PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637018 (AUTONOMOUS) REGULATIONS 2023 CHOICE BASED CREDIT SYSTEM B.E. CSE – INTERNET OF THINGS CURRICULUM

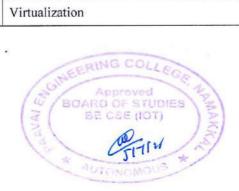
(Applicable to the candidates admitted during the academic year 2023-2024 onwards)

SEMESTER V

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	BA23151	Entrepreneurship Development	3	0	0	3
2	PC	CI23501	Theory of Computation	3	1	0	4
3	PC	CI23502	Embedded Systems with IOT	3	0	0	3
4	PC	CI23503	Computer Networks	3	0	0	3
5	PC	CI23504	Design and Analysis of Algorithms	3	0	0	3
6	PE	CI23***	Professional Elective – I	3	0	0	3
Practic	al						
7	PC	CI23505	Embedded Systems with IOT Laboratory	0	0	2	1
8	PC	CI23506	Computer Networks Laboratory	0	0	4	2
9	EE	CI23507	Industrial Training	0	0	2	1
10	EE	GE23501	Professional Development III	0	0	2	1
			Total	18	1	10	24

VERTICAL SYLLABUS LIST

S. No	Subject Code	Name of the Subject	L	Т	P	C
		VERTICAL - I				
1	CI23151	Foundations of Data Science	3	0	0	3
2	CI23152	Image and Video Analytics	3	0	0	3
3	CI23153	Neural Networks	3	0	0	3
4	CI23154	Blockchain Technology	3	0	0	3
5	CI23155	Knowledge Engineering	3	0	0	3
6	CI23156	Data Visualization	3	0	0	3
7	CI23157	Big Data Analytics	2	0	2	3
		VERTICAL - II				
1	CI23251	Mobile Application Development for IoT	2	0	2	3
2	CI23252	Principles of Programming Languages	3	0	0	3
3	CI23253	Programming Languages for IoT	3	0	0	3
4	CI23254	Web Technologies	3	0	0	3
5	CI23255	R Programming	3	0	0	3
6	CI23256	Software Testing and Automation	2	0	2	3
7	CI23257	DevOps	3	0	0	3
		VERTICAL - III				
1	CI23351	Data Warehousing and Data Mining	3	0	0	3
2	CI23352	Edge Computing	3	0	0	3
3	CI23353	Cloud Services Management	3	0	0	3
4	C123354	Storage Technologies	3	0	0	3
5	CI23355	IoT Platforms and System Design	3	0	0	3
6	CI23356	Software Defined Networks	3	0	0	3
7	CI23357	Virtualization	3	0	0	3



S. No	Subject Code	Name of the Subject	L	Т	P	c
		VERTICAL - IV				_
1	CI23451	Cryptography and Network Security	3	0	0	3
2	CI23452	Mobile Ad Hoc Networks	3	0	0	3
3	CI23453	Network Security	3	0	0	3
4	CI23454	Cyber Security	3	0	0	3
5	CI23455	Privacy and Security in IOT	3	0	0	3
6	CI23456	Ethical Hacking	3	0	0	3
7	CI23457	Digital and Mobile Forensics	3	0	0	3
		VERTICAL - V				
1	CI23551	IoT Device Programming	3	0	0	3
2	CI23552	Service Oriented Architecture	3	0	0	3
3	CI23553	UI and UX Design	3	0	0	3
4	CI23554	3D Design Principles and Patterns	3	0	0	3
5	CI23555	Cloud Computing	3	0	0	3
6	CI23556	Architecting Smart IoT Devices	3	0	0	3
7	CI23557	Dynamic Paradigm in IoT	3	0	0	3
		VERTICAL - VI				
1	CI23651	IoT Automation	3	0	0	3
2	CI23652	Virtual Reality and Augmented Reality	3	0	0	3
3	CI23653	Fog and Edge Computing	3	0	0	3
4	CI23654	Deep Learning	3	0	0	3
5	CI23655	Machine Learning Techniques	3	0	0	3
6	CI23656	Natural Language Processing	3	0	0	3
7	CI23657	Social Network Security	3	0	0	3



DAZSI	ENTREPRENEURSHIP DEVELOPMENT	3 0 0	3
COUR	RSE OBJECTIVES		
To ena	nable the students to		
1	empower to adopt the management principles		
2	build entrepreneurial competencies and analyze support from gover entrepreneurship development.	nment and agencie	s in
3	appraise factors for launching a small business		
4	adopt business opportunities and prepare feasibility reports.		-
5	develop entrepreneurial mindset, creativity, and understand startup ecos	evetems	-
UNIT			9
	agement: Meaning, Definition, Nature and Importance, Roles - Leve		
Develo	tional areas of Management: Marketing, Finance, Production, HRM elopment. Introduction to Entrepreneurship and Intrapreneurship – sims of entrepreneurs - Functions of an entrepreneur		
UNIT	T II ENTREPRENEURIAL COMPETENCE AND ENVIRON	MENT	9
Entre	repreneurial Competence: Definitions, Roles, Styles, Characteristics, Con		t for
Entre _l Entre _l small e		Institutional Suppor	
Entre Entre small of Skillse UNIT	repreneurial Competence: Definitions, Roles, Styles, Characteristics, Competencerial Environment: Socio-cultural, Economic, Political factors; It entrepreneurs. Central and State Government Industrial Policies and Regulate: motivation, stress, ethical challenges TIII ENTREPRENEURIAL DEVELOPMENT AND STRUCTURES Structures: Proprietorship, Partnership, Company, Cooperative	Institutional Suppor lations - Entreprene URES e, Franchise. Busi	urial 9 ness
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Entreport Entrep	repreneurial Competence: Definitions, Roles, Styles, Characteristics, Consepreneurial Environment: Socio-cultural, Economic, Political factors; In entrepreneurs. Central and State Government Industrial Policies and Regulate: motivation, stress, ethical challenges TIII ENTREPRENEURIAL DEVELOPMENT AND STRUCTURES Proprietorship, Partnership, Company, Cooperative ortunity Identification, Feasibility Report, Financial & Technical Evaluation Programs, Role of SSI, Failure Causes and Turnaround Strategies Chinking Hats, Idea validation, Lean Canvas model. TIV BUSINESS PLAN AND FUNDING STRATEGIES The service of the ser	Institutional Supportations - Entreprene URES e, Franchise. Busilluation. Entreprene s. Creativity technical sibility Study - A capital funding, furting - Pitching, functions.	ness urial ques:
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At the end of this course, students will be able to	BT Mapped (Highest Level)
COI implement the necessary managerial skills to become an entrepreneur	Applying (K3)
CO2 develop self-employment having been exposed to entrepreneurial environment.	Synthesis (K5)
cos select a best business idea by using appropriate methods to assess its viability	Knowledge(K1)
formulate a business plan and deploy the resources for sustainable growth	Synthesis (K5)
analyze government support systems and startup ecosystem resources like incubators and funding options	Analyzing (K4)

- Entrepreneurship: Theory, Process, and Practice By Donald F. Kuratko
 11th Edition, 2021, Cengage Learning
- Entrepreneurship Development: New Venture Creation By S.S. Khanka 6th Edition, 2021, S. Chand Publishing

REFERENCE BOOKS

- 1. Entrepreneurship Development, by Sharma Sangeeta Second Edition, 2020, PHI Learning
- 2. Entrepreneurship by Rajeev Roy Second Edition, 2011, Oxford University Press
- 3. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, By Steve Blank and Bob Dorf, 2020 Edition
- 4. Entrepreneurship: Starting and Operating A Small Business, By Steve Mariotti and Caroline Glackin, 7th Edition, 2021, Pearson

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

			Programme	Outcomes(Pe	Os)	
CO's	PO1	PO2	PO3	PO4	PO5	PO6
CO1		1	-	1	•	_
CO2	-	-	-	•	1	2
CO3	-	-	-	1		1
CO4	-	•	2	-	2	<u>-</u>
CO5	1		1	-	. 2	_



CI	23501		THEORY OF COMPUTATION		3	1	0	4
cou	RSE OF	BJECTIVES						1
i o er	nable the	students to						-
1,	learn t	he concepts of fin	te automata with its types and constructi	on.		-		
2.			ages, finite automata, and their theoretical		ıs.	-		
3.			nars, derivation techniques, and normal f			uage t	heory	
4.		stand the design ar	d operation of pushdown automata and					
5.	learn a	bout Turing mach	nes, decidable and undecidable problem	s.				
UNIT	LI I	NTRODUCTION	TO AUTOMATA				-	12
Need	for auto	mata theory - Int	roduction to formal proof - Finite Au	tomata (FA)	- Dete	ermini	istic F	inite
Autor	nata (DF	FA) — Non-determ om NFA to DFA.	inistic Finite Automata (NFA) – Equi	valence bety	ween N	FA aı	nd DF	Ά -
UNIT	II F	REGULAR EXPR	ESSIONS AND LANGUAGES		7			12
Regul	ar expres	sion – Regular La	nguages- Equivalence of Finite Automat	a and regula	r expres	sions	- Pro	ving
langua	ages to be	e not regular (Pum	ping Lemma) - Closure properties of reg	ular languag	es			,
UNIT	III C	CONTEXT FREE	GRAMMAR			-		12
Conte	xt-Free (Grammar (CFG) -	Defintions - Derivations and Parse tr	ees – Ambi	guity in	gran	nnars	
langua	ages - Cl	nomsky Normal Fo	rm (CNF) – Pumping lemma for CFL –	Closure pro	nerties	of Co	ntext	Free
Langu					F	01 00	1110711	
UNIT	IV P	USH DOWN AU	ГОМАТА					12
Push]	Down A	utomata (PDA): I	efinition - Moves - Instantaneous des	criptions -La	anguage	s of i	pushd	
autom	ata – Ec	quivalence of pusi	ndown automata and CFG-Conversion	of CFG to	PDAP	DA t	o CF	G -
		ushdown Automat						M(2)
UNIT	V T	URING MACHIN	NES AND UNDECIDABILITY				T	12
Turing	Machin	e: Basic model -	Language acceptance by TM - Univer	sal Turing	Machine	e – U	nsolv	
			Problem(PCP) – Tractable and Intractable					
		problems.		•			-preces	i Coo
				то	TAL P	ERIO	DS	60
COUR	RSE OUT	COMES						
		is course, students	1-2		(High		evel)	
CO1			or a given language with its types.		Appl	ying (K3)	
CO2	prove the expression		nguages described by finite automata and	l regular	Appl	ying (K3)	
CO3	construction form.	ct CFG for a give	n language, simplify and transform to a	normal	Appl	ying (K3)	
CO4	design p	oush down automa	a, convert into CFG and vice-versa.		Appl	ying (K3)	
					-rr	-6(

CO5 construct Turing machine and prove the undecidability or complexity of a variety of problems.

Applying (K3)

TEXT BOOKS

- Hopcroft J.E., Motwani R. & Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2008.
- John C Martin, "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw Hill, 2011.

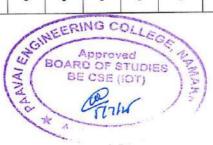
REFERENCES

- Harry R Lewis and Christos H Papadimitriou, "Elements of the Theory of Computation", 2nd
 Edition, Prentice Hall of India, 2015.
- Peter Linz, "An Introduction to Formal Language and Automata", 6th Edition, Jones & Bartlett, 2016. K.L.P.Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata Languages and Computation", 3rd Edition, Prentice Hall of India, 2006.
- H.R.Lewis and C.H.Papadimitriou, Elements of the theory of Computation, Second Edition, PHI, 2003.
- 4. Deepak D' Souza, Priti Shankar, "Modern Applications of Automata Theory", IISc Press, 2012.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

					Progr	amme	Outco	mes P(O's				PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	2	-	-	2	=	-	1	1	3	3
CO2	2	2	2	2	2		:=:	-	-	(#)	1	1	3	2
CO3	3	2	3	3	3	-	-	-			1	1	2	3
CO4	2	3	2	2	2	-	-	-	-	-	1	1	3	3
CO5	3	3	3	3	3	-		-	•	-	1	1	2	2



	02		EMB	EDDED) SYST	EMS W	ТТН ІО	Т		3	0	0	3
COUR OBJE	RSE CTIVE	s											
To ena	ble the	students to											
1.	know	the basic conc	ept and	compon	nents of	embedde	ed syster	ns.					-
2.	unders	tand the desig	gn of em	bedded	systems	ŝ.			-				
3,	recogn	ize the function	ons of r	eal-time	operati	ng syster	ns.	- 50					-
4.	learn t	he architectur	e and de	esign flo	w of Io	T.							
5.	build a	in IoT based s	system.										
UNIT	I J	NTRODUCT	TION T	О ЕМВ	BEDDE	D SYST	EMS				11575		9
Introdu	uction -	Classification	of an e	mbedde	d system	m -Major	r applica	tion area	s of en	bedded	syste	ms -Pı	irpose
		Systems - Gen											
		System - Men		· ************************************									
		sive compone										•	
UNIT	•	DESIGN OF		DDED S	SYSTE	MS				,			(
CAR DEVICE NEED		ctuators - mo					ommon	sensors:	Embed	ded Pro	ocesso	rs -Tv	nes o
		rallelism; Me											
•		ut hardware -								•			
UNIT		OPERATING					200						-
	100	71 131 W 11 11 1				SEDDEL	10101						
Funda	mentals	of Real Time	e Onera						es of	operatir	g syst	ems:	Tasks
		of Real Time		ting Sys	stem (R	TOS) –	The Ke	rnel, Typ					
Proces	s and T	Threads: Mult	tiproces	ting Sys	stem (R d Multi	TOS) – tasking •	The Ke	rnel, Typ					
Proces synchr	s and T	Threads: Mult on - Device dr	tiproces rivers - I	ating Sys sing and How to c	stem (R d Multi choose a	TOS) – tasking - m RTOS.	The Ke - Task	rnel, Typ schedulin					-Tasl
Proces synchr UNIT	s and Tonization	Threads: Multon - Device dri	tiproces ivers - I ORK AI	ating Syssing and How to c	stem (R d Multi choose a	TOS) – tasking – an RTOS. RE AND	The Ke - Task s . DESIG	rnel, Typschedulin	g - Ta	isk com	nmunic	cation	-Tasi
Proces synchr UNIT Driver	ronization IV 1	Threads: Multion - Device dragon of NETWO dragon network	tiproces rivers - I ORK AI k Archit	ating Syssing and How to c	stem (R d Multi choose a ECTUR	tasking - tasking - nn RTOS. RE AND	The Ke - Task s . DESIG	rnel, Typ schedulin N network	g - Ta	paring	imunic	cation	-Tasl
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Proces synchr UNIT Driver the one Archite	onization on onization on	Threads: Multion - Device drawn - De	tiproces rivers - I ORK AI k Archit zed Arch ta manag	ating Syssing and How to contecture, Contecture, Germent and EMS W	stem (R d Multi choose a ECTUR Constra , IoT W and Con	tasking - taskin	The Ke - Task s - DESIG ices and um (IoT ick.	network: WF) stan	g - Ta	paring ed Arch	IoT Aritectur	rehitece, simp	-Task
Proces synchr UNIT Driver the one Archite UNIT Case S	ronization IV I I I I I I I I I I I I I I I I I I	Threads: Multion - Device drawn - De	DRK AI k Archited Archited manager D SYST	ating Syssing and How to contecture, Conte	stem (R d Multi choose a ECTUR Constra , IoT W and Con ITH IC	tasking - taskin	The Ke - Task s - Tas	network WF) stan	s, Comdardize	paring ed Arch	IoT Anitectur	rehitece, simp	-Tasl
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CO5	design an IoT based system for any application.	Applying (K3)
TEXT	BOOKS	
I.	Shibu K.V, "Introduction to Embedded Systems", Second Edition, Me G	raw Hill, 2017.
2.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Ba	arton, Jerome Henry,"IoT
	Fundamentals: Networking Technologies, Protocols, and Use Cases for the	4

REFERENCES

Press, 2017.

- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
- 2. Steve Ferbur, "ARM System on Chip", 2nd Edition, Pearson, 2017.
- 3. Raj Kamal, "Embedded Systems", Tata McGraw Hill, 4th Edition, 2020.
- Dr. Ovidin Vermesan, Dr. Peter Fress, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publisher, 2013.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

					Progra	amme (Outcor	nes PO	's				PSC)'s
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-		2	1	-	-	2	1	3	2
CO2	3	2	1	-	-	-	2	-	-		2	1	3	2
CO3	3	2	2	-	2	-	2	-	-	-	2	2	3	2
CO4	3	3	2	2	2	-	-	(+)		4		3	3	2
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	2



CI23:	503	COMPUTER NETWORKS 3	0	0	3
COU	RSE OB	SJECTIVES			
To en	able the	students to			
1.	perion	uce the foundational concepts of the computer network, structure, switchi			
2.	explor specifi	e the design and operation of application-layer protocols and network application condels.	ons incl	uding	IoT
3.	study t	he principles, protocols, and services of the transport layer, focusing on reliabili	ty and	conge	stio
4.	unders algorit	tand the functions and components of the network layer including IP add	dressin	g, rot	itin
5.	describ	be the link layer functionalities, LAN technologies, wireless networks, network stivity options.	securit	y, and	Io'
UNIT	I I	NTRODUCTION TO COMPUTER NETWORKS			
Compu		vorks and the Internet - definition, services and protocols - uses of networks, ty			
types o	of topolog	gy - Network edge - Access networks, Physical media – Network core - Packet s	pes of	netwo	orks
switchi	ing. Nety	work of networks - Delay, loss and throughput in packet-switched networks - I	witchin	ng, Cii	cui
A nobite		The Performance Manager of the Performance Manag	Protoco	ol Laye	ere
Alchie	echire -				
		The Reference Models: OSI and TCP/IP reference Model.			
UNIT Princip Protoco	II A bles of ne	PPLICATION LAYER etwork applications – Client-server and peer-to-peer models – Web and HTTF – Electronic Mail – Domain Name System (DNS) – Video streaming and conte	ent dist	ributio	sfer
UNIT Princip Protoco Socket CoAP.	II A ples of ne ples of ne program	PPLICATION LAYER etwork applications – Client-server and peer-to-peer models – Web and HTTF – Electronic Mail – Domain Name System (DNS) – Video streaming and conte ming: Creating Network applications - Case Study: IoT-focused application pre	ent dist	ributio	sfer
Princip Protoco Socket CoAP.	II A bles of ne bl (FTP) program	PPLICATION LAYER etwork applications – Client-server and peer-to-peer models – Web and HTTF – Electronic Mail – Domain Name System (DNS) – Video streaming and conte ming: Creating Network applications - Case Study: IoT-focused application pro	ent dist	ributio	sfer on -
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UNIT Princip Protoco Socket CoAP. UNIT I	II A bles of ne bl (FTP) program III TI ort layer e Data Tr	PPLICATION LAYER etwork applications – Client-server and peer-to-peer models – Web and HTTF – Electronic Mail – Domain Name System (DNS) – Video streaming and conte ming: Creating Network applications - Case Study: IoT-focused application pre	ent distrotocols P - Pri	inciple	sfer
Princip Protoco Socket CoAP. UNIT I Transpo Reliable ssues in	II A ples of ne pl (FTP) program III TH port layer e Data Tr n IoT.	PPLICATION LAYER etwork applications – Client-server and peer-to-peer models – Web and HTTP – Electronic Mail – Domain Name System (DNS) – Video streaming and conte ming: Creating Network applications - Case Study: IoT-focused application pro RANSPORT LAYER services – Multiplexing and demultiplexing – Connectionless Transport: UDI	ent distrotocols P - Pri	inciple	sferon - TT.
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Princip Protoco Socket CoAP. UNIT I Transpo Reliable ssues ir UNIT I	II A ples of ne pl (FTP) program III TH port layer prog	etwork applications – Client-server and peer-to-peer models – Web and HTTF – Electronic Mail – Domain Name System (DNS) – Video streaming and conte ming: Creating Network applications - Case Study: IoT-focused application pro RANSPORT LAYER services – Multiplexing and demultiplexing – Connectionless Transport: UDI ransfer- Connection-Oriented Transport: TCP - TCP congestion control – Case S ETWORK LAYER de a router – Internet Protocol (IP): IPv4, Addressing, IPv6 – Generalized forwards	ent dist	inciple	9 of
Princip Protoco Socket CoAP. UNIT I Transpo Reliable ssues in UNIT I Overvie Routin	II A ples of ne pl (FTP) program III TI prt layer e Data Tr n IoT. V NE ew – Inside	etwork applications – Client-server and peer-to-peer models – Web and HTTP – Electronic Mail – Domain Name System (DNS) – Video streaming and conteming: Creating Network applications - Case Study: IoT-focused application processors of the services – Multiplexing and demultiplexing – Connectionless Transport: UDI ansfer- Connection-Oriented Transport: TCP - TCP congestion control – Case Services – Multiplexing – Connection Control – Case Services – Multiplexing – Connection Control – Case Services – Internet Protocol (IP): IPv4, Addressing, IPv6 – Generalized forwards a router – Internet Protocol (IP): IPv4, Addressing, IPv6 – Generalized forwards in the Internet: Office of the Internet of Inte	ent dist	inciple	9 of
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	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain the fundamentals of computer networks.	Understanding (K2)
CO2	use HTTP, DNS, and IoT-focused protocols MQTT and CoAP in application layer and design a top-down approach application.	Applying (K3)
CO3	analyze the mechanisms of transport protocols TCP and UDP and evaluate congestion control techniques to ensure reliable transport communication.	Analyzing (K4)
CO4	apply IP addressing, routing algorithms, and the concept of Software- Defined Networking (SDN) in the network layer.	Understanding (K2)
CO5	discuss link layer protocols, wireless technologies, and network security techniques and incorporate into IoT environments.	Understanding (K2)

- James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson Education, 2022.
- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

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- 2. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2013.
- 3. Andrew S. Tanenbaum, David J. Wetherall," Computer Networks", 5th Edition, Prentice Hall.
- James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 7th Edition, Pearson Education, 2017.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Г				Progr	amme	Outco	mes PO	O's				PS	O's
CO's	PO1	PO2	PO3	PO4						PO10	PO11	PO12	PSO1	PSO2
COI	2	2	2	-	2	-	-	-	2	-	1	1	3	3
CO2	3	2	2	2	2	1	1	-	1	2	2	1	3	2
CO3	3	3	2	2	1	1	-	-	1	-	-	1	2	3
CO4	3	3	3	2	1	1	-	2	2		127	1	3	3
COS	3	3	2	2		-	-	848	-	-		1	2	2



