar and Are Hjorungnes, “Game Theory in Wireless and Communication Networks”, Cambridge University Press, 2012.
7.	Y.Narahari, “Game Theory and Mechanism Design”, IISC Press, World Scientific.
8.	William Spaniel, “Game Theory 101: The Complete Textbook”, CreateSpace Independent Publishing, 2011.