CI235	3504 DESIGN AND ANALYSIS OF ALGORITHMS								3	0	0				
COU	RSE O	BJECTIVES	8												
To en	able the	students to													0
1.	under	rstand the diff	ferent t	techni	iques for	r proble	em solvi	ng and	algorith	ım desig	gn.	-	5	17 10	
2.	analy	ze the import	tance o	of brut	te force	and div	ide-and-	-conqu	er techn	iques.					665
3.		dynamic pr	rogram	mming	and gr	reedy to	echnique	es to	solve co	omplex	optin	nizatio	on pr	oblen	s
4.	learn	the iterative of	design	n techn	niques ap	pplying	in real	life pro	blems.					-	-
5.	acqui	re knowledge	e of bac	acktrac	cking an	d branc	h and bo	ound to	echnique	es.					-
UNIT	I	INTRODUC	CTION	N							dis v				
-	ematical	Algorithm Ef	Recurs	rsive ar	nd Non-	Recurs	ive Algo	orithms	s – Com	puting n	nth Fi				
		Selection ar													_
and St	avelling Salesman Problem - Knapsack Problem - Assignment Problem - Depth-First and Breadth arch - Divide and Conquer: Merge sort - Quick sort - Binary tree traversals - Multiplication of Large Int d Strassen's Matrix Multiplication. NIT III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUES Anamic Programming: Knapsack Problem and Memory functions, Optimal Binary Search Tree - Wars											ge Inte	g		
UNIT Dynar	rassen' III nic Pro	s Matrix Mul	PROC napsac	ation. GRAN ack Pro	MMING	G AND	- Binary GREEI nory fun	DY TE	CHNIQ Optima	s - Multi QUES al Binary	y Sea	rch Tr	ree - N	Warsh	a
UNIT Dynar and F	III mic Progloyd's a	s Matrix Mul DYNAMIC gramming: K	PROC napsac	ation. GRAN ack Pro	MMING	G AND	- Binary GREEI nory fun	DY TE	CHNIQ Optima	s - Multi QUES al Binary	y Sea	rch Tr	ree - N	Warsh	a
UNIT Dynar and Fl Huffir UNIT	rassen' III nic Proployd's an tree	by Matrix Multiple DYNAMIC gramming: Kalgorithms - Calgorithms - Calgorithms and Codes.	PROC napsac Greedy	GRAM GRAM ack Pro y Tech PROV	MMING oblem ar nnique:	G AND ond Mem Prim's a	- Binary GREEI nory fun algorith	DY TE netions, nm - Kı	CHNIC Optima ruskal's	QUES al Binary algorith	y Seam - I	rch Tr Dijkstr	ee - Vra's a	Warsh lgoritl	a
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UNIT Dynar and Fl Huffir UNIT Iterati Graph Trees, UNIT Backtt Assign	mic Prodoyd's a nan tree IV ve Impres - The P, NP. V racking	by Matrix Multiple of the stable marria NP Complete BACKTRAC	napsac Greedy E IMP e Simp age Probl CKING roblem	PROV plex M roblems. WG AN m - Har	MMING oblem ar nnique: TEMEN' fethod - n; Limita ID BRA miltonia em - Tra	G AND and Memory Prim's a T AND The Mation of NCH And Circumvelling	GREEI nory fun algorith LIMIT aximum AND BO uit Probing Salesm	DY TE nections, am - Kn FATIO -Flow than Po DUND iem - S nan Pro	CHNIC Optima ruskal's ONS OF Problem wer - L	QUES ALGO - Maximower Boundary	y Sear m - I	HM Po Match Argum	OWI	Warsh lgoritl ER n Bipa , Deci	a
UNIT Dynar and Fl Huffir UNIT Iterati Graph Trees, UNIT Backtt Assign	mic Prodoyd's a nan tree IV ve Impres - The P, NP. V racking	by Matrix Multiple of the Stable marries NP Complete BACKTRAC in Queens problem - Kna	napsac Greedy E IMP e Simp age Probl CKING roblem	PROV plex M roblems. WG AN m - Har	MMING oblem ar nnique: TEMEN' fethod - n; Limita ID BRA miltonia em - Tra	G AND and Memory Prim's a T AND The Mation of NCH And Circumvelling	GREEI nory fun algorith LIMIT aximum AND BO uit Probing Salesm	DY TE nections, am - Kn FATIO -Flow than Po DUND iem - S nan Pro	CHNIC Optima ruskal's ONS OF Problem wer - L	QUES ALGO ALGO ALGO MIQUES Um Prob	y Sear m - I RITI mum ound S blem	HM Po Match Argum	OWI oma's a OWI ning in ments	Warsh Ilgorith ER n Bipa n Bipa nd Bo ns for	a
UNIT Dynar and Fl Huffir UNIT Iterati Graph Trees, UNIT Backtt Assign	mic Proplement problem	by Matrix Multiple Stable marria NP Complete BACKTRAC in-Queens problem - Knas: Traveling Stables Stables of the Stable marria of the Stables	napsac Greedy E IMP e Simp age Probl CKING roblem	PROV plex M roblems. WG AN m - Har	MMING oblem ar nnique: TEMEN' fethod - n; Limita ID BRA miltonia em - Tra	G AND and Memory Prim's a T AND The Mation of NCH And Circumvelling	GREEI nory fun algorith LIMIT aximum AND BO uit Probing Salesm	DY TE nections, am - Kn FATIO -Flow than Po DUND iem - S nan Pro	CHNIC Optima ruskal's ONS OF Problem wer - L	QUES ALGO ALGO ALGO MIQUES Um Prob	y Sear m - I RITI mum ound S blem	HM Po Match Argum	OWI oma's a OWI ning in ments	Warsh Ilgorith ER n Bipa n Bipa nd Bo ns for	r
UNIT Dynar and Fl Huffir UNIT Iterati Graph Trees, UNIT Backtt Assign hard F	mic Prodoyd's a nan tree IV ve Impress - The P, NP. V racking ment p	by Matrix Multiple of the Stable marries NP Complete BACKTRAC in Queens problem - Kna	PROC mapsac Greedy E IMP e Simp age Probl CKING roblem	PROV plex M roblems. NG AN m - Har k proble man pro	MMING MMING Oblem ar Inique: I EMEN Iethod - In; Limita ID BRA miltonia em - Tra oblem -	G AND and Mem Prim's a T AND The Ma ation of NCH A nn Circu avelling Knapsa	GREEI nory fun algorith LIMIT aximum AND BO uit Probing Salesm	DY TE nections, am - Kn FATIO -Flow than Po DUND iem - S nan Pro	CHNIC Optima ruskal's ONS OF Problem wer - L	QUES ALGO ALGO ALGO MIQUES Um Prob	y Sear m - I RITI mum ound S blem	HM Pe Match Argum	OWITAIN TO THE TOTAL THE T	Warsh Ilgorith ER n Bipa nd Bo ns for	a mil
UNIT Dynar and Fl Huffir UNIT Iterati Graph Trees, UNIT Backtt Assign hard F	mic Proplement problem Problement problemen	s Matrix Multiple Stand Codes. ITERATIVITY Ovement: The Stable marria NP Complete BACKTRAGE in-Queens problem - Kna s: Traveling Staveling Stavel	PROC Inapsac Greedy E IMP e Simp age Probl CKING roblem apsack Salesm	PROV plex M roblem k problem k problem m - Han k proble man pro	MMING MMING MMING Delta ar Innique: I EMEN Iethod - In; Limita ID BRA miltonia em - Tra oblem -	G AND and Mem Prim's a T AND The Ma ation of NCH And Circu avelling Knapsa	GREEI GREEI Hory fun algorith AND BO uit Probin g Salesm ack prob	DY TE netions, m - Ki FATIO -Flow thm Po DUND tem - S nan Pro blem.	CHNIC Optima ruskal's ONS OF Problem wer - L	QUES ALGO ALGO ALGO MIQUES Um Prob	y Sear y Sear m - I RITI mum ound S blem matio	HM Pe Match Argum	OWIning in ments or ithm	Warsh lgoritl ER n Bipa nd Bo ns for DDS	all nir

CO3	make use of dynamic programming and greedy techniques to solve overlap or sub problems.	Applying (K3)
CO4	illustrate the real-life problems solving by iterative design techniques.	Understanding (K2)
CO5	solve difficult combinatorial problems with backtracking and branch & bound techniques.	Applying (K3)

- Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.

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- Sandeep Sen and Amit Kumar, "Design and Analysis of Algorithms: A Contemporary Perspective", IIT Delhi, 2018.
- 3. Steven S. Skiena, "The Algorithm Design Manual", Third Edition, Springer, 2021.
- 4. Donald E. Knuth, "The Art of Computer Programming", Volumes 1 & 3, Pearson Education, 2016.

CO-PO MAPPING:

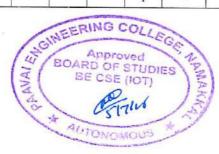
Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

		Programme Outcomes PO's													
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	1	1	2	-	9	-	1.7	-	-	2	3	3	
CO2	2	3	2	2	2		-	-	-	-	-	1	3	3	
CO3	3	2	3	1	3	-	-		-	-	-	-	2	3	
CO4	2	3	2	2	2	-	*	-	-	-	100	-	3	3	
CO5	3	3	3	3	3	-	-	_	-	-	-	2	3	3	



CI23:	505		EM	BEDD	ED SY	STEM	is wi	TH IO	Γ LAB	ORATO	RY	0	0	2
COU	RSE C	BJEC	TIVES										<u> </u>	
To en	able th	e stude	nts to					Siri-			*			
1.	unde	erstand	the fun	damen	tals of	LED ar	nd seve	n segm	ent disp	olay.				1000
2.	unde	erstand	about t	he com	ponent	s such	as Buzz	zer and	LCD.					
3.	unde	erstand	workin	g princ	iples o	f senso	rs such	as tem	peratur	e and LI	DR.			
4.	unde	rstand	about k	ey inp	ut and s	servo m	otor ar	d DC 1	Motor.					
LIST	OF E	XPERI	MENT	rs										
1.	Impl	ement	a progr	am to l	Blink L	ED usi	ng ESF	32.						
2.	Impl	ement	a progr	am for	LCD I	Display	using A	ARM.						
3.	Impl	ement	a progr	am for	Buzzei	Indica	tion us	ing ES	P32.		-			
4.	Impl	ement	a progr	am for	LDR u	sing E	SP32.							
5.	Impl	ement	a progr	am for	LM35	Sensor	for ten	nperatu	re mea	suremen	t using E	ESP32.		
6.	Impl	ement	a progr	am for	Servo	Motor (Control	using	ESP32.			· · · · · · ·		
7.	Impl	ement	a progr	am for	DC Mo	otor Co	ntrol u	sing ES	P32.					-
8.	Dete	rmine o	ligital o	output 1	for a gi	ven An	alog in	put usii	ng inter	nal ADO	of ARI	M Contr	oller	
9.	Inter	face a	4*4 key	board	and dis	play th	e key c	ode on	an LCI	O Using	Arm Co	rtex.		
10												iate dela	y in betw	veen
	Usin	g Arm	Cortex.				5							
		- 1									TO	OTAL P	ERIOD	S 30
COU	RSE O	UTCO	MES											
At the	end of	this co	urse, st	udents	will be	able to)						Mapped est Leve	
CO1	acqui	re knov	vledge	about 2	Arduin	o, LED	and co	ntrol in	tensity	of light		Appl	ying (K	3)
CO2	imple	ment b	uzzer a	nd LC	D in ap	plication	ons.					Appi	ying (K	3)
CO3			M35se									Appl	ying (K3	3)
CO4		ment the		to blin	k LED	throug	h key ii	nput an	d work	ing with		Appl	ying (K3	3)
		PPING												
N	lappin						Outc	omes F	'SO's			l Progra	ımme Sı	oecific
		-0.	(1/2/31	naicat		ngtn of amme				ng, 2-M	eaium,	1-Weak	PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1	-	-		2	1 1
CO2	3	2.	2	1	3	-	-	-	1	-		1	2	1
CO3	3	2	3	1	3	•,	-	-	1	-	1	2	2	1
CO4	3	2	3	1	3	-	-	-	1	(2)	2	3	2	1



C123	506	COM	IPUTER NETWORKS LABOR	RATORY		0	0	4	2
cot	RSE OBJE	ECTIVES							
To er	nable the stu	intra disparet ologi							
1.	like Wire	eshark.	the functioning of various networ				inalys	sis t	ools
2.			ver applications using socket prog						
3.			twork topologies and devices usin						
4.	and analy	protocol behavisis.	rior and troubleshoot network per	rformance us	ing real	-time	data	cap	ture
	OF EXPE								
			of the packet / protocol analyzer						
2. (Capture HT	TP packets by	etrieving different HTML files an	d experiment	HTTP	GET/	POS	Γ	
C	connections	and HTTP aut	nentication using Wireshark.						
3. (Capture the	DNS packets th	nat are generated by ordinary web-	-surfing activ	ity and p	orodu	ce th	e	
c	details of DN	NS query and re	esponse messages using Wiresharl	k.					
4. (Create UDP	and TCP based	l network applications using socke	et programmi	ng.				
5. (Capture UDI	P packet traces	through DNS messages and prepa	are UDP datag	grams w	ith th	e pac	ket	
		lds using Wire			-		10 - 1.		
6. T	ransfer a fil	le to a remote s	erver, analyze the traces of the TC	P segments s	ent and	recei	ved a	ind	
			TCP using Wireshark.						
7. (apture pack	ets from an ex	ecution of traceroute/tracert progra	am and analy	ze the II	Pv4 d	atagr	am.	IP
			ms using Wireshark.				-		
8. C	Capture and	analyze the pac	ket traces of DHCP and ICMP us	ing Wireshar	k.				
9. C	Capture pack	et traces by ref	rieving an HTML file and investig	gate the opera	itions of	Ethe	rnet		
			col using Wireshark.						
			ogies (Bus, Ring, Star and Mesh) ı	using Cisco P	acket Tr	racer.			
			fference in working operation of I					cket	_
	racer.				<u>.</u>			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
				Т	OTAL 1	PFR	- ODS		60
COU	RSE OUTC	OMES			OTAL.	LIC	ODS	<u>. </u>	00
207			s will be able to		BT (High	Map		`	
CO1		otocol operation	ns such as HTTP, DNS, DHCP, A	RP, and	N283 - 4875	lying		300	
CO2	implemen		and UDP client-server application	ns using	App	lying	(K3))	
CO3			rk topologies and devices to unc enarios using Cisco Packet Tracer		App	lying	(K3))	
CO4	investigate	and interpre	t the behavior of network layer- t-level traces and simulations.		Арр	lying	(K3)	1	

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

		PO's													
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2	-	2	-		•	-	-	-	3	2	2	
CO2	3	2	3	-	2	-	-	-	-	-	€ # .6	2	2	2	
CO3	3	2	3	2	2		-	-	-	-	-	3	2	3	
CO4	3	3	2	2	2	-	-	-	- 1	-	:=:	3	2	3	



CI23	industrial training	0	0	2	1
COUR	SE OBJECTIVES				1_
To enal	ble the students to				
1.	understand the organizational hierarchy and operational workflows	in software compani	es.		
2.	gain exposure to real-time problem solving skills in IoT based proj	ects.			
3.	familiarize with industry tools, platforms, and coding standards fol	lowed in software inc	lustr	ies.	
4.	develop hands-on experience in project execution, deployment, and setup.	d teamwork in a profe	ssio	nal	

DESCRIPTION

- The objective of the Industrial Training is to provide hands-on exposure to real-time software
 applications in reputed companies or institutions, focusing on areas such as IoT, AI, data science, web
 development, machine learning, cloud computing., etc.,
- The training involves hands-on experience in real-world systems like Sensors, Devices, software
 development, exposure to machine learning workflows, case studies in system design, data handling,
 and emerging techniques in IoT, artificial intelligence, analytics, cloud computing, etc., used in the
 industry.
- The students are required to undergo industrial training for a duration of 10–15 days / 90 hours in a reputed company, preferably a Private Limited company in Bangalore, Chennai, or other IT hubs.
- Students will work in teams of up to four members, collaborating on project-based or task-oriented
 assignments as allocated by the host industry. The students shall submit and present the progress report
 at the Institute at least thrice in this duration for internal assessment. The presentation will be attended
 by a committee. Alternately, a faculty mentor may visit the Industry to get the feedback of the students.
- The final assessment will be conducted through seminar, viva-voce, submission of training report, and a certificate issued by the company.
- Each student must submit a report detailing the company profile, tools and technologies used, the nature of the tasks assigned, and learning outcomes. This report should be attested by the company supervisor and submitted within 2 to 4 weeks of completing the training via email or hard copy.
- Students will be evaluated twice: once midway through the training and again at the end, to track
 progress and provide constructive feedback.
- The assessment shall be carried out by a committee comprising of a representative of the Industry
 where the candidate is undergoing training and a faculty member from the respective program from
 the college.

 For Institution level evaluation of industrial training, a committee consisting following faculty members. (1) Head of Dept. concerned. (2) Faculty member who assessed the student in the industry (3) any other staff member of department concerned may be formed.

	TOTAL PERIO	OS 30
	SE OUTCOMES and of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	appreciate the organizational hierarchy and team structure in IT/software companies.	Analyzing (K2)
CO2	practice software development, IoT integration and AI workflows followed in industry.	Applying (K3)
CO3	develop programming, data handling, and analytical skills.	Applying (K3)
CO4	understand the software project lifecycle and deployment processes.	Understanding (K

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

						P	O's						PSC	O's
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-		-	-	-	-	=	2	1	-	2	2	3
CO2	2	2	3	2	3	-	-	-	2	2	-	2	3	3
CO3	3	2	3	2	2	-	-	-	1	2	-	3	3	3
CO4	2	2	2	2	2	-	-	-	2	2		2	3	2



G	E23501	PROFESSIONAL DEVELOPMENT III	0	0	2	1
CO	URSE OB	JECTIVES				
То е	enable stud	ents to				
1.	enhanc	e their Resume writing skills and improving corporate vocabularies to su	rvive in the	corpor	ate w	orld.
2.	evaluat	e their interview skills and improve their interview presentation.				
3.	solve th	e quantitative aptitude problems and improve their mental ability.				
4.	improv	e critical thinking and reasoning skills.				
U	NIT I	RESUME WRITING SKILLS				6
Updat	ted Resume	Building III – Self Introduction III – Dressing Etiquette – JAM V – C	orporate Vo	cabula	ary.	178
	NIT II	INTERVIEW SKILLS			_	6
Mock	Interview		- Presentati	on Co		
5.000	III TIV	QUANTITATIVE APTITUDE				9
Cube	Root and S	quare Root - Time and Work - Ages - Permutation and Combination	- Probabilit	y – C	alend	ar.
UN	NIT IV	LOGICAL REASONING				9
Series	s Completi	on - Blood Relations - Coding and Decoding - Data Sufficiency - S	Statements a	nd A	ssumj	ption
		TOTA	L PERIO	S:	3	30
	RSE OUT completio	COMES n of the course, the students will be able to		MAP hest L		
CO1	excel in o	Irafting Resumes and speaking.	Appl	ying (K3)	
CO2	demonstr	ate the participative skills in group discussions and Interviews.	Apply	ing (I	(3)	
CO3	solve pro	blems based on quantitative aptitude.	Apply	ing (I	(3)	
CO4	enhance	heir logical and verbal reasoning.	Analy	zing (K4)	
TEX	TBOOKS					
1.		R. S. A Modern Approach to Verbal & Non-Verbal Reasoning. Revise Ltd., 2024.	d ed., 2024–	25, S.	Chan	d &
2.	Aggarwal,	R. S. Objective General English: Fully Revised Video Edition. S. Chan	d & Compar	y Ltd.	, 2022	2.
REFI	ERENCES					
1.	Abhijit Gu	ha, "Quantitative Aptitude", Tata-Mcgraw Hill.2015.				
2.	Word Pow	er Made Easy By Norman Lewis, Wr.Goyal Publications.2016.				
3.	Johnson, I Bacon.201	O.W. Reaching out — Interpersonal Effectiveness and self- actualisation 9.	. Boston:	Al	lyn	aı

CO/PO MAPPING: Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak Programme Outcomes (PO's) CO's PO1 PO12 PS01 PS02 PO8 PO3 PO₄ PO5 **PO6** PO7 PO9 PO10 PO1 PO₂ 3 2 3 1 2 2 3 CO1 3 -3 2 2 3 2 -2 --CO₂ _ 2 3 2 2 2 1 CO₃ 3 3 2 2 3 2 2 1 CO4



VERTICAL-I

DATA SCIENCE

CI23	3151	FOUNDATIONS OF DATA SCIENCE 3 0 0 3						
COL	JRSE (OBJECTIVES						
To er		he students to						
1.	unde	rstand the data sci	ience fundamentals and its process					
2.	descr	ibe the data for b	uilding the model along and statistical basis for AI					
3.	analy	ses the relationsh	ip between data using predictive model evaluation					
4.	utiliz	e the Python libra	ries for Data Wrangling.					
5.	prese	nt and interpret da	ata using visualization libraries in Python					
UNIT		INTRODUCT				9		
Data	Scienc	e: Benefits and us	ses - facets of data - Data Science Process: Overview - Defining	o rece	arch	0.000		
- Ret	rieving	g data – Data prep dications.	paration - Exploratory Data analysis - build the model- presenti	ng fin	ding	s and		
UNIT	. II	DESCRIBING	DATA			9		
Types	of Da	ta - Types of Vari	ables - Basic Statistical descriptions of Data - Describing Data w	rith To	hlas			
_				1111 13	ibles	and		
Graph	ıs –De	scribing Data wit	th Averages - Describing Variability - Normal Distributions of	ad Sta	n don	4 (_)		
Graph Scores	ıs –De s.	scribing Data wit	th Averages - Describing Variability - Normal Distributions ar	nd Sta	ındar	d (z)		
Scores	s.	scribing Data wit	th Averages - Describing Variability - Normal Distributions at RELATIONSHIPS	nd Sta	ndar	d (z)		
Scores UNIT	s.	DESCRIBING	th Averages - Describing Variability - Normal Distributions at RELATIONSHIPS	nd Sta		d (z)		
Scores U NIT Correl	s. TIII lation -	DESCRIBING -Scatter plots -con	th Averages - Describing Variability - Normal Distributions at RELATIONSHIPS relation coefficient for quantitative data –computational formula	nd Sta	orrela	9 ation		
Scores UNIT Correl coeffic	s. 'III lation -	DESCRIBING -Scatter plots -cor - Regression -re	RELATIONSHIPS relation coefficient for quantitative data –computational formula gression line –least squares regression line – Standard error	nd Sta	orrela	9 ation		
Scores UNIT Correl coefficenterpi	s. CIII lation - cient - retation	DESCRIBING -Scatter plots -cor - Regression -re	th Averages - Describing Variability - Normal Distributions at RELATIONSHIPS relation coefficient for quantitative data –computational formula	nd Sta	orrela	9 ntion		
Scores UNIT Correl coeffic nterpi	s. CIII lation - cient - retation	DESCRIBING -Scatter plots -con- Regression -regression -regression by Thomas Python Library	RELATIONSHIPS relation coefficient for quantitative data –computational formula gression line –least squares regression line – Standard error regression equations –regression towards the mean. RARIES FOR DATA WRANGLING	a for co	orrela	9 ntion te -		
UNIT Correl coefficenterpr UNIT Basics	s. IIII lation - cient - retation IV s of Nu	DESCRIBING -Scatter plots -con- Regression -regression -regression -regression LIBI	RELATIONSHIPS relation coefficient for quantitative data –computational formula gression line –least squares regression line – Standard error regression equations –regression towards the mean. RARIES FOR DATA WRANGLING regations –computations on arrays –comparisons, masks, boolea	nd Sta	orrela stima c – fa	9 ntion te -		
Scores UNIT Correl coeffice nterpr UNIT Basics ndexim	lation - cient - retation IV of Nu	DESCRIBING -Scatter plots -con - Regression -regression -regression by The PYTHON LIBERT - aggregative tructured arrays -	RELATIONSHIPS relation coefficient for quantitative data –computational formula gression line –least squares regression line – Standard error regression equations –regression towards the mean. RARIES FOR DATA WRANGLING regations –computations on arrays –comparisons, masks, boolea – Data manipulation with Pandas – data indexing and selection	nd Sta	orrela stima c – fa	9 ation te - 9 ancy g on		
Scores UNIT Correl coeffic nterpr UNIT Basics ndexin	s. lation - cient - retation IV s of Nu mg - st missin	DESCRIBING -Scatter plots -con - Regression -regression -regression by The PYTHON LIBERT - aggregative tructured arrays -	RELATIONSHIPS relation coefficient for quantitative data –computational formula gression line –least squares regression line – Standard error regression equations –regression towards the mean. RARIES FOR DATA WRANGLING regations –computations on arrays –comparisons, masks, boolea – Data manipulation with Pandas – data indexing and selection ical indexing – combining datasets – aggregation and grouping –	nd Sta	orrela stima c – fa	9 ntion te - 9 nncy g on		
Scores UNIT Correl coeffice nterpi UNIT Basics ndexin lata —	ation - cient - retation IV of Nu missin V	DESCRIBING -Scatter plots -con- Regression -regression	RELATIONSHIPS relation coefficient for quantitative data –computational formula gression line –least squares regression line – Standard error regression equations –regression towards the mean. RARIES FOR DATA WRANGLING regations –computations on arrays –comparisons, masks, boolea Data manipulation with Pandas – data indexing and selection ical indexing – combining datasets – aggregation and grouping – IZATION	nd Sta	orrela stima c – fa erating	9 ntion 9 nney 9 nney 9 nney 9 nney 9 nney 9		
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CO3	gain knowledge on relationships between data	Applying (K3)
CO4	use the Python Libraries for Data Wrangling	Applying (K3)
CO5	apply visualization Libraries in Python to interpret and explore data	Analyzing (K4)

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CO-PO MAPPING:

6.5					Progra	mme C	utcom	es(POs)					PS	O's
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	+	-	-	1	1	1	2	2	2
CO2	2	1	-	1	1	-	-	-	2	1	1	2	2	3
CO3	2	2	1	2	- 2	1	1	-	1	2	1	3	2	2
CO4	3	2	2	1	1	•	-	9 -	1	1	2	2	3	3 ·
CO5	2	2	1	2	2	1	1	-	1	1	1	2	2	2



CI23	30,500,000,000		IMAGE ANI	IMAGE AND VIDEO ANALYTICS 3 0						
		ECTIVES								
To ena	ble the stu									
1.	understar	d the basics of	image processin	g techniques for com	puter visi	on.				
2.	learn the	echniques us	d for image pre-p	rocessing.						-
3.	discuss th	e various obj	et detection techn	iques.						_
4.	understar	d the various	bject recognition	n mechanisms.						
5.	elaborate	on the video	alytics technique	es.		-				-1
UNIT	I	RODUCTION							T	9
Compu	ter Vision	– Image repre	entation and imag	ge analysis tasks - Ima	age repres	contation			D.	9
Traditio	onal and H	ierarchical in	ige data structure	es for Image Analysi	is - Level	s of imag	ge data	repres	entati	on
	2772005 30	GE PRE-PRO		nsformations - Local						9
arame	tric edge n	odels - Edge	n multi- speralct	itive - Scale in imag images - Local pre-p	processing	g in the fr	equenc	y doma	nin - L	ine
JNIT I	n by local OBJE	pre-processin	operators - Imag	images - Local pre-pge restoration. ACHINE LEARNIN	orocessing	g in the fr	equenc	y doma	nin - L	ine
JNIT I	n by local OBJE detection—	pre-processin CCT DETEC Object detec	operators - Imag ION USING MA on methods - D	images - Local pre-pge restoration. ACHINE LEARNIN eep Learning framew	NG vork for (g in the fr	equenc	y doma	nin - L	9
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JNIT II Dbject co pproach R-CNN ingle sl INIT IV ace Re	n by local OBJE detection— h-Intersect V - Faster I not Multib V FACE cognition—	pre-processing CCT DETEC Object detection over Union Ox Detector (Section 1981).	in multi- speralet operators - Imag ION USING MA on methods - Do (IOU) - Non-man only Look Once(Y SD).	images - Local pre-p ge restoration. ACHINE LEARNIN eep Learning framew ax suppression - Anc OLO)-Salient feature FURE RECOGNITI Face Recognition-Pre-	NG vork for the boxes es-Loss F	Object dos - Deep I unctions-	equence etection Learnin YOLO	y doma	nding itecture	9 box res
Diplet of pproach pproach ingle should be shou	n by local II OBJE detection— h-Intersect N - Faster I not Multib V FACE cognition- by Facebo VIDEO	pre-processing CT DETEC Object detection over United R-CNN-You Cox Detector (STECOGNITAL Introduction-ok-FaceNet 10 DANALYTI	in multi- speralet coperators - Imag ION USING MA on methods - Do I (IoU) - Non-man only Look Once(Y SD). ION AND GEST applications of I or Face Recognitions	images - Local pre-p ge restoration. ACHINE LEARNIN eep Learning framew ax suppression - Anc. COLO)-Salient feature FURE RECOGNITI Face Recognition-Propon-Implementation u	NG Vork for the boxes es-Loss For the control of t	Object dos - Deep I unctions-	equence etection Learnin -YOLO ecognit	n- bound Archite	nding itecture eepFation.	boxres - 9
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CO4	understand the various face recognition mechanisms.	Understanding (K3)
33333	elaborate on deep learning-based video analytics.	Analyzing (K4)
CO5	elaborate on deep learning-based video analytics.	

- Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4th edition, Thomson Learning, 2013. (UNIT-I and II)
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CO-PO MAPPING:

					Progr:	amme	Outco	mes(PC	Os)				P	SO's
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	2	-	-	77	3	3	2	1	2	1
CO2	2	2	3	3	3	-	-	-	3	2	1	1	2	2
CO3	1	2	2	2	3	-	-	-	1	2	1	2	1	1
CO4	1	2	3	2	3	-	-	-	2	2	2	3	2	2
CO5	3	5	1	3	2	-	-		2	1	1	3	3	2 ,



	3153		1	NEURAL	NETW	ORKS				3	0	0	3
COU	RSE OF	JECTIVES											
To en	able the	students to											
1.	introdu	ce the foundation	ns of Ar	tificial Net	ıral Netw	vorks.							
2.	learn va	arious types of pa	attern as	sociation i	n Neural	Network	s.						
3.	evaluat	e whether neural	l networ	ks are appr	opriate to	o a partic	ular app	lication.					
4.	apply n	eural networks t	o partic	ılar applica	ition.								
5.	analyze	the steps neede	d to imp	rove perfo	rmance o	of the sele	ected ne	ıral netw	ork.				
UNIT	I IN	FRODUCTION	Į.										9
Artific	cial Neu	rai Networks, B	iologica	l Neural N	etworks,	Where a	nd how	Neural N	lets are	Bei	ng Us	ed –	Signa
Proces	ssing, Co	ontrol, Pattern Re	ecogniti	on, Medicii	ne, Speec	ch Process	sing, Sp	eech Rec	ognitio	n, Bu	ısines	s; Ho	w Ar
Neura	al Netwo	rks Used- Typic	al Arch	tecture, Se	tting the	Weights,	Comm	on Activa	ation F	ancti	ons, S	Summ	ary c
Notati	ion; The	McCulloch Pitt	s Neuro	n – Archite	ecture, A	lgorithm,	, Applic	ations; S	imple i	neura	ıl nets	for p	atter
classi	fication	- Neural Net Arc	chitectu	e, Biases a	nd Thres	sholds, Li	near Sej	arability	, Data	Repr	esent	ation;	Heb
net - A	Algorith	m, Applications;	; Percep	tron - Arch	itecture,	Algorith	m, App	ications,	Percep	tron	Learr	ning I	Rule
Conve	ergence '	Theorem; Adalin	ne - Arcl	nitecture, A	lgorithm	ı, Applica	tions, D	erivation	s. Mad	aline	,		
UNIT	II PA	TTERN ASSO	CLATI									T	0
			CIMIL	ON									9
Traini	ing Alge	orithms for Patt			Hebb R	Rule for l	Pattern	Associat	ion, D	elta	Rule	for F	
		orithms for Patt Hetero associati	tern As	sociation -									atter
Assoc	ciation;		tern Ass ve Men	sociation - nory Neura	al networ	rk - Arch	nitecture	, Applic	ation,	Auto	assoc	iative	atter net
Assoc Archi	ciation; tecture,	Hetero associati	tern Ass ve Men olication	sociation - nory Neura and Stora	nl networ	rk - Arch ity , Itera	nitecture ative au	, Applic to associ	ation, ative n	Auto	assoc Recur	iative rent	atter net Linea
Assoc Archi Autoa	ciation: tecture, associate	Hetero associati Algorithm, App	ve Men olication n-a-Box	nory Neura and Stora	nl networ ge capac ociator	rk - Arch ity , Itera With Th	nitecture ative au reshold	, Applic to associ Functio	ation, ative n n, Dis	Auto	assoc Recur	iative rent	atter net Linea
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Algorithm.

UNIT V | SELF-ORGANIZING FEATURE MAP AND FUZZY SETS

9

TOTAL DEDICAR

Self-organization, Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Competitive Learning, Vector Quantization, Mexican Hat Networks, SOM, Application of SOM, Fuzzy Sets- Need for Numeric and Linguistic Processing, Fuzzy Uncertainty and the Linguistic Variable, Membership Functions, Geometry of Fuzzy Sets, Simple Operations on Fuzzy Sets, Fuzzy Rules for Approximate Reasoning, Rule Composition and Deffuzification, Fuzzy Engineering.

		TOTAL PERIODS	45
COURS	SE OUTCOMES	£	
At the e	nd of this course, students will be able to	BT Map (Highest I	
CO1	explain about Artificial Neural Networks	Understandi	ng (K2)

At the en	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain about Artificial Neural Networks.	Understanding (K2)
CO2	differentiate various types of Artificial Neural Networks	Analyzing (K4)
CO3	analyze the architectures of various competitive and self-organizing neural network models.	Analyzing (K4)
CO4	apply neural networks to particular application	Applying (K3)
CO5	analyze the steps needed to improve performance of the selected neural network.	Analyzing (K4)

TEXT BOOKS

- Laurene Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", 2019, Prentice Hall publications. (Unit I-IV)
- Satish Kumar, "Neural Networks A Classroom Approach", McGraw Hill Education (India) Pvt. Ltd, Second Edition. (UNIT V)

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- 1. Simon Haykin, "Neural Networks and Learning Machines", 3rd Edition, Pearson Prentice Hall.
- 2. Michael Nielsen, "Neural Networks and Deep Learning", 2015, Determination Press.
- 3. J.M. Zurada "Introduction to Artificial Neural Systems", 2019, Jaico Publications.
- Herbert Jones "Neural Networks: An Essential Beginners Guide to Artificial Neural Networks and their Role in Machine Learning and Artificial Intelligence", 2020, Bravex Publications.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

CO-					Progra	mme O	utcome	s(POs)					PS	O's
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	I	2	2	2	-	-	-	3	3	2	1	2	1
CO2	2	2	3	3	3	-	-	-	3	2	1	1	2	2
CO3	1	2	2	2	3	-	-	-	1	2	1	2	1	1
CO4	1	2	3	2	3		-		2	2	2	3	2	2
CO5	3	5	1	3	2	-	-	-	2	1	I	3	3	2



CI	23154		BLOCKCHAIN TECHNOLOGY		3	0	0	3
COU	RSE O	BJECTIVES						
To en	able the	e students to					-	
1.	defin	e and explain the fi	undamentals of Blockchain.					
2.	famil	iarize the mechanis	sm of cryptography in cryptocurrency.			T		
3.	under	rstand the fundame	ntals of bitcoin and its applications.					
4.	learn	the standard rules	and regulations of cryptocurrency.					
5.			enario of transforming blockchain in to cryp	otocurrency.				
UNIT	ГІ	INTRODUCTIO	ON TO BLOCKCHAIN					9
a blo	ckchair	n - Benefits and Types of blockchai	nnology - Distributed Systems - The history Limitations of blockchain - Tiers of blo n - Consensus - CAP theorem and blockcha	ockchain technol ain.				
UNIT	ГII	FOUNDATIONS	ZATION, CRYPTOGRAPHY AND TEC S	HNICAL				9
UNIT	LIII	BITCOIN AND	al signature algorithm. ALTERNATIVE COINS	and the				9
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CO3	present bitcoin technology, alternative coins and smart contracts.	Understanding(K2)
CO4	develop a distributed application using Ethereum.	Analyzing (K4)
CO5	deploy an application using Hyperledger.	Analyzing (K4)

- Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018. (Unit 1-5]
- 2. Andreas Antonopoulos, "Mastering Bitcoin: Programming the open blockchain", 2nd Edition, O'Reilly Media, 2017. [unit5]

REFERENCES

- Brenn Hill, Samanyu Chopra & Paul Valencourt, "Blockchain Quick Reference: A guide to exploring decentralized blockchain application development", Packt, 2018.
- William Stallings, "Network Security Essentials (Applications and Standards)", Pearson Education, India, 2017.
- 3. Aravind Narayanan, Joesph Bonneau, Edward Felten, Andrew Miler and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
- Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, "Blockchain By Examples: A developer's guide to
 creating decentralized applications using Bitcoin, Ethereum and Hyperledger", Packt Publishing Limited, 2018.

CO-PO MAPPING:

					Progra	amme	Outcor	nes(PC	Os)				PS	O's
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	3	3	-	3	-	-	-	3	3	3
CO2	1	2	3	3	3	3	-	3	-	-		3	3	2
CO3	2	2	3	3	3	3	-	3	-	-	-	3	3	3
CO4	1	3	3	3	3	3	-	3	+		-	3	2	3
CO5	1	3	3	3	3	3	120	3	-	-	-	3	3	3



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COURS	SE OBJ	ECTIVES				- 39	
To enab	le the st	udents to					
1.	unders	tand the basics of Knowledge Engineering.					
2.	discus	s methodologies and modeling for Agent Design and Development.					
3.	design	and develop ontologies with rules.					
4.	unders	tand learning and rule learning.					
5.	define applica	the role of agents, use planning and designing with principles ations.	for cr	itique	-base	ed	
UNIT I	B	EASONING UNDER UNCERTAINTY					9
Probabil	istic rea e-Based	Understanding the World through Evidence-based Reasoning - Assoning - Evidence-based reasoning - Artificial Intelligence - Know Reasoning - Sample Evidence-based Reasoning Task: Intelligence Anag Tasks.	wledg	e Eng	ginee	ring	-
UNIT II	N	IETHODOLOGY AND MODELING				T	9
Methodo	ologies a	and Tools for Agent Design and Development - A Conventional Design	ion and	Dev	elon	neni	
UNIT II Ontologi		NTOLOGIES, DESIGN AND DEVELOPMENT AND RULES					9
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CO2	apply methodologies and modelling for design and develop for Agents and reusable ontologies.	Analyzing (K4)
CO3	illustrate ontologies with proper guidelines and rules in the method of design and development.	Analyzing (K4)
CO4	define learning, rule learning and refinement practice.	Understanding(K2)
CO5	use ontologies engineering to create and manage knowledge-based model.	Applying (K3)

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 I -V)

 Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.

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- 3. King, Knowledge Management and Organizational Learning, Springer, 2009.
- 4. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition, 2001.

CO-PO MAPPING:

				P	rogra	mme C	utcom	es (PC	s)				PS	SO's
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	rso2
CO1	3	1	1	1	1	1	-	0.5	1	2	1	2	1	1
CO2	3	2	3	2	2	-	-	-	2	1	2	1	3	3
CO3	2	2	3	2	2	-	-	-	3	2	2	2	3	2
CO4	2	2	3	1	1	-	s=s	8=8	2	2	2	2	1	1
CO5	2	2	2	1	1	-	7-	-	2	1	1	1	2	1



	2315	66 DATA VISUALIZATION			3	0	0		3
COU	RSE	EOBJECTIVES					-		
To en	able	the students to							
1.	unc	derstand the principles of visual perception and carryout preproc	essing	in rea	l time o	data.			
2.	ide	entify the various visualization techniques.				1000			
3.	app	ply visualization techniques for the applications.							
4.	cre	eate a different visualization technique for the given problems.							
5.	unc	derstand the best practices in information dashboard.							
UNIT		INTRODUCTION					T		9
		tion - visualization process - role of cognition - Pseudocode							
		n: Types of data - Structure within and between records -							
visual	lizati	ion - Visualization foundations - The visualization process	in deta	ail – s	semiol	ogy o	of g	raph	nical
symbo	ols - '	The eight visual variables.							
UNIT		SPATIAL AND GEOSPATIAL, TIME ORIENTED DATA	AND						
		MULTIVARIATE DATA							9
		, Three dimensional data - Dynamic data - Combining techniq				- 27			
		ion of point data - Visualization of line data - Visualization of a							
		ion - Characterizing and visualizing Time oriented data- Point,	Line a	ıd regi	on bas	ed te	chni	que	S
for mu	ıltiva	ariate data.							
T. 12.12									
UNIT	Ш	TREE, GRAPH, NETWORKS, TEXT AND DOCUMENT	7						9
		TREE, GRAPH, NETWORKS, TEXT AND DOCUMENT hierarchical structure – Displaying Arbitrary Graphs/Netwo		Other	issues	s. Vi	sual		-
Displa	ying		rks –					zati	on
Displa technic	iying ques	g hierarchical structure - Displaying Arbitrary Graphs/Netwo	rks – – Vec	tor sp	ace m	odel		zati	on
Displa technic	ying ques nent	g hierarchical structure – Displaying Arbitrary Graphs/Netwo s for Tree- Graph and Networks - Levels of text representation	rks – – Vec	tor sp	ace m	odel		izati Sing	on
Displatechnic Docum	ques nent	g hierarchical structure – Displaying Arbitrary Graphs/Netwo for Tree- Graph and Networks - Levels of text representation Visualization – Document collection visualization- Extend	rks – – Vec ed tex	tor sp	ace m	odel n.	- T	Sing	on gle
Displatechnic Document UNIT Steps	ques nent IV	g hierarchical structure – Displaying Arbitrary Graphs/Netwo for Tree- Graph and Networks - Levels of text representation Visualization – Document collection visualization- Extend DESIGNING EFFECTIVE VISUALIZATION	rks – – Vec ed tex	tor sp	ace m	odel n.	- T	Sing	on gle
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- Matthew O. Ward., Georges Grinstein and Daniel Keim, "Interactive Data Visualization:
- 1. Foundations, Techniques, and Applications", 2nd Edition, CRC Press, 2015. (UNIT I IV)

Stephen Few, "Information Dashboard Design: The Effective Visual Communication of Data", 2nd

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REFERENCES

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Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",

2. O'Reilly, 2012.

Gert H.N.Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business

3. intelligence beyond reporting", Wiley 2012.

Edward R.Tufte,"The Visual display of quantitative information", Second Edition, Graphics Press,

4. 2010.

CO-PO MAPPING:

						Pro	gram	me Ou	tcomes	(POs)				
COs	PO1	PO2	РО3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	3	2	2	3	3	-	3	3	3
CO2	3	3	3	1	3	3	-	2	2	2	-	3	3	3
CO3	3	3	3	1	3	3	-	-	3	3	1	3	3	2
CO4	3	3	3	1	3	2		2	3	2	2	3	3	3
CO5	3	2	1	1	1	3	-	1	2	3	2	3	3	2



CI231:	BIG DATA ANALYTICS	2	0	2	3
COURS	E OBJECTIVES				
To enable	e the students to				
1. un	derstand fundamentals and applications of Big Data analytics.				
2. lea	rn and use NoSQL big data management.				
3. lea	rn MapReduce analytics using Hadoop and related tools.				
4. em	ploy MapReduce programming model to process the big data.				
5. un	derstand the usage of Hadoop related tools for Big Data Analytics.				
UNIT I	UNDERSTANDING BIG DATA				6
Introducti	ion to big data – convergence of key trends – unstructured data – indus	stry examples	of big	data -	web
	 big data applications— big data technologies — introduction to Hadoo big data — mobile business intelligence — Crowd sourcing analytics — int 			- 5	
UNIT II	NOSQL DATA MANAGEMENT				6
Introducti	on to NoSQL – aggregate data models – key-value and document data	models - rela	ationsh	ine _ (
	- schemaless databases - materialized views - distribution model				10-11-62
	cy - Cassandra - Cassandra data model - Cassandra examples - Cassan		ave le	piicati	OII -
UNIT III	The state of the s	dia chems.			6
	ce workflows – unit tests with MRUnit – test data and local tests – and				
	ap-reduce – YARN – failures in classic Map-reduce and YARN – job s	scheduling – s	huffle	and so	ort –
task exect	ntion – MapReduce types – input formats – output formats.				
UNIT IV	BASICS OF HADOOP	ngH .			6
Data form	at – analyzing data with Hadoop – scaling out – Hadoop streaming – Had	doop pipes – d	lesign o	of Had	loop
distribute	d file system (HDFS) - HDFS concepts - Java interface - data flow -	Hadoop I/O -	data i	ntegri	ty –
compressi	on - serialization - Avro - file-based data structures - Cassandra - Ha	doop integrati	ion.		
UNIT V	HADOOP RELATED TOOLS			T	6
Hbase – d	ata model and implementations - Hbase clients - Hbase examples - pr	axis. Pig – Gi	runt – p	ig dat	a
model – l	Pig Latin - developing and testing Pig Latin scripts. Hive - data type	es and file for	mats –	Hive() L
data defin	ition - HiveQL data manipulation - HiveQL queries.				
		TOTAL PER	IODS		30
PRACTI	CAL EXERCISES				100
List of I	Experiments:				
1. Do	wnloading and installing Hadoop; Understanding different Had	oop modes.	Startu	p sci	ipts,
Co	nfiguration files.				
	doop Implementation of file management tasks, such as Adding files and Deleting files.	d directories,	retriev	ing	files
and	Determing files.				

- 3. Implement of Matrix Multiplication with Hadoop Map Reduce.
- 4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
- 5. Installation of Hive along with practice examples.
- 6. Installation of HBase, Installing thrift along with Practice examples.
- 7. Practice importing and exporting data from various databases.

COUR	SE OUTCOMES .	TOTAL PERIODS	30
055 SX	end of this course, students will be able to	BT Mapp (Highest Le	
CO1	describe big data and use cases from selected business domains.	Understanding	g (K2)
CO2	explain NoSQL big data management.	Understanding	g (K2)
CO3	install, configure, and run Hadoop and HDFS.	Analyzing ((K3)
CO4	perform map-reduce analytics using Hadoop.	Analyzing ((K3)
CO5	use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for b data analytics.	ig Applying ((K4)
TEXT	BOOKS		
,	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big D	ata, Big Analytics: E	mergin

- 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.

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- 2. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
- Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010. 3.
 - 4. Alan Gates, "Programming Pig", O'Reilley, 2011.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

00				P	rogran	ıme O	utcom	es(POs)				PS	O's
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	-	-	:=	2	-	2	1	2	2
CO2	3	2	3	2	3	155	1) 3 	::=:	2		2	1	2	2
CO3	3	1	3	1	3	-		-	2	-	2	1	2	2
CO4	3	1	3	1	3	-	-	-	2	-	2	1	2	2
CO5	3		3	1	3	-	19.3	:-	2		2	1	2	2



Vertical - II SOFTWARE DEVELOPMENT

To enable the students to 1. understand the architectural overview of Idea. 2. understand the basic UI design of mobile and design IoT based mobile app in real-world and learn frameworks and architectures to design. IoT applications that integrate phonormal develop IoT applications that integrate phonormal development IoT and Integrate phonormal development IoT	pplications. scenario. gn UI in Android development environment. vsical devices with digital systems itecture, Main design principles and needed cap M and IoT Technology Fundamentals- Device nt, Business processes in IoT, Everything as a n - Embedded OS - Design constraints for mobile applications - user interfaces for mobile	Service (Xaa Service (Xaa Dile application availability a
1. understand the architectural overview of Id 2. understand the basic UI design of mobile a 3. design IoT based mobile app in real-world 4. learn frameworks and architectures to des 5. develop IoT applications that integrate ph UNIT I OVERVIEW IoT-An Architectural Overview - Building an architecture outline, standards considerations. Mi Local and wide area networking, Data management M2M and IoT Analytics. UNIT II BASIC DESIGN Introduction - Basics of embedded systems design both hardware and software related - Architecting touch events and gestures - Achieving quality modifiability. UNIT III IoT MOBILE APPS IoT Mobile App Development Trends In 2020 - Red design for IoT Mobile apps - challenges of UX/UI of apps - IoT App Design Solutions.	pplications. scenario. gn UI in Android development environment. vsical devices with digital systems itecture, Main design principles and needed cap M and IoT Technology Fundamentals- Device nt, Business processes in IoT, Everything as a n - Embedded OS - Design constraints for mobile applications - user interfaces for mobile	pabilities, An I- es and gatewa Service (Xaa pile application availability a
2. understand the basic UI design of mobile a 3. design IoT based mobile app in real-world 4. learn frameworks and architectures to des 5. develop IoT applications that integrate ph UNIT I OVERVIEW IoT-An Architectural Overview - Building an architecture outline, standards considerations. Mi Local and wide area networking, Data management M2M and IoT Analytics. UNIT II BASIC DESIGN Introduction - Basics of embedded systems design both hardware and software related - Architecting touch events and gestures - Achieving quality modifiability. UNIT III IoT MOBILE APPS IoT Mobile App Development Trends In 2020 - Redesign for IoT Mobile apps - challenges of UX/UI capps - IoT App Design Solutions.	pplications. scenario. gn UI in Android development environment. vsical devices with digital systems itecture, Main design principles and needed cap M and IoT Technology Fundamentals- Device nt, Business processes in IoT, Everything as a n - Embedded OS - Design constraints for mobile applications - user interfaces for mobile	pabilities, An I- es and gatewa Service (Xaa pile application availability a
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UNIT I OVERVIEW IoT-An Architectural Overview - Building an architecture outline, standards considerations. M. Local and wide area networking, Data management M2M and IoT Analytics. UNIT II BASIC DESIGN Introduction - Basics of embedded systems design both hardware and software related - Architecting touch events and gestures - Achieving quality modifiability. UNIT III IoT MOBILE APPS IoT Mobile App Development Trends In 2020 - Reddesign for IoT Mobile apps - challenges of UX/UI capps - IoT App Design Solutions.	visical devices with digital systems itecture, Main design principles and needed cap M and IoT Technology Fundamentals- Device nt, Business processes in IoT, Everything as a n - Embedded OS - Design constraints for mob	pabilities, An I- es and gatewa Service (Xaa pile application availability a
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design for IoT Mobile apps - challenges of UX/UI of apps - IoT App Design Solutions.	1 (3)(1)	
UNIT IV ANDROID ARCHITECTURE		
Introduction - Establishing the development environment	ament - Android architecture - Activities and vie	ews - Interacti
with UI - Persisting data using SQLite - Packagi	g and deployment - Interaction with server sid	le application:
Using Google Maps, GPS and Wifi - Integration w	th social media applications- an overview of IoS	S.
UNIT V ANDROID THINGS		6
Android things - Installation of Android things - V		n Android IoT
Setting up the Android things - Building your first	erification of Android things installation - API in	

PRACTICAL EXERCISES

List of Experiments:

- 1. Set up a basic mobile application in Android Studio
- Establish communication between the mobile app and an IoT device
- 3. Fetch temperature data from an IoT sensor using Mobile Application
- 4. Create a mobile app to collect real-time data from loT sensors.
- 5. Implement a button to turn an LED on/off
- 6. Integrate control buttons (e.g., ON/OFF, Increase/Decrease) in the mobile UI.

		TOTAL PERIODS 30
COUR	SE OUTCOMES	
At the e	nd of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	explain the fundamental concepts of IoT and its te	chnology evolution. Understanding (K2)
CO2	discuss the basic designing consideration of mobi	II-11: (V2)
CO3	identify the various mobile applications applied in	ToT environment. Applying (K3)
CO4	design UI in Android development environment.	Applying (K3)
CO5	Analyze the scenario of integrating APIs in IoT ba	ased mobile app. Analyzing (K4)

TEXT BOOKS

- 1. IoT Product Development with Programming: Stepwise programming approach with Particle Development board Kindle Edition by Mahesh Jadhav and Tejas Sarang Patil.
- 2. Kale, Vivek. Parallel Computing Architectures and APIs: IoT Big Data Stream Processing 1st edition, CRC Press, 2019.

REFERENCES

- 1. IoT Product Development with Programming: Stepwise programming approach with Particle Development board Kindle Edition by Mahesh Jadhav and Tejas Sarang Patil.
- 2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
- 3. Charlie Collins, MichelGalpin and Matthias Kappler, "Android in Practice", DreamTech, 2012.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

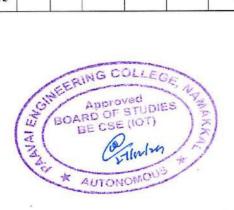
(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

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CO3	3	-	1	2	2		-	-	-	-	2	1	-	2
CO4	2	2	-	3	2	-	-	2	-	-		-		2
CO5	3	10	COLLI	1	2	-		1	-		-	2	-	2

Approved
BOARD OF STUDIES
BE CSE (IOT)
BE CALLED
APPROVED
BE CSE (IOT)
AUTONOMOUS

CI23	252	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	0	3
COU	RSE O	DBJECTIVES				
To en	able th	e students to				
1.	des	cribe syntax and semantics of programming languages.				
2.	und	derstand data, data types, and basic statements.				
3.	und	derstand call-return architecture and ways of implementing them.				
4.	app	bly object-orientation, concurrency, and event handling in programming lang	guages.	-		
5.	dev	relop programs in non-procedural programming paradigms				
UNIT	C I	INTRODUCTION TO PROGAMMING LANGUAGES				9
Évolu	ition of	f programming languages - Describing syntax - Formal Methods of De	scribing Sy	vntax-	Attri	bute
gramı	mars –	Describing semantics - Lexical Analysis - Parsing Problem - Recursive-De	escent – Bo	ttom u	p par	sing.
UNIT	LII	BASIC PRIMITIVES			T	9
Primi – Poir and B	tive Da nters an Boolean	ariables - Binding -Scope - Scope and Lifetime - Referencing Environmental Types - Character String Types - Array Types - Associative Arrays - Ind References Types - Arithmetic Expressions - Overloaded Operators - Types - Expressions - Assignment Statements - Mixed Mode Assignment - Cont	Record type pe conversi	es – Ur ons – I	nion t Relati	ypes onal
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CO2	defi	ne and	identify	data, da	ita types	, and ba	sic state	ments ir	proble	m solving	g	Under	standing	(K2)
CO3		onstrat		eturn, ne	sted stru	cture, th	ne scope	of varia	bles in			App	lying (K	(3)
CO4	app		ct-orien	tation, c	oncurrei	icy, and	event h	andling	in progr	amming		Арр	lying (K	(3)
CO5				in non-p	rocedur	al progra	amming	paradig	ms.			App	lying (K	(3)
TEXT	BOC	KS												
1.	Rob	ert W.	Sebesta,	, "Conce	pts of P	rogramr	ning La	nguages	", Twelf	th Editio	n, Pears	on, 2022	2.	
2.	Fran	klyn T	urbak, I	David Gi	fford, a	nd Mark	A. She	ldon, "D	esign C	oncepts i	n Progra	mming	Languag	ges"
REFE	REN	CES					- 55.85							
1.	Mic	hael L.	Scott, "	Progran	nming L	anguage	Pragma	atics", F	ourth E	dition, El	sevier, 2	.018.		
2.	R. K	ent Dy	bvig, ""	The Sch	eme pro	grammir	ng langu	age", Fo	ourth Ed	lition, Pre	entice H	all, 2011	*	
3.	Jeffi	ey D.	Ullman,	"Eleme	n t s of M	L progr	amming	", Secor	nd Editio	on, Pears	on, 1997	7.		
4.	W. I		ksin and	IC.S.M	ellish, "	Program	nming in	Prolog:	Using t	he ISO S	tandard'	', Fifth E	dition,	Springer
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CO2	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	3	2	3
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	2
200000000	3	3	3	3	3								3	3



CO5

	PROGRAMMING LANGUAGES FOR IOT 3 0	0
COUR	SE OBJECTIVES	
To enal	ble the students to	
1.	equipped with professional knowledge and strong practical skills in the Raspberry Pi	
2.	focuses on higher-level operating systems with computing intensive IoT applications	
3.	connect devices ans systems to collect, exchange and analyze data	
4.	learn how to develop IoT applications using various technologies and platforms	
5.	learn how to assess the impact of data acquisition and integration strategies on IoT system	- 13
UNIT	I INTRODUCTION	
	ration and use, booting Raspberry Pi 3, Downloading an Operating System, format an SD card and Interfacing Hardware with the Raspberry Pi, Raspberry Pi Remote Access, operates the Raspberrs mode."	
	is mode.	
UNIT	INTRODUCING MICRO DUTHON	Т
Window Print Lo	INTRODUCING MICRO DUTHON	valuate
MicroPy Window Print Lo	INTRODUCING MICRO PYTHON withon Features, MicroPython Limitations, Experimenting with Python on PC, Installing Python is 10, Running the Python Console, Running Python Programs with the Interpreter, The Run, E op (REPL Console), Off and Running with MicroPython, Additional Hardware, Basic Electron and Jumper Wires and 3 Examples.	valuate
MicroPy Window Print Lo Breadbo	INTRODUCING MICRO PYTHON withon Features, MicroPython Limitations, Experimenting with Python on PC, Installing Python is 10, Running the Python Console, Running Python Programs with the Interpreter, The Run, E op (REPL Console), Off and Running with MicroPython, Additional Hardware, Basic Electron and Jumper Wires and 3 Examples.	valuate
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MicroPy Window Print Lo Breadbo UNIT I IoT Phys Server – Connects UNIT I Powering Installing Compute UNIT I Bill of HelloRas	INTRODUCING MICRO PYTHON Then Features, MicroPython Limitations, Experimenting with Python on PC, Installing Pythor is 10, Running the Python Console, Running Python Programs with the Interpreter, The Run, E op (REPL Console), Off and Running with MicroPython, Additional Hardware, Basic Electron and and Jumper Wires and 3 Examples. III IOT PHYSICAL SERVERS AND CLOUD OFFERINGS Sical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication AP Web server for IoT, Cloud for IoT, Python web application framework. Designing a RESTful wing to APIs. IV BAKING Pi g Raspberry Pi, Formatting SD cards, Installing and connecting Raspberry pi, Raspberry pi wg Raspbian with NOOBS, Networking Raspberry Pi, Connecting with Ethernet, Connecting View Network, Connecting Via Wireless Network, Updating and Upgrading, Setting up a Host Name V CASE STUDIES WITH JAVA Materials, Getting Started with NetBeans, Downloading and Configuring NetBeans, Re	valuate ics Kit

At the	end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	appreciate the development technology for IoT	Applying (K3)
CO2	familiar with basic concepts of Linux.	Understanding (K2)
CO3	design real time IoT devices using python programming and libraries.	Applying (K3)
CO4	comprehend the basic concepts of mobile cloud computing.	Applying (K3)
CO5	understand the applications of IoT.	Understanding (K2)
TEXT	воокѕ	
1.	Simon Monk, "Programming the Raspberry Pi: Getting Started with Python!" Professional.	", January 2012, McGraw H
2	MicroPython for the Internet of Things, A Beginner's Guide to Pro Microcontrollers, Charles Bell, Apress.	ogramming with Python

- 1. Eben Upton and Gareth Halfacree, "Raspberry Pi User Guide", August 2016, 4th edition, John Wiley & Sons.
- 2. Alex Bradbury and Ben Everard, "Learning Python with Raspberry Pi", Feb 2014, John Wiley & Sons.
- 3. Michael Margolis, "Arduino Cookbook", First Edition, March 2011, O'Reilly Media, Inc The official raspberry Pi Projects Book.
- 4. "Raspberry Pi with Java: Programming the Internet of Things (IoT)", Oracle Press, 1st edition.

CO-PO MAPPING:

					Progr	amme (Outcom	es(POs)				P	SOs
COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO1 2	PSO 1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-	-	1	2	1
CO2	1	2	-	3	-	1	-	-				2	-	2
CO3	3	(2)	1	2	2	-	-	(2)	2	-	2	1	-	2
CO4	2	2	-	3	82	-	-	2	2	-	-	12	-	2
CO5	3	1	2	1	2	-	-	1	-	-	-	2	-	2



CI2	23254	WEB TECHNOLOGIES		3	0	0
COUR	SE OBJECTIVES					
To enab	ole the students to					
1.	understand about w	reb pages, HTML and CSS				
2.	design interactive a	nd dynamic web pages using JavaScript.				
3.	develop web applica	ations using CANVAS, XML, AJAX.				-
4.	create a server side	web application using PHP with database	connectivity.			-
5.	develop web applica	ations using frameworks.	The state of the s			
UNIT		ON TO HTML AND CSS				9
		Web 2.0; HTML 5 Introduction, Linki				
		line, embedded and external style sheets, E	Backgrounds, Color, Sl	nadows,	Anima	tions
UNIT						9
	SCRIPT - Introduction (DOM).	on to Scripting; Control Statements; Fund	ctions; Arrays; Object	s; Docu	ment (bjec
UNIT I		DEVELOPMENT				
		awing, Shadows, Images, Patterns, Transfo	ermation: YMI Basis	DTD	VICT	9
		nternet Applications with AJAX, Creating				
UNIT		DRIVEN WEB DEVELOPMENT	· · · · · · · · · · · · · · · · · · ·		- I	9
Web S	erver - HTTP Transac	ctions. Apache and IIS; Database - Relat	tional Database Overv	iew. SO	L. My	- 50
		Data types, Operators, String and form pr				4-14-5
		and IIS; Database - Relational Database				
DB; PF	HP - Data types, Opera	ators, String and form processing, reading	Database.			
UNIT		CATIONS FRAMEWORK				9
		ltitier Application Architecture, ASP.NET	Application, Controls	s, Sessio	n Trac	king;
C# - SC	DAP, REST. JSON, Ca	ase study.				
			TOTAL PERIO	DS	45	
	SE OUTCOMES					
COUR						
		students will be able to			MAP	
At the e	end of this course, the	students will be able to static web pages using HTML and CSS.		(Hig	ghest L	evel)
At the e	end of this course, the			(Hig	ghest L	evel) K3)
	design and develops develop interactive a	static web pages using HTML and CSS.		(Hig App	ghest L	K3)

develop a complete, full-stack web application using modern frameworks and tools like ASP.Net and C#.

Applying (K3)

TEXT BOOKS

CO5

- Deitel and Deitel and Nieto, Internet and World Wide Web How to Program, Prentice Hall, 5th Edition, 2012.
- 2. Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011

REFERENCES

- 1. Uttam K.Roy, Web Technologies, Oxford University Press, 2010.
- 2. Rajkamal, Web Technology, Tata McGraw-Hill, 2009
- 3. Gopalan N.P. and Akilandeswari J., "Web Technology", Prentice Hall of India, 2011.
- 4. Chris Bates, Web Programming Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.
- 5. Uttam K.Roy, Web Technologies, Oxford University Press, 2010.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes: (1,2,3 indicates the strength of correlation) 3 – Strong , 2 – Medium , 1 – Weak

-					Progra	mme O	utcome	s (POs)),					8
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
COI	3	2	2	1	2	-	-		-		-	-	2	1
CO2	3	3	2	1	2	-		(*)	-	-	-	5	3	2
CO3	3	3	3	2	3	-	-	-5	=	-	2	2	3	3
CO4	3	3	2	3	2	17.1	-	150	3	-	1	5	3	2
CO5	3	3	3	3	3		-	-	7	-	2	2	3	3

Approved

Approved

BOARD OF STUDIES

BE CSE (IOT)

AUTONOMOUS

AUTONOMOUS

CI2325	55	R PROGRAMMING	3	0	0	3
COURS	E OBJECTIVES					
To enal	ole the students to				022	CHESTA.
1.	understand the basic for	ndamentals of R language.				
2.	knowledge the basic ty	pes of statistical models.				
7	equip R programming	from a statistical perspective.				
4.	understand the operation	ons of control statements.				
5.	provide insights into in	terfaces.				
UNIT	I INTRODUCTION	N TO R				9
Introduc	ction - History and ov	erview of R - elements and data structures - Sessions a	and Function	ıs - V	arial	oles
- Data T	ypes - Vectors - Scalar	s - Conclusion - Data Frames - Lists - Matrices - Arrays - C	Classes- Data	a inpu	it/out	put
- Data st	orage formats - Subsett	ng objects -Vectorization.				
UNIT I	MATRICES, AR	RAYS AND LISTS		-	9	
		eating matrices Matrix operations Applying Functions to M	fatulu Davon	10		
		d columns Vector/Matrix Distinction Avoiding Dime				
	5	ing lists General list operations Accessing list component	ents and va	lues a	pply	ring
function	s to lists recursive lists.					
UNIT I	II DATA MANIPU	LATION			9	
Math ar	d Simulation in R, Fu	nctions, Math Function. Probability Calculation Cumula	tive Sums a	ind Pr	rodu	cts-
Minima	and Maxima- Data sort	ing - Linear Algebra Operation on Vectors and Matrices -	- Set Operat	ion.		
UNIT I		TEMENTS, FUNCTIONS, R GRAPHS			9	
UNIT	V CONTROL STA	TEMENTS, TUNCTIONS, ROKAT IIS			1	
		and Boolean operators and values-Default values for argum	ents - Retur	ning l	1	ean
Control	statements - Arithmetic				Bool	
Control values f	statements - Arithmetic a	and Boolean operators and values-Default values for argum	n Replacem	ent fi	Bool	ons
Control values f	statements - Arithmetic a	and Boolean operators and values-Default values for argum vironment and Scope issues. Writing Upstairs - Recursio code Math and Simulations in R Creating Graphs -Cust	n Replacem	ent fi	Bool	ons
Control values for Tools for graphs to	statements - Arithmetic a functions are objects En or composing function of files - Creating three-	and Boolean operators and values-Default values for argum vironment and Scope issues. Writing Upstairs - Recursio code Math and Simulations in R Creating Graphs -Cust	n Replacem	ent fi	Bool uncti -Sav	ons
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Control values for Tools for graphs to UNIT Value for models	statements - Arithmetic at functions are objects Enter composing function of files - Creating three- INTERFACING ing R to other languages - Time Series and Auto- SE OUTCOMES end of the course, the state the capabilities	and Boolean operators and values-Default values for argum vironment and Scope issues. Writing Upstairs - Recursio code Math and Simulations in R Creating Graphs -Cust dimensional plots. 3 -Parallel R-Basic Statistics- Linear Model Generalized Licorrelation Clustering. TOT	inear models FAL PERIC BT (Hi Unde	ent fi raphs s- No DDS	Booluncti -Sav 9 nn-lim 4 PPE Lev Lev	ons ing sear 5 D (K2

3.	1 60	ply R p		ming f	or mani	ipulatio	n of dat	asets at	nd analy	ze data ι	ising rea	ıl	Applyi	ng (K3)
4.	pr	oduce v	arious	graphs	and dis	tributio	n plots	using F	₹.	-3			Applyi	ng (K3)
5.	de	velop i	nterfaci	ing R to	other l	anguag	es.					_	Analyzi	ng (K4)
TEXT I	воок	S									=			
1.		is Brun ised Ed							r Spatia	l Analysi	s and M	apping,	2 nd	
2.		man M ss,2011		Γhe Art	of R Pi	rogram	ming: A	tour of	fStatisti	cal Softs	ware Des	sign" NO	Starch	¥1 30
REFE	ERENC	ES												
1.	Mai 201		ener, B	eginnir	ig R -Tl	he Stati	stical P	rogram	ming La	inguage .	John W	iley and	Sons,Inc	ì.,
2.		d P Lar es,2013		For Ev	eryone	: Adva	nced Aı	nalytics	and Gr	aphics A	ddsion-	Wesley 1	Data Ana	lytics
O-PO	MAPF	ING:										-		W 14-3-5-
			M (3/	apping 2/1 ind	of Cou	urse Ou	itcome	s with l	Program	mme Ou rong,2-N	tcomes	1-Weak		L 1
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CO2	1	2	-	3	-	1	-	-	•	-	-	2	-	2
CO3	3	-	1	2	2	-	-	-	-	-	2	1	-	2
CO4	2	2	2	3	-	-	-	2	: = 1	-	-		-	2
CO5	3	1	2	1	2			1	16.1	-	-	2	-	2



CI23250	SOFTWARE TESTING AND AUTOMATION	2	0	2	3
COUR	SE OBJECTIVES				
To enal	ble the students to				
1.	inderstand the basics of software testing				
2. 1	earn how to do the testing and planning effectively	7			
3. t	build test cases and execute them				
4. f	ocus on wide aspects of testing and understanding multiple facets of testing				
5. §	get an insight about test automation and the tools used for test automation				-
UNIT I	FOUNDATIONS OF SOFTWARE TESTING				6
IoT-An A	Architectural Overview - Building an architecture, Main design principles and nee	ded cap	abiliti		
loT arch	itecture outline, standards considerations. M2M and IoT Technology Fundame	entals-	Devic	es ar	d
gateways	s, Local and wide area networking, Data management, Business processes in Io	oT, Eve	rythin	g as	a
	XaaS), M2M and IoT Analytics, Knowledge Management			•	
UNIT I					5
	tion - Basics of embedded systems design - Embedded OS - Design constraints for	makila	ommli o		
- touch e	dware and software related - Architecting mobile applications - user interfaces for vents and gestures - Achieving quality constraints - performance, usability, secur ility.		0.00		is
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touch e	vents and gestures - Achieving quality constraints - performance, usability, secur		0.00		ıs
touch e	vents and gestures - Achieving quality constraints - performance, usability, securility.		0.00	ty ar	ıs
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- 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.

Mini Project: a) Build a data-driven framework using Selenium and TestNG

- 9. b) Build Page object Model using Selenium and TestNG
 - c) Build BDD framework with Selenium, TestNG and Cucumber

TOTAL PERIODS	30

COURSE OUTCOMES

At the e	nd of this course, the students will be able to	BT MAPPED (Highest Level)
COl	understand the basic concepts of software testing and the need for software testing	Applying (K3)
CO2	design Test planning and different activities involved in test planning	Understanding (K2)
CO3	design effective test cases that can uncover critical defects in the application	Applying (K3)
CO4	carry out advanced types of testing	Applying (K3)
CO5	automate the software testing using Selenium and TestNG	Understanding (K2)

TEXT BOOKS

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

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- 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
- 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.

CO-PO MAPPING:

		Programme Outcomes(POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO12	PSO1	PSO2	
CO1	3	2	2	2	1	-		-		-	-	-1	2	1	
CO2	1	2	-	3	-	1		-	-	-	-	2	-	2	
CO3	3	-	1	2	2	14	-	-	Re:	TH.	2	1	-	2	
CO4	2	2	-	3	112	-	-	2	-	-	-	-	-	2	
C05	3	1	2	1	2	-	-	1	-	-	-	2	-	2	



			DEVOPS			3	0	0		
COURS	E O	BJECTIVES								
To enal	ble tl	ne students to						-	-	
1	unc	erstand the differ	Version control tools lik	e Git, Mercurial		-				
2			of Continuous Integratio						-	
3	unc	lerstand Configura	on management using An	sible	ng/ Continuo	ous De	ploymen	ıt)		_
4			d drive the adoption of el		tools to	•				
5	imp	lement the devop	pelines	oud based Devops	tools to solv	e real-	world p	roble	ms	-
UNIT		INTRODUCTIO		0			-		T	
Devops I	Esse	ntials - Introductio	to AWS, GCP, Azure - Ve	arcion control	<i>C'</i> 10					
UNIT					ns: Git and G	itHub.	3			
1000 (0000)			BUILD USING MAVEN							1
UNIT I			ation of Gradle- understa							_
UNIT II Install & (Plugins to workspace	II Conf	CONTINUOUS figure Jenkins - Jenkins - Configurin Bamboo and its role	ins Architecture Overview Jenkins to work with Jav a CI/CD – Bamboo Archit	JENKINS AND BA v- creating a Jenkins ra- Git- and Mayen	AMBOO Job- Config	Ienkir	e Build		T 1 -	ng
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CO2	build continuous integration, Testing and Deployment in Jenkins by automating test cases using Maven & Gradle.	Analyzing (K4)
001	ability to perform automated continuous deployment.	Applying (K3)
CO3	ability to do configuration management using Ansible.	Applying (K3)
CO5	understand to leverage cloud-based DevOps tools using Azure DevOps.	Analyzing (K4)
1.	Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From I Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.	
2.	Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System Kindle Edition, 2014.	and Command Line"
REFI	EDENCES	
1.	Hands-On Azure DevOps: Cicd Implementation For Mobile, Hybrid, And Web Appl DevOps And Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure Paperback – 1 January 2020 by Mitesh Soni.	ications Using Azure ure (English Edition)
2	Jeff Geerling, "Ansible for DevOps: Server and configuration management for huma	ns", First Edition, 20

2.

David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second

3. Edition, 2016.

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. 4.

CO-PO MAPPING:

			(3,	/2/1 IIIG			Outcom				earum,		PS	Os
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-		1	2 ·	. 1
SER III	3	2	-	-	-				_	-	-	2	-	2
CO ₂	1	2	-	3	-	1					2	1		2
CO3	3	=	1	2	2	-	-	-	-		2	1		
CO4	2	2	(4)	3		T.S.	-	2	-	-		-	-	2
	-		2	1	2	-	-	1	-	-	-	2	-	2
CO ₅	3	1	2	1	-									



VERTICAL – III DATA CENTER TECHNOLOGIES

	DATA WAREHOUSING AND DATA MINING	3	0	0	3
COURSE O	BJECTIVES				
This course	vill enable the students to				- V
1. unde	erstand the design and implementation of a data store.				
2. acqu	ire knowledge on data and various preprocessing techniques.				
3. stud	the various correlation based frequent patterns mining in large da	tasets.			
4. learn	various classifiers in data mining.				
5. unde	erstand the data mining techniques and methods to be applied on lar	rge dat	asets.		
UNIT I	DATA WAREHOUSING			T	9
Data wareho	use - Basic Concept, Modeling, Design and usage; Implem	entatio	n -	Data	cube
	Methods, Data Generalization by Attribute, Oriented Induction App				
UNIT II	DATA MINING				9
Introduction -	Kinds of Data and Patterns, Major Issues in Data Mining, Statistic	al Dec	crinti	on of	-50
	ata Similarity and Dissimilarity; Data preprocessing - Data Clear		- 100		
	mation Data Reduction; Data Discretization- Concept Hierarchy Go			megra	atton,
			OII.		
UNIT III	ASSOCIATION RULE MINING s-Frequent Item set Mining Methods, A priori algorithm; A Pattern				9
	sed Association Mining.				
UNIT IV	CV + CCVTVC + TVCV				
Basic Concen	CLASSIFICATION				9
	ts- Decision Tree Induction, Bayes Classification Methods, Rule				ition,
Classification	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative				ition,
Classification	ts- Decision Tree Induction, Bayes Classification Methods, Rule				ition,
Classification	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative				ition,
Classification Learners, Othe UNIT V	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative er Classification Methods, Prediction.	e Clas	sificat	ion,	tion, Lazy
Classification Learners, Othe UNIT V Cluster analys	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative or Classification Methods, Prediction. CLUSTERING AND DATA MINING APPLICATIONS	Metho	sificat	rion,	Lazy 9 Based
Classification Learners, Othe UNIT V Cluster analys Methods, Mo	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative et Classification Methods, Prediction. CLUSTERING AND DATA MINING APPLICATIONS is, Partitioning Methods, Hierarchical Methods, Density Based	Metho	ods, C	ion, Grid E	Lazy 9 Based
Classification Learners, Othe UNIT V Cluster analys Methods, Mo Clustering An	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative or Classification Methods, Prediction. CLUSTERING AND DATA MINING APPLICATIONS is, Partitioning Methods, Hierarchical Methods, Density Based del Based Clustering Methods, Clustering High Dimensional D	Metho	ods, C	ion, Grid E	Lazy 9 Based
Classification Learners, Othe UNIT V Cluster analys Methods, Mo Clustering An	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative or Classification Methods, Prediction. CLUSTERING AND DATA MINING APPLICATIONS is, Partitioning Methods, Hierarchical Methods, Density Based del Based Clustering Methods, Clustering High Dimensional Dealysis -Outlier Analysis; Data Mining Applications - Financial Industrial Control of the Control of t	Metho Data, C	ods, Constra	orid Baint Baint B	Lazy 9 Based
Classification Learners, Othe UNIT V Cluster analys Methods, Mo Clustering An	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative or Classification Methods, Prediction. CLUSTERING AND DATA MINING APPLICATIONS is, Partitioning Methods, Hierarchical Methods, Density Based del Based Clustering Methods, Clustering High Dimensional Dealysis -Outlier Analysis; Data Mining Applications - Financial Eng, Intrusion Detection and Prevention.	Metho Data, C	ods, Constra	orid Baint Baint B	9 Based Based ence
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Classification Learners, Othe UNIT V Cluster analys Methods, Mo Clustering An and Engineerin COURSE O At the end of t	ts- Decision Tree Induction, Bayes Classification Methods, Rule by Back propagation, Support vector machines, Associative or Classification Methods, Prediction. CLUSTERING AND DATA MINING APPLICATIONS is, Partitioning Methods, Hierarchical Methods, Density Based del Based Clustering Methods, Clustering High Dimensional Dealysis -Outlier Analysis; Data Mining Applications - Financial Eng, Intrusion Detection and Prevention. TOTAL	Metho Data, C Data A	ods, Constrainalysi	DS APPE	9 Based Based ence

СОЗ	analyze the various correlation based frequent patterns mining in large datasets.	Applying (K3)
CO4	compare and contrast the various classifiers.	Analyzing (K4)
CO5	apply clustering techniques and methods to large datasets.	Understanding (K2)

- Jiawei Hanand Micheline Kamber, Data Mining Concepts and Techniques, 3rd Edition, Elsevier, 2012
- Parteek Bhatia Data Mining and Data Warehousing Principles and Practical Techniques, Cambridge University Press, 2019

REFERENCES

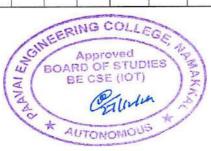
- Alex Berson and Stephen J.Smith,"Data Warehousing, Data Mining & OLAP", Tata McGraw Hill Edition, 35th Reprint 2016.
- K.P.Soman, Shyam Diwakar and V.Ajay, "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall of India, 2006.
- 3. Ian H.Witten and Eibe Frank,"Data Mining: Practical Machine Learning Tools and Techniques", Elsevier, Second Edition.
- 4. Sam Anahory and Dennis Murray, "Data Warehousing in the Real World", Pearson, 2006.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

		Programme Outcomes(POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2	1	-	-	-	-	-	1.	-	2	3	2	
CO2	3	3	2	1	1	-		•	-		-	3	3	2	
CO3	3	3	3	2	2	-		-	-	-	-	3	3	2	
CO4	3	3	2	2	1		-	2-	7-	_	-	3	3	2	
CO5	3	2	2	1	17.1	-	-	1-	-	-		3	3	2	



CI23	352			EDC	GE COM	PUTING				3	0	0	3
COUR	SE OBJE	ECTIVES										!	
This co	urse will	enable the stu	uden	its to									
1.	learn ab	out an overvi	iew (of the Ec	dge Comp	outing.							
2.	impleme	ent edge routi	ting a	and prote	ocols tecl	nniques.							
3.	apply va	arious topolog	gies	of cloud	d and fog.								
4.	perform	cloud pipelin	ne us	sing moo	deling fra	mework.							
5.	apply va	arious security	ty sch	hemes fo	or manip	ulation an	d storage	service	l.				
UNIT I	EDG	E COMPUTI	ING	;			170						9
Operati	ng syster	and definition on choice point omputing.				X Week				500		S	
UNIT I	I EDGI	E ROUTING	GAN	ND PRO	TOCOL	S							9
protoco UNIT I	I, STOMI	networking; P, AMQP.	g; Ed OG T	lge to C	OGIES	tocols -		MQTT-	SN, Co	onstra			
protoco UNIT I Topolog Constra OpenFo	II CLOU gies - Clo ined of cl	P, AMQP. UD AND FOO oud service m loud architect ce architectur	g; Ed OG Tonodel ctures are, E	OPOLO I, Public s for IoT	OGIES c, Private T; Fog Co	and Hyb	rid cloud - The Ha	, The O	PpenStac	onstra	oud a	rchite	cture,
protoco UNIT I Topolog Constra OpenFo	II CLOU gies - Clo ined of cl og referen V DATA	P, AMQP. UD AND FOO oud service m loud architect ce architectur AANALYTIC	g; Ed OG To nodel etures are, E	TOPOLO I, Public s for IoT EdgeX.	OGIES c, Private f; Fog Co	and Hybomputing	rid cloud - The Ha ING IN	, The O	OpenStac	ck ele	oud a	rchitecompu	cture.
DIVITION TOPOLOGY CONSTRA OPENFO UNITI Basic dand data History	II CLOU gies - Cloudined of cloudined of cloudined of cloudined of cloudined of cloudined and the clou	P, AMQP. UD AND FOO oud service m loud architect ce architectur	eg; Edd OG Tonodel OG Service Edges OG S	COPOLO I, Public s for IoT EdgeX. AND Ma -level cl cessing, rming m	OGIES c, Private f; Fog Co ACHINE loud pipe Lambda	and Hybomputing -	rid cloud The Ha ING IN s Engine re, Secto	THE E s, Inges	OpenStachhilosoph DGE stion – s sses; Ma	ck electory for stream	oud a fog	proce	oture, uting, 9 ssing n IoT
DIVITION TOPOLOGY CONSTRA OPENFO UNITI Basic dand data History	II CLOUDIES - Cloudined of clouding referent V DATA lata analytical lakes, Cury of AI in Forest, In	P, AMQP. UD AND FOO oud service m loud architecture AANALYTIC tics in IOT- omplex even and machine	OG Tonodels CCS A Top- 1 processes learned by the second of the secon	COPOLO I, Public s for IoT EdgeX. AND Ma- level cl cessing, rning m , CNN.	OGIES c, Private f; Fog Co ACHINE loud pipe Lambda hilestones	and Hybomputing -	rid cloud The Ha ING IN s Engine re, Secto	THE E s, Inges	OpenStachhilosoph DGE stion – s sses; Ma	ck electory for stream	oud a fog	proce	oture. uting. 9 ssing
DIVITION TO	II CLOUDE CLOUDE CONTROL CONTR	P, AMQP. UD AND FOO oud service m loud architecture ANALYTIC rtics in IOT- omplex even and machine Bayesian mod	OG Tonodel ctures are, E	COPOLO I, Public s for IoT EdgeX. AND Ma -level cl cessing, ming m , CNN. CURITY Anaton re defin	OGIES c., Private T; Fog Co ACHINE loud pipe Lambda nilestones my of IoT med perin	and Hybromputing	rid cloud The Ha ING IN s Engine re, Secto learning tacks, Ph ockchain	THE E s, Inges or Useca mysical a	openStachilosoph DGE stion – s ases; Mass, classi	ck elections characteristics are the constructions of the constructions of the construction of the constru	oud a fog	proce proce ning in Regres	9 sssing n IoT ssion,
DIVITION TO	II CLOUDE CLOUDE CONTROL CONTR	P, AMQP. UD AND FOO oud service m loud architecture ANALYTIC rties in IOT- complex even and machine Bayesian mod ND EDGE S Cyber Secun graphy, Soft	OG Tonodel ctures are, E	COPOLO I, Public s for IoT EdgeX. AND Ma -level cl cessing, ming m , CNN. CURITY Anaton re defin	OGIES c., Private T; Fog Co ACHINE loud pipe Lambda nilestones my of IoT med perin	and Hybromputing	rid cloud The Ha ING IN s Engine re, Secto learning tacks, Ph ockchain	THE E s, Inges or Useca mysical a	openStachilosoph DGE stion – s ases; Mass, classi	ck electory characteristics of the characteri	ning, e lear	proce ming in Regres	9 sssing n IoT ssion,
Dental Protoco UNIT I Topolog Constra OpenFo UNIT I Basic d and data Histor Randon UNIT V Edge S security Government	II CLOUDE CLOUDE CONTROL CONTR	P, AMQP. UD AND FOO oud service m loud architect ce architectur ANALYTIC tics in IOT- omplex even and machine Bayesian mod ND EDGE S Cyber Secun graphy, Soft llations and in	OG Tonodel ctures are, E	COPOLO I, Public s for IoT EdgeX. AND Ma -level cl cessing, ming m , CNN. CURITY Anaton re defin	OGIES c., Private T; Fog Co ACHINE loud pipe Lambda nilestones my of IoT med perin	and Hybromputing	rid cloud The Ha ING IN s Engine re, Secto learning tacks, Ph ockchain	THE E s, Inges or Useca mysical a	DenStachilosoph DGE stion – states; Mass, classiand hare crypto	ck electory characteristics of the characteri	ning, e lear	proce ming in Regres	9 sssing n IoT ssion, 9 Shell IoT,
UNIT I Topolog Constra OpenFo UNIT I Basic d and data Histor Randon UNIT V Edge S security Government	II CLOUDined of close referent V DATA lata analy a lakes, Cry of AI in Forest, In Forest, In Cryptoment regularity —	P, AMQP. UD AND FOO oud service m loud architect ce architectur ANALYTIC tics in IOT- omplex even and machine Bayesian mod ND EDGE S Cyber Secun graphy, Soft llations and in	eg; Edd OG Tonodel Topologic process Topologic process addels, SEC Trity, fitwar	COPOLO I, Public s for IoT EdgeX. AND Male cessing, aming man, CNN. CURITY Anaton re definition,	Cloud Pro OGIES c. Private T: Fog Co ACHINE loud pipe Lambda hilestones my of IoT ned perii	and Hybromputing	rid cloud The Ha ING IN s Engine re, Secto learning tacks, Ph ockchain	THE E s, Inges or Useca mysical a	DenStachilosoph DGE stion – states; Mass, classiand hare crypto	ck electory characteristic character	ning, e learnion, l	proce ming in Regres	ssing partial sides of the state of the stat

CO2	analyze Edge Routing and Networking Protocols	Analyzing (K4)
CO3	design cloud and Fog architecture in real world environment	Applying (K3)
CO4	train a ML model in IoT and Edge Computing platform	Analyzing (K4)
CO5	design and Implement Edge-Based secured Solutions	Applying (K3)

- 1. Perry Lea "IoT and Edge Computing for Architects", Second Edition, Publisher: Packet Publishing, 2020.
- Rajkumar Buyya , Satish Narayana Srirama , "Fog and Edge Computing: Principles and Paradigms", Wiley, 2019.

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- James Broberg, Andrzej M. Goscinski Rajkumar Buyya, "Cloud Computing: Principles and Paradigms", Wiley, 2011.
- Deepak Gupta (Editor), Aditya Khamparia (Editor) "Fog, Edge, and Pervasive Computing in Intelligent IoT Driven Applications", Wiley-IEEE Press, 2020.
- 4. Imad M. Abbadi "Cloud Management and Security", Wiley-IEEE Press,2014.

CO-PO MAPPING:

co-		Programme Outcomes(POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2	1		-	-	-	-	-	-	2	3	2	
CO2	3	3	2	1	1	-	-	-	140	-	-	3	3	. 2	
CO3	3	3	3	2	2	1	-	-	-	-	-	3	3	2	
CO4	3	3	2	2	1	 -	-	-	-		-	3	3	2	
CO5	3	2	2	1	-	-	-	-	-	1 -	A	3	3	2	



CI23	353	CLOUD SERVICES MANAGEMENT	3	0	0	3
COUR	SE OBJ	ECTIVES		4		
This co	urse will	enable the students to				
1.	introd	uce Cloud Services Management terminology, definition & conce	pts	-		-
2.	compa	ire and contrast cloud service management with traditional		vice		
3.		ement. Y strategies to reduce risk and eliminate issues associated with ad-	ontion o	fclo	nd	
4.		appropriate structures for designing, deploying and running cloud	-			
5.	786	ate the benefits and drive the adoption of cloud-based services to s				sue
UNIT I		CLOUD SERVICE MANAGEMENT FUNDAMENTALS				9
		m, The Essential Characteristics, Basics of Information Technology	m: Com	rica N		
Models		ce Management, Service Perspectives, Cloud Service Models, Cl	oud Ser	vice	Depl 	oyn
UNIT I		CLOUD SERVICES STRATEGY				9
Cloud S	Strategy	Fundamentals, Cloud Strategy Management Framework, Cloud	Policy.	Key	Dri	ver
Adoptic	n, Risk	Management, IT Capacity and Utilization, Demand and Capa	city ma	itchii	ng, D	Dem
Queueii	ıg, Chan	ge Management, Cloud Service Architecture				
UNIT I	II (CLOUD SERVICE MANAGEMENT				
Cloud S	ervice F	Reference Model, Cloud Service LifeCycle, Basics of Cloud Serv	ice Des	ign, I	Deali	ng v
Legacy	Systems	and Services, Benchmarking of Cloud Services, Cloud Service C	Capacity	Plar	ning	, Cl
Service	Deployr	nent and Migration, Cloud Marketplace, Cloud Service Operation	s Manag	geme	nt	
UNIT	IV C	CLOUD SERVICE ECONOMICS				9
Pricing	models	for Cloud Services, Freemium, Pay Per Reservation, Pay	per Us	er, S	ubsc	ript
based (Chargin	g, Procurement of Cloud-based Services, Capex vs Open	Shift,	Clo	ud s	serv
Chargi	ıg, Clou	ad Cost Models				
UNIT	v C	LOUD SERVICE GOVERNANCE AND VALUE				9
CITI		Devision Devision 10				
	ernance	Definition, Cloud Governance Definition, Cloud Governance	nce Fra	mew	ork,	Clo
IT Gov		ructure, Cloud Governance Considerations, Cloud Service				
IT Gov Govern	ance St		e Mode	el R	isk N	Mat
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CO2	understand Cloud Service Management Strategies.	Understanding(K2)
CO3	identify the Services of Cloud Technologies.	Understanding(K2)
CO4	select Appropriate Tools for Cloud Service Economics.	Analyzing(K4)
CO5	evaluate and optimize Cloud Governance for efficiency and effectiveness.	Analyzing(K4)

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CO-PO MAPPING:

COs					Progr	amme	Outcon	nes(PO	s)				P	SOs
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	2	3	2
CO2	3	3	2	1	1	-	-	-	-	72	-	3	3	2
CO3	3	3	3	2	2	-	-	-	-	:50	-	3	3	2
CO4	3	3	2	2	1	-	-	-	-	-	-	3	3	2
CO5	3	2	2	1	-	-	-	-	-	-	-	3	3	2



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COUR	SE OB	JECTIVES		T					-								-	_	
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2.	descr	ibe various s	torag	ge n	netv	wor	rkins	g tech	hnole	ogies									
3.	5-16-7	fy different		-		2.7.5	0.00	-			es								
4.	discu	ss the differe	ent ba	ack	kup	and	d rec	cover	ry str	rategie	es								
5.	under	stand comm	on sto	tora	age	ma	anag	emer	nt ac	tivitie	es and	soluti	ons						
UNIT	I	STORAG	E SY	YST	TE	MS	3												9
Cloud analyti	compu	n of computing and its cial networomputer systems	s esse king	sent g ar	tial ind	cha	narac obile	eterisi e coi	stics mpu	Cloud	d serv Data	ices a	ind c	loud nviro	depl nmen	oymen t: Bu	it mod	iels,	Big
UNIT	II	INTELLI	GEN'	NT S	ST	OR	RAG	E SY	YST	EMS	AND	RAII)						9
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	various models of Cloud infrastructure services and deployment.	3
CO2	illustrate the usage of advanced intelligent storage systems and RAID	Applying(K3)
СОЗ	interpret various storage networking architectures - SAN, including storage subsystems and virtualization	Applying(K3)
CO4	examine the different role in providing disaster recovery and remote replication technologies	Analyzing(K ')
CO5	infer the security needs and security measures to be employed in information storage management.	Analyzing(K4)

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CO-PO MAPPING:

CO-					Progr	amme	Outcon	nes(PO	s)				P	SOs
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	4	-	-	2	3	2
CO2	3	3	2	1	1	-	52	-		252	-	3	3	2
CO3	3	3	3	2	2	-	-	-		-	-	3	3	2
CO4	3	3	2	2	1	-	7-	2=	-	-	-	3	3	2
CO5	3	2	2	1	-	-	-	-	-		-	3	3	2



C1233.	55 IOT PLATFORMS AND SYSTEM DESIGN	3	0	0	3
COUR	SE OBJECTIVES				
This co	urse will enable the students to				
	explain the key requirements for implementing IoT with Arduino Uno and	Raspb	erry	Pi	
1.	development boards.				
2.	describe the Node-RED tool and python code for designing the IoT applications	n Rası	berr	PI.	
3.	understand IoT security issues and concerns to create awareness.				
4.	learn programming languages like C, Java, and Python.				
5.	learn about real-world use cases of IoT systems.				
UNIT	IMPLEMENTING IOT WITH ARDUINO				9
Introdu	ction to Arduino Platforms, Arduino Uno architecture, IDE setup, importing	Arduir	o bo	ards	in
Arduin	o IDE tool, Installation of Arduino libraries, Basics of Embedded C Programming	g. Inte	rfacin	g of	
	s and Actuators with Arduino Uno.				
UNIT	II IMPLEMENTING IoT WITH RASPBERRY Pi (RPi)			T	_
A	II INFLEMENTING OF WITH KASEDERKI FIREI			F 2	0
installi	functionality of RPi board, RPi GPIO pins, Reading the datasheet of RPi setting OS, first boot and basic configuration of Rpi, Basic Linux Commands, Accessive tworking tools, Interfacing Interfacing of Sensors and Actuators with RPi.				-
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installinusing n UNIT I Prerequiservice	functionality of RPi board, RPi GPIO pins, Reading the datasheet of RPi setting OS, first boot and basic configuration of Rpi, Basic Linux Commands, Accessive tworking tools. Interfacing Interfacing of Sensors and Actuators with RPi. NODE-RED TOOL ON Rpi tisite for Node-RED, Installing and upgrading Node-RED, Running Node-RED and	op loca	remo	nd as	9 a
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using n UNIT I Prerequiservice Creation	functionality of RPi board, RPi GPIO pins, Reading the datasheet of RPi setting OS, first boot and basic configuration of Rpi, Basic Linux Commands, Accessive tworking tools, Interfacing Interfacing of Sensors and Actuators with RPi. III NODE-RED TOOL ON Rpi triste for Node-RED, Installing and upgrading Node-RED, Running Node-RED and on network, auto-start on boot, opening the editor, installation of various libraries in and deployment of flows, Case studies on debug window, HTTP server, characteristics.	op loca	remo	nd as -RED	9 a D,
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At the e	nd of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	use Arduino Uno for designing the IoT applications.	Understanding (K2)
CO2	illustrate use of Raspberry Pi for designing the IoT applications	Applying (K3)
CO3	develop an IoT system with Node-RED tool using Raspberry Pi	Understanding (K2)
CO4	develop the logic for Python Programming.	Understanding (K2)
CO5	understand IoT security systems.	Applying (K3)

- Programming the Raspberry Pi: Getting Started with Python, Simon Monk, 3rd Edition, Tata McGraw Hill Publication. 2021.
- 2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

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- Exploring Raspberry Pi: Interfacing to the real world with Embedded Linux, Derex Molly, 1st Edition, ISBN: 978-1119188681, Wiley Publication, 2016.
- 3. Arduino Programming in 24 hours, Richard Blum, 1 st Edition, ISBN: 978-0672337123, Sams Teach Yourself Publishing.2014.
- Aditya Gupta, "The IoT Hacker's Handbook: A Practical Guide to Hacking the Internet e^α Things", ISBN: 1484242998, Apress publisher, 2019.

CO-PO MAPPING:

COs					Progr	amme	Outcor	nes(PC	s)				PSC	Os
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	1	- E	-	2	3	1
CO2	3	3	3	3	1		-	-	2		-	2	3	1
CO3	3	3	3	3	2	140	(4)	-	3	2	-	2	1	2
CO4	3	2	3	2	3	-	-	-	3	-	-	2	2	3
CO5	3	2	2	2	2			-	2	-	-	2	2	2



CI233	356	so	TWARE	DEFINED NI	ETWORKS			3	0	0	3
COUR	SE OB.	JECTIVES							7, -2,		
This cou	urse wi	l enable the st	idents to								
1.	under	rstand the need	for SDN	and its data plan	ne operation	s				-	
2.	under	stand the fund	ions of co	ntrol plane							
3.	comp	rehend the mi	ration of	networking fun-	ctions to SE	N environn	nent				
4.	explo	re various tecl	niques of	network function	on virtualiza	tion					
5.	comp	rehend the cor	cepts behi	nd network virt	tualization						
UNIT I	s	DN: INTROI	UCTION	I							9
Evolving and App	g Netwolication	ork Requirem Plane.	ents-The	SDN Approach	1–SDN arch	itecture-SD	N Data P	lane,	Con	trol p	olane
UNIT II	S	DN DATA PI	ANE AN	CONTROL	PLANE						9
Data Pla	ane fun	ctions and pr	otocols –	Open Flow Pr	rotocol – F	ow Table	- Control	Dlan	o Eu	natio	
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soumbo	und Inte	erface, Northb	ound Inter	face-SDN Con	trollers - Or	en Day ligh	t				
	und Inte	erface, Northb	ound Inter	face–SDN Con	trollers - Op	en Day ligh	t				9
UNIT II	und Inte	erface, Northb	ound Inter	face-SDN Con	trollers - Op		t	ffic F	Engin	peerin	9
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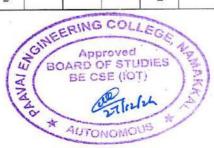
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 O'Reilly Media, 2017

CO-PO MAPPING:

					Progr	amme	Outcon	nes(PO	s)				PSO	s
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	122	1		-	2	3	1
CO2	3	3	3	3	1	-	-	-	2	-	-	2	3	1
CO3	3	3	1	3	2	-	2	-	3	-	-	2	1	2
CO4	3	2	3	2	3	-	2	-	3	-		2	2	3
CO5	3	2	2	2	2		_	0.40	2	-	-	2	2	2



CI233		VIRTUALIZATION	3	0	0	
		DBJECTIVES				
This co		will enable the students to				
2	anal	yze the basic concepts of virtualization technology to derive the best practic	ce mode	el for dep	loyi	ng
1.		d-based applications.				
2.	crea	te an application by utilizing cloud platforms such as Amazon Web Service	es and V	Vindows	Azı	ıre
3.	iden	tify major security and privacy problems in cloud computing environment.				
4.	appl	y the ability to use the architecture of cloud, service and delivery models.				
5.	imp	lement the key enabling technologies that help in the development of cloud	i.			
UNIT		UNDERSTANDING VIRTUALIZATION				100
Describ	ing \	Virtualization - Microsoft Windows Drives Server Growth - Explaining Mod	ore's La	w Under	stan	di
the Im	oorta	nce of Virtualization - Examining Today's Trends - Virtualization as	nd Clo	ud Com	putii	15
		ng Virtualization Software Operation - Virtualizing Servers Virtualizing				
Applica				Marin Resident		
	rione				-	
* ** * * *** * *		WARDING ORG				1000
UNIT	14.57	HYPERVISORS	1.11		9	
Describ	ing a	Hypervisor -Exploring the History of Hypervisors -Understanding Type			- Ty	p
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	RSE OUTCOMES end of the course, the students will be able to	BT MAPPED (Highest Level)
CO1	analyze the concept of virtualization and its properties.	Analyzing (K4)
CO2	apply different forms of virtualization.	Applying (K3)
CO3	implement various architectures for implementing virtualization methods.	Applying (K3)
CO4	create virtual machines and installing various operating systems.	Analyzing (K4)
CO5	evaluate the performance of the virtual machines and deployed applications.	Analyzing (K4)

- Matthew Portney, Virtualization Essentials, John Wiley & Sons, Second Edition, 2016.
- 2. Kailash Jayaswal, Jagannath Kallakurchi, Donald J.Houde, Dr.devan Shah, "Cloud Computing Black Book", Dreamtech press, 2015.

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- 1. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi S, "Mastering in Cloud Computing", McGraw Hill Education, (India) Private Limited, 2013.
- 2. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013.
- Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, 3. Management and Security", CRC Press, 2017.
- George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in 4. the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

CO-PO MAPPING:

COs	Programme Outcomes(POs)													
CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	2	1	_	-	-	1	-	-	2	3	1
CO2	3	2	3	3	1	-	-	-	2	-	-	2	3	1
CO3	3	3	3	1	2	-		-	3	-	-	2 .	1	2
CO4	3	2	3	2	3	-	-	-	3	-	-	2	2	3
CO5	3	2	2	2	2		-		2	-	-	2	2	2



VERTICAL - IV NETWORKS & SECURITY

CI234	4 51	CRYP	TOGRAPHY AND NETWORK SECURITY	3	0	0	3
COU	RSE O	BJECTIVES					
To en	able the	students to					
1.	unde	stand the fundame	ntal concepts of cryptographic systems.				
2.	apply	symmetric and as	ymmetric encryption techniques.				
3.	distri	bution mechanisms					
4.	mech	anisms.	ernet security protocols such as SSL, TLS, HTTPS,				
5.		estand emerging se sion detection	curity trends including endpoint security, IoT secur	rity, and AI	applic	ations	in
UNIT	' I	FOUNDATIONS	OF CRYPTOGRAPHY				9
Introd	luction	· Cybersecurity, In	formation Security and Network Security - Security	Attacks - S	Securit	y Servi	ces –
Secur	ity Mec	hanisms – OSI Sec	urity Architecture - Cryptography - Network Securi	ty – Trust ar	nd Trus	tworth	iiness
- Clas	ssical E	neryption Technic	ues - Symmetric, Substitution and Transposition	Ciphers -	Rotor	Machi	nes –
	analysi						
UNIT			IPHERS AND BLOCK CIPHERS				9
			ock Cipher Structure – The Data Encryption Star	ndard – Blo	ck Cir	her D	1 5
			on Standard: Structure - Key Expansion Algorithm				
			ion - Stream Ciphers - RC4 - LFSR - Case Stud				
				iy. Lightwe	ight Ci	yptogi	apny
conce	pts - Li	*	for IoT (PRESENT, SPECK).				
UNIT	1 10000000		RYPTOGRAPHY				9
			- Modular Arithmetic - Euler's Theorem - Principle				
- RSA	A Algor	ithm – Diffie-Hell	man Key Exchange - Elliptic Curve Cryptography	(ECC) –H	ash Fu	nction	s and
Appli	cations	- SHA-512 – HMA	AC - Digital Signatures – DSA – Key Management	– Symmetri	c, Asyı	nmetri	c and
Public	c Key I	istribution - X.50	9 Certificates.				
UNIT	T IV	NETWORK AN	D INTERNET SECURITY				9
		hentication Requir	rements and Functions - IP Security overview and	policy- Se	cure S	ocket !	Layer
(SSL)	– Wel	Security Consider	rations - Transport Layer Security (TLS) - HTTPS	– Wireless	and M	obile d	levice
20			ternet Mail Architecture - Email Threats - S/MIM				
Priva							
UNIT		EMERGING TE	RENDS IN NETWORK SECURITY				9
			Firewall - Intrusion Detection System - DDOS a	ttack - Clo	ud Sec	curity -	- IoT
			of Big Data Analytics – Security of Smart City – Ar				
		ision Detection Sy					
	-			TOTAL	PER	IODS	45
				IVIA	TIT	TO TOO	100

At the	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain the fundamentals of security services, attacks, and classical encryption techniques including substitution and transposition.	Understanding (K2)
CO2	apply block cipher principles such as DES and AES and implement lightweight encryption algorithms for IoT applications.	Applying (K3)
CO3	apply number theory and cryptographic principles to implement RSA, ECC, and digital signature algorithms.	Applying (K3)
CO4	understand the functioning of network-level security protocols like TLS, HTTPS, S/MIME, and DNSSEC.	Understanding (K2)
CO5	analyze the impact of emerging security threats such as DDOS and identify AI-based solutions in smart city and big data security contexts.	Analyzing (K4)

- William Stallings, "Cryptography and Network Security: Principles and Practice", 8th Edition, Pearson Education, 2023.
- Sarhan M. Musa, "Network Security and Cryptography: A Comprehensive Guide to Network Protection and Encryption Techniques", Mercury Learning and Information, Packt, 1st Edition, 2024.

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- Charles P. Pfleeger and Shari Lawrence Pfleeger, "Security in Computing", 5th Edition, Pearson Education, 2022.
- 2. Behrouz A. Forouzan, "Cryptography and Network Security", 3rd Edition, McGraw Hill, 2023.
- 3. Niels Ferguson, Bruce Schneier, and Tadayoshi Kohno, "Cryptography Engineering", Wiley, 2021.
- Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography", second edition, Chapman & Hall Book, CRC Press, 2011.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

		PSO's												
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	-	1	-		-	1	3	1
CO2	3	3	3	2	1	-	-	1	-	94	8 🖦	2	3	2
CO3	3	3	3	3	2	-	-	1	-	-		2	3	2
CO4	3	2	2	2	2	2	-	-	-	15	-	3	3	1
CO5	2	2	2	3	3	3	1	2	-	-	~	3	3	3



	152	MOBILE AD HOC NETWORKS	3	0	0	3
COUI	RSE OB.	SECTIVES				
To ena	able the s	tudents to				
1	1	and the fundamentals of ad hoc wireless networks and analyze various for such networks.	MAC I	ayer pı	otocol	S
2	explore	and classify routing protocols based on their design strategies and applic	ability	in MA	NETs.	6
3	enhanc	bout transport protocol challenges in ad hoc environments and study (ements.				
4	networ					
5	advanc	and cross-layer design approaches, applications of MANETs, and ements including integration with IoT, AI, and blockchain.	recent	techno	ologica	
UNIT	I	NTRODUCTION AND MAC PROTOCOLS				9
Ad ho	c Wirele:	ss Networks - Cellular vs Ad hoc Wireless Networks - Characteristics and	d applic	ations	of Ad	Нос
Netwo	orks – Iss	ues in Ad Hoc Wireless Networks - Need for Medium Access - Classific	cation c	f MAC	Prote	cols
- Con	tention-E	ased MAC Protocols with Reservation Mechanisms (MACA, MACA-	BI) - 1	Multip	le Cha	nnel
MAC	Protocol	s – Power-Aware MAC Protocols.				
UNIT	II F	ROUTING PROTOCOLS				9
Design	n issues o	of Routing Protocols - Classification of Routing Protocols - Proactive Ro	uting P	rotocol	s – Hy	brid
Routin	ng Protoc	ols - Classification of Multicast Routing Protocols - QoS Routing.				
UNIT		RANSPORT PROTOCOLS AND QOS				9
		ocols: Challenges and design goals – TCP performance – Ad hoc Transpo	ort Prote	ocols –	Ouali	_
	•	nges - Classification of QoS Solutions - QOS extension to AODV Protoc				
		INORA.				
UNIT						
		NERGY MANAGEMENT AND MOBILITY MODELS				9
Energ	w Manao	ENERGY MANAGEMENT AND MOBILITY MODELS rement schemes – Energy-efficient routing protocols – Transmission P	ower o	ontrol	- AO	5-70
	and the second second	ement schemes - Energy-efficient routing protocols - Transmission P				DV:
LEAR	R, PAR ai	ement schemes – Energy-efficient routing protocols – Transmission P nd LPR - Mobility Models – Limitations of Random Waypoint Model - G				DV:
LEAR	R, PAR at	ement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - G	eograp	hic Re	strictio	DV: ons.
LEAR UNIT	R, PAR and A	ement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - G APPLICATIONS AND RECENT DEVELOPMENTS esign – Definition – Principle – Architecture – Approach – Performance	eograp	hic Re	Proto	DV: ons. 9 cols.
LEAR UNIT Cross- PAN	R, PAR and PAR	ement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - GAPPLICATIONS AND RECENT DEVELOPMENTS esign – Definition – Principle – Architecture – Approach – Performance ations and Opportunities – Challenges - Recent Developments – Cas	e objec	hic Re	Proto-	DV: ons. 9 cols. n of
LEAR UNIT Cross- PAN MAN	R, PAR and Park Applied Applied ETs with	rement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - Graphical Scheme Sch	e objec	hic Re	Proto-	DV: ons. 9 cols. n of
LEAR UNIT Cross- PAN MAN	R, PAR and PAR	rement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - Graphical Scheme Sch	e objec	hic Re	Proto-	DV: ons. 9 cols. n of
LEAR UNIT Cross- PAN MAN	R, PAR and Park Applied Applied ETs with	ement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - Graphical Scheme Scha	e objec	tives –	Proto- egration To	DV: ons. 9 cols. n of
LEAR UNIT Cross- PAN MAN OMN	R, PAR and PV A-Layer D - Applied ETs with	ement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - Graphical Scheme Scha	e objecte Studenance	tives –	Proto- egration To	DV: ons. 9 cols. n of
LEAR UNIT Cross- PAN MAN OMN	R, PAR and PV A Applied ETs with RET++/Glo	rement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - Graphications and Recent Developments Resign – Definition – Principle – Architecture – Approach – Performance ations and Opportunities – Challenges - Recent Developments – Cas IoT - Blockchain and AI in MANET Security - Simulation and Performance of MoSim. TOTOMES nis course, students will be able to	e objected see Studenance of OTAL	tives –	Proto- egratio tion Te	DV: 9 cols. n of
LEAR UNIT Cross- PAN MAN OMN	R, PAR and PV A Applied ETs with ET++/Glo	ement schemes – Energy-efficient routing protocols – Transmission P and LPR - Mobility Models – Limitations of Random Waypoint Model - Graphical Scheme Scha	e objected see Studenance DOTAL	tives – ty: Inte	Proto- egratio tion Te	DV: 9 cols. 9 45

CO3	address the challenges in mobility, QoS, and energy constraints and propose solutions.	Analyzing (K4)
CO4	analyze the role of MANETs in IoT systems, VANETs, and UAV networks.	Analyzing (K4)
CO5	discuss link layer protocols, wireless technologies, and network security techniques and incorporate into IoT environments.	Understanding (K2)

- C. Siva Ram Murthy, B. S. Manoj, "Ad Hoc Mobile Wireless Networks: Principles, Protocols, and Applications", Pearson Education, 2004.
- Carlos de Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc & Sensor Networks Theory and Applications", World Scientific, 2006.

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- 1. Charles E. Perkins, "Ad Hoc Networking", Addison-Wesley, 2001.
- 2. Jan F. Akyildiz et al., "Wireless Sensor Networks: A Survey", Computer Networks, 2002.
- 3. Mohammad Ilyas, "The Handbook of Ad Hoc Wireless Networks", CRC Press, 2002.
- Holger Karl and Andreas Willig," Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

			PSO's											
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	2	-	-	-	-	-	1	1	3	3
CO2	3	2	2	2	2	1	1	-	1	2	2	1	3	2
CO3	3	3	2	2	1	1	-	-	1	-	2	1	2	3
CO4	3	3	3	2	1	1		2	2	-	-	1	3	3
CO5	3	3	2	2	-	-	-		-	(34)	-	1	2	2



C123453		NETWORK SECURITY 3	0	0	3
COURSE	OBJECTIVES				
To enable	the students to				
1. une	derstand fundament	tal principles, models, and standards in network security.			
2. lea	rn principles to seco	ure user authentication and describe identity management technique	es.		
- 3. ana	alyze secure commu	unication protocols for confidentiality and integrity.			
		ol and cloud security mechanisms			
5. ex	olore system-level d	defenses and emerging security paradigms.			
UNIT I	INTRODUCTION	ON TO NETWORK SECURITY			9
Security co	oncepts - CIA triad	- OSI Security Architecture - Security attacks, services, and mechanical	anisms	– Att	tack
		security design principles - Overview of security standards and	securit	ty po	licy
framework	s.				
UNIT II	USER AUTHE	NTICATION AND IDENTITY MANAGEMENT			9
User auther	ntication principles	- Remote user authentication - Kerberos protocol - X.509 Certifica	tes – C	ertific	
					cate
	- Public Key Infra	structure (PKI) - Federated Identity Management - Single Sign-Or	n (SSO).	cate
Authorities	T		n (SSO	T	
Authorities UNIT III	SECURE COM	structure (PKI) – Federated Identity Management – Single Sign-Or			9
Authorities UNIT III Web and tr	SECURE COM	structure (PKI) – Federated Identity Management – Single Sign-Or MUNICATION PROTOCOLS ity – TLS Protocol, HTTPS – Secure Shell (SSH) – IPsec Protocol:	ESP,	AH, I	9 IKE
Authorities UNIT III Web and tra Virtual P	SECURE COM	structure (PKI) – Federated Identity Management – Single Sign-Or	ESP,	AH, I	9 IKE
Authorities UNIT III Web and tra Virtual P SPF, DKIM	SECURE COM ansport-layer securi rivate Networks (V I, DMARC.	structure (PKI) – Federated Identity Management – Single Sign-Or MUNICATION PROTOCOLS ity – TLS Protocol, HTTPS – Secure Shell (SSH) – IPsec Protocol:	ESP,	AH, I	9 IKE
Authorities UNIT III Web and tr. Virtual P SPF, DKIM UNIT IV	SECURE COM ansport-layer securi rivate Networks (V I, DMARC.	structure (PKI) – Federated Identity Management – Single Sign-Or MUNICATION PROTOCOLS ity – TLS Protocol, HTTPS – Secure Shell (SSH) – IPsec Protocol: PNs) – Email security protocols: S/MIME and PGP – DNS Secu	: ESP, .	AH, I	9 IKE EC,
Authorities UNIT III Web and tr. Virtual P SPF, DKIM UNIT IV Network A	SECURE COM ansport-layer securivate Networks (VII. DMARC. NETWORK ACceess Control (NAC	structure (PKI) – Federated Identity Management – Single Sign-Orthodols IMUNICATION PROTOCOLS ity – TLS Protocol, HTTPS – Secure Shell (SSH) – IPsec Protocol: IPNs) – Email security protocols: S/MIME and PGP – DNS Secure Structure Security PGP – DNS Secure Secure Secure Secure Secure Secure Security PGP – DNS Secure Security PGP – DNS Secure Security PGP – DNS Secure Secure Secure Secure Secure Secure Secure Security PGP – DNS Secure Secure Security PGP – DNS Secure Secure Security PGP – DNS Security PGP – DNS Security	ESP,	AH, I DNSSI	9 IKE EC, 9
Authorities UNIT III Web and tr. Virtual P SPF, DKIN UNIT IV Network Ac RADIUS an	SECURE COM ansport-layer securivate Networks (VII. DMARC. NETWORK ACceess Control (NAC	structure (PKI) – Federated Identity Management – Single Sign-OrdMUNICATION PROTOCOLS ity – TLS Protocol, HTTPS – Secure Shell (SSH) – IPsec Protocol: /PNs) – Email security protocols: S/MIME and PGP – DNS Secure Structure CCESS CONTROL AND CLOUD SECURITY C) – IEEE 802.1X and EAP – Authentication protocols (EAP-TLS decomputing models – Cloud security risks and mitigation – Security	ESP,	AH, I DNSSI	9 IKE EC, 9
Authorities UNIT III Web and tr. Virtual P SPF, DKIM UNIT IV Network Ac RADIUS ar (SecaaS) —	SECURE COM ansport-layer securivate Networks (VII., DMARC. NETWORK ACCecess Control (NACC) and Diameter – Cloud Cloud governance a	structure (PKI) – Federated Identity Management – Single Sign-OrdMUNICATION PROTOCOLS ity – TLS Protocol, HTTPS – Secure Shell (SSH) – IPsec Protocol: /PNs) – Email security protocols: S/MIME and PGP – DNS Secure Structure CCESS CONTROL AND CLOUD SECURITY C) – IEEE 802.1X and EAP – Authentication protocols (EAP-TLS decomputing models – Cloud security risks and mitigation – Security	ESP,	AH, I DNSSI P, etc.	9 IKE EC, 9
Authorities UNIT III Web and tr. Virtual P SPF, DKIM UNIT IV Network Ad RADIUS an (SecanS) —	SECURE COM ansport-layer securivate Networks (V I, DMARC. NETWORK ACccess Control (NACcond Diameter – Cloud Cloud governance at SYSTEM SECU	structure (PKI) – Federated Identity Management – Single Sign-Orthonology MUNICATION PROTOCOLS ity – TLS Protocol, HTTPS – Secure Shell (SSH) – IPsec Protocol: PNS) – Email security protocols: S/MIME and PGP – DNS Secure Structure (SCESS CONTROL AND CLOUD SECURITY) C) – IEEE 802.1X and EAP – Authentication protocols (EAP-TLS and computing models – Cloud security risks and mitigation – Security and compliance.	ESP, arity: D	AH, I DNSSI P, etc.	9 EC. 9
Authorities UNIT III Web and tr. Virtual P SPF, DKIM UNIT IV Network Ac RADIUS ar (SecaaS) — UNIT V Types of ma	SECURE COM ansport-layer securivate Networks (V I, DMARC. NETWORK AC and Diameter – Cloud Cloud governance a SYSTEM SECU	Structure (PKI) – Federated Identity Management – Single Sign-OrdMUNICATION PROTOCOLS ity – TLS Protocol, HTTPS – Secure Shell (SSH) – IPsec Protocol: /PNs) – Email security protocols: S/MIME and PGP – DNS Secure Structure CCESS CONTROL AND CLOUD SECURITY C) – IEEE 802.1X and EAP – Authentication protocols (EAP-TLS and computing models – Cloud security risks and mitigation – Security and compliance. URITY AND FIREWALLS rms, trojans, rootkits, APTs – Intrusion detection and prevention systems.	ESP, arity: D	AH, I DNSSI P, etc.	9 9 9
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- William Stallings, "Network Security Essentials: Applications and Standards", Sixth Edition, Pearson, 2017.
- 2. Behrouz A. Forouzan, "Cryptography and Network Security", 1st Edition, McGraw-Hill.

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- 1. Behrouz A. Forouzan, "Introduction to Cryptography and Network Security", McGraw-Hil.
- 2. William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson.
- 3. Perrig, D., & Szewczyk, R., "Security and Privacy in Internet of Things (IoT)", IEEE Journals, Springer chapters.
- 4. Joseph Migga Kizza, "Guide to Computer Network Security", Springer International Publishing, 2024.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

		Programme Outcomes PO's														
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO1	3	2	-	-		-	-	-	-	-	-	-	-	1		
CO2	3	2	2	-	2	-	-	-	-	-	S.T.			-		
CO3	3	2	2	2	1	2	-	-	-	-	-	120	525	2		
CO4	3	2	2	2	2	-	-	-	-	5	-	-	.=:	2		
CO5	3	3	3	3	2	1	1	-	-	-	-	-	-	3		



CI234	154	CYBER SECURITY	3	0	0	3
cou	RSE OBJECTIVES					
To en	able the students to					
1.	understand modern cy	bersecurity principles, threats, and defenses.				
2.	classify attackers, ma	lware, and social engineering techniques.				
3.	understand cryptograp	phic principles and forensic techniques for secure and lawf	ful digital	investig	atio	n.
4.	explore mobile, cloud	, and IoT-related cybersecurity challenges.				
5.	explain AI-Blockchai	n-enabled cybersecurity models.		WT- 218C91		
UNIT	I INTRODUCT	ON TO CYBERSECURITY			1	9
Cyber	security Fundamentals	- CIA Triad (Confidentiality, Integrity, Availability) - T	hreats: M	lalware,	Vir	uses,
		- Vulnerabilities and Attack Surfaces - Passive/Active A				
Cyber	Kill Chain – Defense in	n Depth - Real-Time Case Studies: Mirai, WannaCry.				
UNIT	II MALWARE, A	ATTACKS, AND SOCIAL ENGINEERING				9
Classi	fication of Hackers - T	hreat Actors: Script Kiddies, Hacktivists, Cybercriminals	s, State Ac	ctors - N	Malw	are:
Rootk	its, Logic Bombs, Keylo	oggers - Phishing, Spear Phishing, Social Engineering - (Command	l & Con	trol	(C2)
– Hon	eypots – Incident Respo	onse and Cyber Ethics.				
UNIT	III CRYPTOGRA	PHY AND CYBER FORENSICS				9
Зasic	Cryptography – Symme	etric & Asymmetric Encryption - Hashing - Digital Sign	natures - S	Stegano	grap	hy –
IoT Cı	ypto Basics – Cyber La	ws (IT Act India, GDPR) - Ethics - Digital Forensics To	ools – Evi	dence C	ollec	ction
– Chai	n of Custody - Investig	ation Tools (Autopsy, FTK).				
UNIT	IV CLOUD, MOB	ILE, AND NETWORK SECURITY			T	9
Mobile	e & IoT Vulnerabilities	- App, OS, Network Layer Issues - QR/NFC/OTP Explo	oits – Clou	id Threa	ats: I	oS,
API H	acking – Zero Trust & I	AM – VPNs – TLS/SSL – Wi-Fi Security (WPA2/WPA3	3) - Real-	World I	Bread	ches
– Netv	vork Security Basics (Fi	rewall, IDS, VPN).				
UNIT	V AI/ML, BLOC	KCHAIN, AND IoT SECURITY	40			9
IoT De	evice Security - Secure	Communication Protocols (MQTT, CoAP) - Blockchain	for IoT –	Smart C	Contr	acts
– AI ii	n Threat Detection - Be	ehavior Anomaly Detection - AI/Blockchain Case Studi	ies: Smar	t City, e	:-He	alth,
Survei	llance, Smart Grid.					
	N.	Г	TOTAL P	ERIOI	os	45
COUF	RSE OUTCOMES					
At the	end of this course, stude	ents will be able to		Марр		
CO1	explain the core conce	pts of cybersecurity and emerging threats.		hest Le tanding		`
CO2	A Company of the Comp	are, threat actors, and social engineering techniques to		tanding		
	support ethical incider		Onders	ginning	(112	,
CO3	227	orensic tools to ensure data security, evidence integrity,	Ann	lying (K	(3)	
203	and legal compliance.	orense tools to ensure data security, evidence integrity,	App	iying (N)	
	and regar compilance.					

CO4	analyze vulnerabilities in mobile, cloud, and IoT platforms.	Analyzing (K4)
CO5	design secure AI/Blockchain-enabled IoT Systems.	Applying (K3)

- 1. Chuck Easttom, "Computer Security Fundamentals", Pearson, 5th Edition, 2023.
- 2. James Graham, Richard Howard, Ryan Olson, "Cyber Security Essentials", CRC Press, 2011

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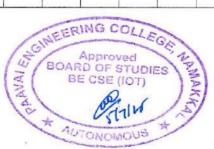
- 1. William Stallings, "Network Security Essentials: Applications and Standards", Pearson, 6th Edition.
- 2. CyBOK Consortium, "The Cyber Security Body of Knowledge (CyBOK)", v1.0.
- Nancy R. Mead Carol C. Woody, "Cyber Security Engineering A Practical Approach for Systems and Software Assurance", Addison Wesley, 2017.
- 4. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations ", CRC Press, 2016.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's										PSO's			
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	353	2	170	-	-	-	-	2	3	2
CO2	3	3	2	-		-	-	-	-	-	-	2	3	2
CO3	3	2	2			-	-	-	-	: -		2	3	2
CO4	3	3	2	-	-	2	-	-	-	-	-	2	3	2
CO5	3	3	3	200	-	7.	9 7 6	S=		S.	-	2	3	2



CI23455		PRIVACY AND SECURITY IN IOT		3	0	0	3
COURSE O	BJECTIVES						
To enable the	e students to						
1. knov	v the state-of-the-	rt methodologies in Cyber Physical system.					
2. unde	rstand cryptograp	nic primitives, privacy protection, and trust fr	ameworks i	n IoT			
3. explo	ore the Privacy Pr	servation and Trust Models in Internet of Th	ings (IoT).				
4. organ	nize and analyze t	ne concept of Internet of Things Security.					
5. plan	and design IoT se	curity and lightweight cryptographic based a	pplication.		AV-		
UNIT I	CYBER PHYS	CAL SYSTEMS AND INTERCONNECT	ION OF TH	HREATS	S		9
for IoT devel Vehicular No	lopment, IoT secu	i, IoT security (vulnerabilities, attacks, and control lifecycle. Network Robustness of Internet Propagation and Control in Internet of Thingms.	t of Things-	Sybil Att	tack D	etectio	n in
UNIT II	CRYPTO FOU						9
	554 14 14 14 15 17 17 18 18 18 18 18 18 18 18 18 18 18 18 18	grity, authenticated encryption, hash funct	tions, Merk	de trees.	ellip	tic cu	rves
cryptography	(ECC), public-k	ey crypto (PKI), signature algorithms – Light	tweight Cry	ptograph	ıy - A <u>l</u>	ppnear	ions
	- 2 E2 W	ey crypto (PKI), signature algorithms — Lightesource-constrained IoT devices.	tweight Cry	ptograph	ıy - A _l	ррпса	ions
	phic primitives in		tweight Cry	ptograph	ıy - A _l	ррпсат	ions 9
of cryptograp	phic primitives in PRIVACY PRI	resource-constrained IoT devices.					9
of cryptograp UNIT III Privacy Pres	PRIVACY PRI ervation Data Diss	resource-constrained IoT devices. SERVATION FOR IOT	nination- So	cial Feat	ures fo	or Loca	9 ition
of cryptograp UNIT III Privacy Press Privacy Enh	PRIVACY PRI ervation Data Dissancement in Inter	resource-constrained IoT devices. SERVATION FOR IOT emination- Privacy Preservation Data Dissem	nination- So	cial Feat	ures fo	or Loca	9 ition
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CO2	explain different Internet of Things technologies and their applications.	Understanding (K2)
CO3	develop an IoT Model and transform into business	Applying (K3)
CO4	customize real time data for IoT applications.	Applying (K3)
CO5	solve IoT security problems using light weight cryptography.	Analyzing (K4)

- Hu, Fei. "Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations", 1st edition, CRC Press, 2016.
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- Souvik Pal, Vicente García Díaz, Dac-Nhuong Le, "IoT Security and Privacy Paradigm", 1st Edition, CRC Press, 2022.
- Dr. Lalit Kumar Sagar, Dr. Rolly Gupta, Mr. Mukesh Kumar, "The Benefits of Privacy and Security in IoT: A Comprehensive Guide", IIP Iterative International Publishers, 2024.

CO-PO MAPPING:

					Progr	ramme	Outco	mes PO)'s				PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	3	-	_	-	2	-	-	-	-	-	3	2
CO4	2	-	3	-	5.	-	-	-	-	-1	-	- :	2 .	2
CO5	3	3	2	2	-	-	-	-	_	-	-		3	2



CILO	156	ETHICAL HACKING		3	0	0	3
COU	RSE O	BJECTIVES					
To ena	able the	students to			2111		
1.	under	estand the basics of computer-based vulnerabilities				-	*
2.	explo	ore different foot printing, reconnaissance and scanning methods					
3.	expos	se the enumeration and vulnerability analysis methods.					1000
4.	under	stand hacking options available in Web and wireless applications					
5.	explo	re the options for network protection.					
UNIT	I	INTRODUCTION					9
Ethica	ıl Hacki	ng Overview - Role of Security and Penetration Testers- Penetration	-Testing	Metho	odolog	ies- L	aws
of the	Land -	- Overview of TCP/IP- The Application Layer - The Transport La	ayer - T	he Inte	rnet L	ayer	- IP
Addre	essing -	Network and Computer Attacks - Malware - Protecting Against Malv	ware Att	acks -	Intrude	er Atta	cks
- Addr	ressing	Physical Security					
UNIT		FOOT PRINTING, RECONNAISSANCE AND SCANNING NE					9
Footpi	rinting (Concepts - Footprinting through Search Engines, Web Services, Soc	ial Netw	vorking	Sites,	Webs	ite,
Email	- Com	petitive Intelligence - Footprinting through Social Engineering - I	Footprin	nting T	ools -	Netw	ork
Scann	ing Cor	ncepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyo	ond IDS	and Fi	rewall	•	
UNIT	III	ENUMERATION AND VULNERABILITY ANALYSIS					9
Enume	eration	Concepts - NetBIOS Enumeration - SNMP, LDAP, NTP, SM	TP and	DNS	Enum	eratio	n -
Vuine	rability	Assessment Concepts - Desktop and Server OS Vulnerabilities - 152	2 Windo	ows OS	Vulne	erabili	ties
- Tools	s for Ide	entifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vul	nerabili	ties of	Embed	lded C	Ss.
UNIT	IV	SYSTEM HACKING					9
'lackir	ng Web	Servers - Web Application Components- Vulnerabilities - Tools fo	or Web	Attacke	ers and	Secu	rity
Tester	s Hacki	ng Wireless Networks - Components of a Wireless Network – Wardri	iving Wi	ireless	Hackir	ıg - To	ols
of the	Trade.						
UNIT	V	NETWORK PROTECTION SYSTEMS					9
Access	s Contro	ol Lists Cisco Adaptive Security Appliance Firewall - Configuration	on and R	Risk An	alysis	Tools	for
Firewa	alls and	Routers - Intrusion Detection and Prevention Systems - Network-Ba	ased and	Host-	Based	IDSs :	and
	Web Fi	Iltering - Security Incident Response Teams - Honeypots.					
IPSs -	.,	S					
IPSs -			то	TAL P	ERIO	DS	45
		UTCOMES	то	TAL P	ERIO	DS	45
COUR	RSE OU		ТО	ВТ	ERIO Mapp hest L	oed	45
COUR	RSE OU	UTCOMES		ВТ	Mapp hest L	oed evel)	45
COUF At the	end of	this course, students will be able to ss knowledge on basics of computer-based vulnerabilities. re the knowledge of different foot printing, reconnaissance and scann		BT (Hig	Mapp hest L	ped evel) g(K1)	

CO3	demonstrate the enumeration and vulnerability analysis methods	Applying (K3)
CO4	gain knowledge on hacking options available in Web and wireless applications	Applying (K3)
CO5	acquire knowledge on the options for network protection.	Analyzing(K4)

- Michael T. Simpson, Kent Backman, and James E. Corley, "Hands-On Ethical Hacking and Network Defense", Course Technology, Delmar Cengage Learning, 2010.
- 2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing", SYNGRESS, Elsevier, 2013.

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- Dafydd Stuttard and Marcus Pinto, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", 2011.
- 4. Allen Harper, Shon Harris, Jonathan Ness, "Chris Eagle, Gideon Lenkey, and Terron Williams Gray Hat Hacking: The Ethical Hacker's Handbook", Mc Graw Hill, 2011.

CO-PO MAPPING:

					Progr	ramme	Outco	mes PC)'s				PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	1	-	-	17	1	1	-	2	3	3
CO2	3	3	3	3	3	-	-	-	2	2	- 2	1	3	2
CO3	3	3	2	3	1	-	-	-	3	2	-	-	2	2
CO4	3	1	2	2	3	140	-	-	1	3	-	-	2	2s
CO5	1	3	2	3	2	150	-	-	2	3	-	2	3	3



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Identifying D Enforcement C Digital Eviden					
Enforcement (Digital Eviden		onac	Duagaa	ain a I	-
Digital Eviden	Crime Scenes – Preparing for a Search –Securing a Computer Incident or				
	nce at the Scene –Storing Digital Evidence –Obtaining a Digital Hash –Rev				smg
	CURRENT TOOLS AND GRAPHIC FILES		g u cus	- -	9
Evaluating Di	gital Forensics Tool Needs-Digital Forensics Software Tools-Digital Forensics	ensics	Hardwa	are To	
	d Testing Forensics Software-Recognizing a Graphics File-Understandi				
	nknown File Formats.				
UNIT V	DIGITAL FORENSIC VALIDATION AND E-MAIL INVESTIGATI	ONS			9
Determining V	What Data to Collect and Analyze-Validating Forensic Data-Addressing Data	ata Hic	ding Te	chniqu	ies-
	Role of E-mail in Investigations-Exploring the Roles of the Client				
	E-mail Crimes and Violations - Understanding E-mail Servers-Using Specia				
	ng Digital Forensics Methods to Social Media Communications.		me uma Datta filik	www.archias.ti.e.	

COUL	RSE OUTCOMES	
At the	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain the principles of digital forensics and professional conduct during the investigation process	Understanding (K2)
CO2	discuss the most effective data acquisition methods, tools, and techniques for different types of digital evidence	Understanding (K2)
CO3	identify, collect, and preserve digital evidence in line with legal and forensic standards.	Applying (K3)
CO4	classify digital forensic tools, especially in relation to graphics files and data compression, to identify and examine digital evidence.	Applying (K3)
CO5	justify forensic data in email and social media investigations, applying appropriate tools and techniques	Analyzing(K4)

- Nelson Bill, Phillips Amelia and Steuart Christopher, "Guide to Computer Forensics and Investigations", 6th Edition, Cengage Learning, 2018.
- Nhien-An Le-Khac, Kim-Kwang Raymond Choo, "Cyber and Digital Forensic Investigations", Springer, 2020.

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- Linda Volonino, Reynaldo Anzaldua, "Computer Forensics for Dummies", Wiley Publishing, Inc., 2008.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

					Progr	amme	Outco	mes PC)'s			11	PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	1	2	-	-	1	1	-	3	3	3
CO2	3	3	3	3	3	-	-		2	2	-	2	3	2
CO3	3	3	2	3	1	-	-	-	3	2	-	1	3	2
CO4	3	1	2	2	3	•	-	-	1	3	-	2	2	2
CO5	1	3	2	3	2	-	-	-	2	3	-	3	3	3



VERTICAL - V DESIGN AND ARCHITECTURE

CI2	23551		10	OT DE	VICE I	PROGR	RAMMIN	\mathbf{G}		3	0	0	3
COU	RSE O	BJECTIVES											
To en	able the	students to											
1.	devel	op logical IoT sy	ystem	design	s using l	Python p	programm	ning.					====
2.	progr	am Arduino boar	rds to	contro	l sensors	s and ac	tuators.						
3.	interf	ace IoT devices	with p	hysica	l sensors	s and ac	ctuators.	WEST - 1988					-51
4.	enabl	e communication	n betw	een Io	T device	es and e	external sy	stems.					
5.	integr	rate IoT devices	with c	loud p	latforms	for data	a and con	trol.				-100-20-2000	THE STATE OF
UNIT	T	IOT SYSTEMS	S - LC	GICA	L DES	IGN US	SING PY	THON					9
Introd	luction,	Motivation for us	ising p	ython,	python /	date typ	e and data	structures	s, Control	flow, fun	ctions	, modi	iles
packa	ges, file	handling, date/ti	ime op	eratio	ns, class	es, pytho	on packag	es of inter	est for Io	Γ- JSON,	XML,	HTTI	Lil
& UR	LLib, S	MTPLib - examp	ple pr	ogram									
UNIT	TII	RASPBERRY	PI PR	ROGR	AMMIN	NG							9
Basic	buildin	g blocks of an Io	oT de	vice, E	xemplai	ry devic	ce, about t	he raspbe	rry pi boa	ard, interf	ace ra	spberr	ур
board:	: IOT pl	nysical Servers ar	ind clo	oud off	ering – I	ntroduc	tion to ele	oud storage	e models	and comm	nunica	tion A	PIs
	m i										.:	LED	
WAM	IP, pyth	on web applicati	ion fra	amewo	rk. Prog	grammin	ng Raspbe	erry pi wit	n python	 interface 	ang or		anc
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LDR,	Control	0.7574						erry pi witi	n python	- interfac	ing of		9
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CO4	capability to establish communication between IoT devices and networks.	Analyzing (K4)
CO5	proficiency in integrating IoT systems with cloud services for management	Applying (K3)
	and analytics.	

- Andy King, "Programming the Internet of Things: An Introduction to Building Integrated, Device-to-Cloud IoT Solutions", Published by O'Reilly Media, Inc., first edition, 2021.
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CO-PO MAPPING:

					Progr	ramme	Outco	mes PC)'s				PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	120	-	12	-	-	-	-	-	-	3	2
CO2	3	3	3	1	3	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	3	-	-	-	-	-	3	2	3	2
CO4	3	3	3	3	3	2#3	-	-			12	2	3	2
CO5	3	3	3	3	3	-		-	-	-	-	3	3	2



	5552		SERV	ICE OF	RIENTI	ED AR	CHITI	CTUI	RE		3	0	0	Seute
COUR	SE OF	BJECTIVES												
To ena	ble the	students to												
1.	explai	in fundamentals	s, and	key tech	nologie	s of SC	A and	veb se	vices.					-
2.	learn	the principles of	of serv	ice orien	tation a	nd SOA	extens	ions li	ke orcl	nestratio	n and ch	oreogr	aphy.	
3.	explo	re WS-* standar	ırds su	ich as W	S-Secur	ity, WS	-Policy	, and F	Celiable	e Messa	ging.			
4.	under	stand the servic	ce life	cycle, se	ervice co	omposi	ion, an	d proce	ss mo	delling u	ising BPI	EL.		
5.	gain i	nsights into mic	croser	vices, co	ntaineri	zation,	and ele	ud-nat	ive SC	A patte	rns.			
UNIT	I	INTRODUCT	TON										T	
Introdu	ction:	Concepts of Dis	stribu	ted Com	puting,	XML, I	undam	ental o	f SOA	, evolut	ion of SC	A. We	b Serv	ic
Fundar	nental	and Standard: Y	Web S	Services:	Definit	tion, A	chitect	ares ar	d Star	dards. I	Directory	servic	es, SC	Α
		, UDDI.												
UNIT	II .	SOA AND WS	S-* EX	XTENSI	ON									
Princip	les of	Service-Oriente	ed Arc	chitecture	e- Servi	ce- orie	ntation	and ol	oject- o	rientati	on, SOA	Stand	ards S	ac
SOA v	vith W	eb Services, K	Key P	rinciples	of SO	A. SO.	A and	WS-*	Extens	ion: M	essage E	xchan	ge Pat	tei
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UNIT	ш	WS TECHNO	LOG	IES AN	D STA	NDAR	DS			-				-
WS-A	dressi	ng, WS- Relia	able N	Messagin	g, WS-	Policy	(includ	ling W	/S-Pol	icy Atta	achments	and	WS-P	oli
Asserti	ons), V	WS-Metadata Ex	xchan	ge, WS-	Security	(inclu	ding Xl	ЛL-En	eryptic	n, XMI	- Signati	ure, an	d SAN	ΙL
	TX7	PRINCIPLES	OFS	SERVIC	EODI			TAX ICENT	NC					
UNIT	IV				E-ORI	ENTE	CON	PUII	NG					
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CO4	analyze the service life cycle and model composite services using BPEL.	Analyzing (K4)
CO5	compare microservices and monolithic architectures and identify modern	Applying (K3)
	SOA patterns.	

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- 4. Rajbalasubhramaniam, "SOA with .NET", Prentice Hall.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

		Programme Outcomes PO's													
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	1	-	-	1-	-	-	-	-		-	3	1	
CO2	1	2	2	:=:	-	-	2	-	-	-		-	2	_ 3	
CO3	1	1	3		2	//E	2	-	-	-	1+1	2	1	3	
CO4	1	2	3	-	2	-	2	-	1 1/2/	-	-	-	1	3	
CO5	2	1	1	-	1	-	2		2	-	*:	2	2	2	



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COU	RSE O	BJECTIVES								
		students to								Н
1.	unde	rstand to do user re	esearch, persona	mapping, custo	mer journey n	napping.				
2.	desig	n of interactive pr	oducts Methods	of interaction d	esign Tools fo	r interaction	n de	sign.		10
3.		n wireframes on p								-
4.		and practice the						vario	us U	I
5.	imple	ement the process	of conducting us	sability tests Lea	rning steps fo	r digital pr	odu	cts.		
UNIT	I	USER-CENTER	RED DESIGN I	PROCESS				-		9
Scrip	ing La	nguages - HTML,	, CSS - Fundar	nentals of grap	hics design, p	orinciples	of v	isual	desi	gn -
vs Us	ser Exp	UI UX Design - Or erience (UX) - D ersona - Requireme	efining problen	and vision sta	ntement - Pers	sona creati	on ·	- Prir	nary	and
Scena	rios and	I functionality extr	raction - Informa	ation Architectur	re - Task flow	s – Wirefra	me	desig	n.	
UNIT	esterio	FUNDAMENTA ples for UX and U								9
Principal Prototo Designation Tools UNIT Build or image	ples of Syping - n and I - Intera	ELEMENTARY Sketching - Core R Wireflow Creation Designing for According Patterns - De UNDERSTAND Esign System - Stylind illustration - Us	esponsive Design - Work with disessibility - Buil esigning animate STYLE GUID le guides, color	in - Wireframing fferent tools - Fig ding High-Fidel ions and interact ES, ELEMENT palette, fonts, gr	gws Wireflows gma – Low-Hi ity Mockups tions. TS, PROTOT id, iconograph	igh Fidelity - Designin YPING ny, UI elem	Des g Es	sign:	Incluintly vitogra	sive with
UNIT		USABILITY EV	ALUATION A	ND PRODUC	r DESIGN		-			9
Type Unmo	of usa	bility evaluation remote usability and advantages - bility Test explicit	 Qualitative (testing, Card Designing evaluation 	Quantitative eva sorting, Sessi nation protocol	luation - Gu on recording, - Conducting	, think al usability	oud eval	Thir	ık al	ing,
						TOTA	DI	RIO	DS	45
						IOIA	L PI	SICIO		-

At the	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain the principles of user-centered design, UI vs UX, personas, and wireframe creation.	Understanding (K2)
CO2	apply design heuristics and interaction principles for different digital platforms and interface types.	Understanding (K2)
CO3	design responsive wireframes and interactive prototypes using tools like Figma while ensuring accessibility.	Applying (K3)
CO4	develop a structured design system with cohesive style guides and interaction patterns for consistent UI design.	Applying (K3)
CO5	analyze the usability through qualitative and quantitative testing techniques and synthesize findings to improve product design and user experience.	Analyzing (K4)

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- Nielsen, Jakob. Usability Engineering. Morgan Kaufmann, 1993. ISBN: 9780125184069.

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- 2. Wilbent. O. Galitz," The Essential Guide to User Interface Design", John Wiley Sons, 2001.
- 3. Alan Cooper, "The Essential of User Interface Design", Wiley Dream Tech Ltd.,2002.
- 4. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's

		Programme Outcomes PO's													
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	1	2	1		-	-	8	-	-	-	1	1	
CO2	2	2	3	2	2	-	-		-	-	-	-	2	2	
CO3	2	2	2	2	3	-	-	-	-	-	-	-	2	2	
CO4	2	3	2	2	1	-	-	-	-	:=:) - /2	-	2	2	
CO5	2	3	3	2	1	-	-	-	-	-	-	-	2	2	



C12.	3554	3D DESIGN PRINCIPLES AND PATTERNS				
COU	RSE OI	BJECTIVES:				
To ena	able the	students to				
1.		stand the fundamental concepts and sensory aspects of 3D design, includi-	ing form	n, con	text, a	nd
2.	mater	ials. core elements and principles of three-dimensional design, such as form	snace	hala	nce a	nd
۷.	rhythr	n.				
3.		ze various 3D fabrication techniques and the interplay of structure, utility		•		
4.	descri	be digital representation methods for 3D objects and modeling, including	curves	, surfa	aces, a	nd
5.		transformations and viewing techniques essential for 3D graphics and int	teractiv	e appl	icatio	ns.
UNIT	I	INTRODUCTION TO 3D DESIGN			T	1
Introd	uction -	- Form Organization - Design definition - Looking: Attentive obse	ervation	, con	npariso	on,
connec	ctions -	- Touch: Tactile sensation - Context: Shaping force, site specific - I	earnin	g – Io	deas a	nd
Appro	aches:	Process - Tools - Transformation - variation and deformation - Co	nceptu	al stra	itegies	; –
Proble	em solvi	ing – Sketching, Model making and prototyping.				
UNIT		EL EMENTE OF AD DECICAL & DDINGIDLES				_
	11	ELEMENTS OF 3D DESIGN & PRINCIPLES				
Textur	– Cube re, Colo	Mass and Space – Line – Plane: 2D Element – Convention of 2D to 3I or – Chromatic Luminosity – Time and Motion. 3D Design Principles:	Unity	and \	/ariety	es:
Textur Repeti	– Cube re, Colo	- Mass and Space - Line - Plane: 2D Element - Convention of 2D to 3I	Unity	and \	/ariety	es:
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At the	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	describe 3D design, including form, tactile perception, context, and sketch-based ideation.	Understanding (K2)
CO2	explain the elements and principles of 3D design such as unity, variety, balance, rhythm, and scale.	Understanding (K2)
CO3	list and discuss various fabrication techniques and structural principles involved in 3D construction and material usage	Understanding (K2)
CO4	use geometric modeling techniques and digital tools to represent 3D objects using surfaces, curves, and forms.	Applying (K3)
CO5	analyze 3D transformations and viewing operations to evaluate and improve digital design outputs.	Analyzing (K4)

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- 2. Shaun Foster, David Halbstein "Integrating 3D Modeling, Photogrammetry and Design", Springer, 2014.

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- Samit Bhattacharya, "Computer Graphics", Oxford University Press, ISBN13:978-0-19-809619-1, 2015.
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CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

Programme Outcomes PO's

2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS6

PSO's

													100	
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-		2	1
CO2	3	2	3	1	-	-	-		140	-	-	-	2	1
CO3	2	3	2	2	2	-	-		15	i.t.	. UTS	-	3	2
CO4	3	2	3	2	3	-	-	-	740	-	-	-	3	3
CO5	3	2	3	3	3		-		17.	-	-	-	3	3



CI23	555		CI	LOUD CO	OMPUTIN	NG			3	0	0	3				
COUR	SE OI	BJECTIVES		V												
To enal	ble the	students to														
1.	under	stand the fundar	nental con	cepts and p	principles	of Cloud	Compu	iting an	d its eco	systen	1					
2.	trace t	the evolution of	Cloud Cor	mputing fr	rom traditi	onal and	distribu	ted com	puting p	aradig	gms.					
3.	recognize Cloud Computing as a next-generation computing model and its deployment, servi models.										service	3				
4.	learn	learn virtualization technologies and their role in cloud infrastructure.														
5.	explore cloud programming models, software environments, and security governance in closystems.										cloud	i				
UNIT																
Evoluti	ion of	Cloud Computir	g – Princi	ples of par	rallel and c	listributed	d compu	ıting – (Cloud ch	aracte	ristics	an				
elastici	ty – (Cloud service 1	nodels (Ia	aaS, PaaS.	s, SaaS) –	Deploy	ment m	odels ((public,	privat	e, hyb	ric				
commu	ınity c'	louds) – Cloud e	cosystem	- Comput	ting on den	nand – Ca	ase Stuc	ly: clou	d-based	AI ser	vices.					
UNIT	munity clouds) - Cloud ecosystem - Computing on demand - Case Study: cloud-based AI service T II VIRTUALIZATION TECHNOLOGIES															
	11	VIKTUALIZA	HON IL	CHNOLC	OGILS	Basics of virtualization – Types: full, para-virtualization, hardware-assisted, containerization										
05-02549 657	227					zation, 1	nardwar	e-assist	ed, con	ntainer	ization					
Basics	of ·	virtualization -	Types:	full, par	ıra-virtuali							1				
Basics Implen	of v	virtualization - on levels and vi	Types:	full, par	ra-virtuali: es – Virtua	alization (of CPU	, memo	ry, I/O d	levices	s – Vii	ı tu				
Basics Implen	of mentati	virtualization - on levels and vi	Types: rtualizatio ment – Hy	full, par n structure ypervisors	es – Virtuali es – Virtua and tools	alization ((Xen, K	of CPU VM, VN	, memo Aware,	ry, I/O (Docker)	levices – Vir	s – Vii tualiza	tu:				
Basics Implen clusters for data	of mentati	virtualization - on levels and vi	Types: rtualizatio ment — Hy d disaster	full, par n structure ypervisors recovery -	es – Virtualis and tools Case Stud	alization ((Xen, KV ly: Virtua	of CPU VM, VM alized I	, memo Aware,	ry, I/O (Docker)	levices – Vir	s – Vii tualiza	tu tic				
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COUI	RSE OUTCOMES	
At the	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain the fundamental concepts, characteristics, and system models of Cloud Computing.	Understanding (K2)
CO2	apply virtualization technologies and middleware concepts to design efficient cloud-based systems.	Applying (K2)
CO3	design cloud-based service models and storage solutions suitable for diverse applications.	Applying (K3)
CO4	analyze the architecture and infrastructure of cloud systems, including resource provisioning and security.	Analyzing (K4)
CO5	discuss cloud security challenges and governance mechanisms to ensure secure cloud operations.	Understanding (K2)

- Rajkumar Buyya, James Broberg, and Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", 2nd Edition, Wiley.
- Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", First Edition, Prentice Hall, 2013.

REFERENCES

- Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", 1st Edition, VPT, 2014.
- 2. Vishal Lall, "Virtualization and Cloud Computing with VMware", 4th Edition, Wiley, 2019.
- Ray J. Rafaels, "Cloud Computing: From Beginning to End", 1st Edition, CreateSpace Independent Publishing Platform, 2017.
- 4. John W. Rittinghouse, James F. Ransome, "Cloud Computing: Implementation, Management, and Security", 3rd Edition, CRC Press, 2017.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

Programme Outcomes PO's PSO's CO's PO₁ PO₂ PO₃ PO₄ PO5 PO₆ PO7 PO8 PC9 PO10 PO11 PO12 PSO₁ PSO₂ CO₁ 3 2 2 3 3 CO₂ 3 2 2 3 2 2 3 2 2 2 CO₃ 2 3 1 2 3 2 3 CO₄ 2 2 2 2 2 3 2 3 2 CO₅ 3 2 3 3 3 3



CI23556	ARCHITECTING SMART IOT DEVICES	3	0	0	3
COURSE O	DBJECTIVES				
To enable the	e students to				
1. unde	erstand the architectural overview of the Internet of Things (IoT).				
2. acqu	ire skills on data acquisition and communication in IoT.				
3. unde	erstand the threats of loT.				
4. unde	erstand and apply Real-Time Operating Systems (RTOS) in embedded IoT	systems.			
5. use n	modern tools and platforms and identify IoT physical devices for various ap	plication	ıs.	-10-1	
UNIT I	DESIGN PRINCIPLES OF IOT				9
Design princ	liples and characteristics of connected devices – Functional blocks of IoT – I	oT enabl	ling tec	hnole	gies
	s and deployment templates - IoT communication models and APIs				
	in IoT - Cloud and edge computing in IoT - System architecture and analy				
UNIT II	PROTOTYPING THE EMBEDDED DEVICES FOR IOT			Т	9
	ware platforms – Sensors, actuators, and transducers – Device interfaces	- Protot	yping o	embed	lded
	oberry Pi, BeagleBone Black) – Wireless sensor networks – Radio modules				
	[18] 18] 18] 18] 18] 18] 18] 18] 18] 18]				
Fi) – Gatewa	ays and connectivity – Embedded software components.				
Fi) – Gatewa	ays and connectivity – Embedded software components. EMBEDDED PROGRAMMING FOR IOT			-1	9
UNIT III	EMBEDDED PROGRAMMING FOR IOT	acing per	ipheral	ls – G	1100
UNIT III Programming	EMBEDDED PROGRAMMING FOR IOT g tools for IoT – C and Python programming for embedded systems – Interfa		3		PIO,
UNIT III Programming I2C, SPI. U	g tools for IoT – C and Python programming for embedded systems – Interfa ART – Sensor data acquisition – File handling and data logging – Ca		3		PIO,
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CO-PO MAPPING:

					Progr	Programme Outcomes PO's												
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2				
CO1	3	1	3	2	1	-	-	-	-	-	-	2	3	3				
CO2	3	3	3	3	3	; =	-	-	_	-	<u>.</u>	1	3	2				
CO3	3	3	2	3	1	-	-	-	-	-	_		2	2				
CO4	3	1	2	2	3	-	-		<u> </u>	-	_		2					
CO5	1	3	2	3	2	+	_	_	-	_		2	2	2				



	3557		DYNAMIC PARADIGM IN IOT 3	0	0	
COU	RSE OF	BJECTIVES				
To ena	able the	students to				
1.	explor	e the role of the	e cloud in Internet of Things deployment.		-	_
2.	introd	ice the usage o	f different machine learning algorithms on IoT Data.	- X		
3.			and data visualization on IoT Data.			
4.	explor	e design issues unication in Io	and working principles of security measures and various standard.	rds for	secur	e
5.	develo	p the ability to	integrate IoT with Dev-ops.			-
UNIT	II	OT AND CLC	OUD		7	
Cloud	Compu	ting Concept-C	Grid/SOA and Cloud Computing- Cloud Middleware NIST's	SPI Ar	chitec	tur
			loud of Things- The Internet of Things and Cloud Computing			
			eployment Models-Foundational Technological Enabler Clou			
System	ns – Mic	rosoft Azure Id	T-Amazon Web Services- Google's cloud IoTs.			
UNIT			CHINE LEARNING		-	
4 1					- 1	
Advan	tages of	IoT and Machi	ne Learning Integration-Implementation of Supervised Algori	thm_R	eorese	
Advani (Linear	tages of r and Lo	IoT and Machi gistic) – SVM	ne Learning Integration—Implementation of Supervised Algori	thm-R	egress	sior
(Linear	tages of r and Lo sion–SV	gistic) – SVM	ne Learning Integration—Implementation of Supervised Algori for IoT–Neural Network on case study: Agriculture and Io T–S	thm–R Smart I	egress Home	sion
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	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	identify the need for the cloud in IoT deployment and describe different Cloud provider's architecture	Understanding (K2)
CO2	use and correlate machine learning techniques on IoT Data	Understanding (K2)
CO3	apply IoT analytics and data visualization	Applying (K3)
CO4	explain the need of security measures in the Internet of Things	Understanding (K2)
CO5	apply the knowledge of Dev-ops in IoT applications	Applying (K3)

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CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

					Progr	amme	Outco	mes PC)'s				PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	1	-	-	-		-	= .	3	3	3
CO2	3	3	3	3	3	-	-		-	-	-	2	3	2
CO3	3	3	2	3	1	-	-	-	200	-	-	1	3	2
CO4	3	1	2	2	3	-	-	-	-	-	-	2	. 2	2
CO5	1	3	2	3	2	-		-		1.	-	3	3	3



VERTICAL - VI

EMERGING TECHNOLOGIES

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egistry system, Author for a local cloud, Trans APPLICATION S	prization system, Orchestration system, Application systems, Denslation system.	
e for a local cloud, Trans	aslation system.	
APPLICATION S		
	SYSTEM AND SERVICES	
nd implementation – Intro	roduction, Application service design - Control application design, Dem	10 syster
	cer, consumer, Authorization service consumer. Deployment of a loc	
ad Framework tools.		
ENGINEERING O	OF IOT AUTOMATION SYSTEMS	
ion, Engineering of an	Arrowhead compatible multi-domain facility, Component-based er	ngineeri
ogy, Safety and security	y, Engineering scenarios - Efficient deployment of a large number of lo	T sensor
ce monitoring.		
APPLICATION S	SYSTEM DESIGN	
ion, energy optimization	on - Optimization's based on a virtual market of energy, Context awa	are stree
	cation and certification service.	
i	on, Engineering of arogy, Safety and securities monitoring. APPLICATION on, energy optimization	on, Engineering of an Arrowhead compatible multi-domain facility, Component-based er ogy, Safety and security, Engineering scenarios - Efficient deployment of a large number of loce monitoring. APPLICATION SYSTEM DESIGN on, energy optimization - Optimization's based on a virtual market of energy, Context awance - Data structure, Plant monitoring system components: High security – Introduction

COU	RSE OUTCOMES	
At the	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	understand the growing need for new technologies in driving industrial and societal automation and digitization.	Understanding (K2)
CO2	understand the fundamentals of automation architecture, including key definitions and documentation structures.	Understanding (K2)
CO3	utilize Arrowhead Framework tools for efficient service registration, orchestration, and monitoring in automation systems.	Understanding (K2)
CO4	apply component-based engineering methodologies for scalable and maintainable system development.	Applying (K3)
CO5	understand energy-efficient and secure IoT application systems with smart maintenance and authentication features.	Understanding (K2)

- 1. Jerker Delsing, "IoT Automation: Arrowhead Framework", 1st Edition, CRC Press, 2017.
- Oscar Carlsson, "Engineering of IoT Automation Systems", Lulea University of Technology, Graphic Production 2017.

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- Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cyber manufacturing System", 1st Edition, Springer Cham, 2016.
- 2. Ismail Butun, "Industrial IoT Challenges, Design Principles, Applications, and Security", 1st Edition, Springer Cham, 2021.
- Zaigham Mahmood, Richard Hill, "The Internet of Things in the Industrial Sector", Computer Communication Networks, Springer, 2011.
- Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography", second edition, Chapman & Hall Book, CRC Press, 2011.

CO-PO MAPPING:

					Progr	ramme	Outco	mes PC)'s				PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	1
CO2	2	1	-	-	-	-	-	-	-	-	-	1	120	1
CO3	3	2	1	-	1	(=)	-	-	-	-	1	1	2	1
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	1
C05	3	2	1	-	1	-	-	-	-	-	1	1	2	1



	3652	VIRTU	AL REALITY AND AUGMENTED REALITY	3	0	0	3
COUR	RSE OB	BJECTIVES					
To ena	ble the	students to					
1.	unders	stand to provide	a foundational understanding of Virtual Reality, core	hardwa	are an	d soft	ware
	compo	onents and the ge	ometry of virtual environments.				
2.	analys	se to explore the	behavior of light, optical systems, and the physiology ar	nd perc	eption	of hu	ıman
			ersive Virtual Reality experiences.				
3.	apply	to equip studen	ts with the knowledge of visual rendering techniques,	motion	perce	eption,	and
	1	ATT. 150	tial for building immersive and responsive Virtual Reality				
4.	unders	stand and Apply	the fundamentals of Augmented Reality (AR), its types,	tools,	technic	cal asp	ects.
	and re	al-world applica	tions using Unity, Vuforia, and ARToolkit.				
5.	analys	se the students in	creating an interactive Augmented Reality Solar System us	sing U	nity, V	uforia	, and
	marke	erless tracking tec	hniques.				
UNIT	I	VIRTUAL REA	LITY: CONCEPTS, COMPONENTS, AND SPATIAL	L MOI	DELL	ING	9
Introd	uction:	define Virtual R	teality- Modern VR Experiences-History Repeats; Bird's	s-Eye	View:	Hardy	vare
			and Perception; The Geometry of Virtual Worlds: Geome				
			is-Angle Representations of Rotation- Viewing Transfo				
							g the
Transf	ormatic						g the
Transf	II	ons. VISUAL FOUN	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT				
UNIT	II	ons. VISUAL FOUN HUMAN PERC	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT	ICS, A	AND		9
UNIT Light	II and Opt	VISUAL FOUN HUMAN PERC tics: Basic Beha	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT	ICS, A	AND ameras	s- Disp	olays
UNIT Light	II and Opt	VISUAL FOUN HUMAN PERC tics: Basic Beha gy of Human Visi	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT EPTION vior of Light- Lenses- Optical Aberrations- The Human E	ICS, A	AND ameras	s- Disp sual Co	olays:
UNIT Light: The Pl Eye M	II and Opt tysiolog	VISUAL FOUN HUMAN PERC tics: Basic Beha gy of Human Visi	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT EPTION vior of Light- Lenses- Optical Aberrations- The Human E on: From the Cornea to Photoreceptors- From Photorecept for VR; Visual Perception: Perception of Depth- Perception	ICS, A	AND ameras	s- Disp sual Co	olays:
Light The Pl Eye M of Col	and Optingsiolog In anysiolog In anysiolog	VISUAL FOUNHUMAN PERCEICS: Basic Behavior of Human Visionts- Implications on bining Sources VIRTUAL REATRACKING TO	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT EPTION vior of Light- Lenses- Optical Aberrations- The Human Econ: From the Cornea to Photoreceptors- From Photorecept for VR; Visual Perception: Perception of Depth- Perception of Information. LITY SYSTEMS: RENDERING, MOTION DYNAM ECHNOLOGIES	ICS, A	and ameras the Vis Intion-	s- Disp sual Co Perce	olays:
UNIT Light: The Pl Eye M of Col UNIT	and Optonysiolog Iovementor- Con III	VISUAL FOUN HUMAN PERO tics: Basic Beha gy of Human Visi nts- Implications nbining Sources VIRTUAL REA TRACKING TO	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT EPTION vior of Light- Lenses- Optical Aberrations- The Human Event From the Cornea to Photoreceptors- From Photorecept for VR; Visual Perception: Perception of Depth- Perception of Information. LITY SYSTEMS: RENDERING, MOTION DYNAM ECHNOLOGIES ng and Shading Models- Rasterization- Correcting Optical	Eye- Coors to to on of Market Alexander Alexan	and ameras the Vis Intion-	s- Disp sual Co Perce	olays ortex ption
UNIT Light: The Pl Eye M of Col UNIT	and Optonysiolog Iovementor- Con III	VISUAL FOUN HUMAN PERO tics: Basic Beha gy of Human Visi nts- Implications nbining Sources VIRTUAL REA TRACKING TO	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT EPTION vior of Light- Lenses- Optical Aberrations- The Human Econ: From the Cornea to Photoreceptors- From Photorecept for VR; Visual Perception: Perception of Depth- Perception of Information. LITY SYSTEMS: RENDERING, MOTION DYNAM ECHNOLOGIES	Eye- Coors to to on of Market Alexander Alexan	and ameras the Vis Intion-	s- Disp sual Co Perce	olays ortex ption
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UNIT Light of The Pl Eye M of Col UNIT Visual Latence Accele Track: Bodie UNIT	and Optonysiolog Invisiolog Invisiolog Invisiolog Invisiolog Invisiolog Invisiolog Invisiolog Invision	VISUAL FOUN HUMAN PERO tics: Basic Beha gy of Human Visi nts- Implications mbining Sources VIRTUAL REA TRACKING TO ring: Ray Tracin Frame Rates- Im Frame Rates- Im Grientation- Tr canning of Envir	DATIONS FOR VIRTUAL REALITY: LIGHT, OPT EPTION vior of Light- Lenses- Optical Aberrations- The Human From the Cornea to Photoreceptors- From Photorecept for VR; Visual Perception: Perception of Depth- Perception of Information. ALITY SYSTEMS: RENDERING, MOTION DYNAM ECHNOLOGIES and Shading Models- Rasterization- Correcting Optical mersive Photos and Videos; Motion in Real and Virtual respective System- Physics in the Virtual World- Mismatched Motion acking 3D Orientation- Tracking Position and Orientationments. REALITY: PRINCIPLES, TOOLS, AND APPLICAT	ICS, A Eye- Ca ors to to on of M ICS, A I Disto World on and ion- T	and ameras the Vis Intion- AND rtions- ds: Ve Vection rackin	sual Co Perce Impro locitie on Trac	ortex ption oving s and king achee
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UNIT V AR SOLAR SYSTEM: DEVELOPMENT AND DEPLOYMENT USING UNITY AND VUFORIA

AR Solar System: The project plan- Setting up the project - Building the earth- Building an earth-moon system - Animating the moon orbit- Orbiting the sun- Adding the other planets - Using VuMark targets (Vuforia)- Building and running - Markerless building and running.

		TOTAL PERIODS	45
COUL	RSE OUTCOMES		
At the	end of this course, students will be able to	BT Mapped (Highest Level)	
CO1	understand the gain of ability to explain VR concepts and apply geometric transformations to create realistic and interactive virtual worlds.	Understanding (K2	_
CO2	apply the students will understand impact of VR design and will apply this knowledge to enhance realism and user comfort in virtual environments.	Analyzing (K4)	
CO3	apply the students who will be able to implement efficient rendering methods, understand motion dynamics, and enhance VR interaction and realism.	Applying (K3)	
CO4	apply the design and develop basic AR applications using industry-standard tools and understand the technical challenges and use cases of AR systems.	Applying (K3)	
CO5	analyse how to build, animate, and deploy a complete AR-based solar system model with marker-based and markerless tracking using Vuforia and Unity.	Analyzing (K4)	

TEXT BOOKS

- 1. Steven M. LaValle, "Virtual Reality", University of Oulu, M. LaValle 2020.
- 2. Jonathan Linowes, Krystian Babilinski, "Augmented Reality for Developers" Packt Publisher, 2017.

REFERENCES

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

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

					Progr	ramme	Outco	mes PC)'s				PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	-	-	-	2	2	1	2	2	1
CO2	3	2	2	1	2	-	-	-	2	2	2	3	3	1.
CO3	3	2	2	2	2	-	2		2	2	1	2	3	2
CO4	3	3	3	2	2	-	-	-	2	2	2	3	3	. 2
CO5	3	3	3	2	2	-	-	-	2	3	3	3	3	3



CI2	3653	FOG AND EDGE COMPUTING	3	0	0	3
COUF	RSE OB	JECTIVES				
To ena	ble the	students to				
1.	unders	tand the concepts, architecture, and fundamentals of fog and edge comput	ing.			*******
2.	analyz	e the key components, platforms, and technologies enabling fog computir	ıg.			
3.	design	paradigms and programming models for fog computing.				
4.	learn s	ecurity, privacy, and resource management issues in fog and edge compu	ting.			
5.	apply	fog computing concepts to real-world IoT and smart applications.				
UNIT	I	NTRODUCTION TO FOG AND EDGE COMPUTING				9
termin	ologies	Biological neural network – Artificial Neural Network (ANN): Basic mod of ANN – McCulloch-Pitts neuron – Linear separability – Hebb Network ation Networks (BPN)- Architecture, Training Algorithm.				
UNIT	II I	FOG COMPUTING PLATFORMS AND TECHNOLOGIES	-			9
Fog C	Computin	ng Architecture Models - Edge Node Federation and Resource Manag	ement -	IoT-I	Fog-C	loud
Systen	n Design	1 - Challenges in Resource Allocation, Heterogeneity - Deployment Mode	els and l	Use Ca	ses.	
UNIT	III I	NETWORK SLICING, ORCHESTRATION, AND MIDDLEWARE				9
		orking (SDN) and NFV in Edge Computing - Orchestration and Managesign for Fog-Edge Systems.	gement	of Edg	ge Noo	ies -
UNIT		OPTIMIZATION AND SECURITY IN FOG AND EDGE COMPUT				9
Optim	ization	Strategies: Placement, Scheduling, Latency - Cost and Energy Trade-offs	- Predi	ctive A	nalyti	cs in
		ments - Data Management Models in Fog - Security threats in fog and e				
encryp	otion, in	regrity, and confidentiality - Privacy-preserving mechanisms - Trust management	igement	– Aut	hentic	ation
protoc	ols – Re	source and service orchestration - ML-Based Approaches for Intrusion D	etection	1.		
UNIT		REAL-WORLD APPLICATIONS AND FUTURE DIRECTIONS				9
Big D	ata Ana	lytics at the Edge - Healthcare Monitoring and Emergency Systems - S	mart T	ranspo	rtation	and
		applications - Edge AI and federated learning - Real-time data processing				
of Fog	Applie	ations (Intro to iFogSim) - Legal and Ethical Aspects (Data Sovereignty, G	DPR) -	Resear	rch Tr	ends.
			OTAL	PERI	ods	45
COU	RSE OU	TCOMES				
At the	end of	this course, students will be able to		T Maj ighest)
CO1	explai	n the key principles and motivations of Fog and Edge computing for IoT		rstandi		

CO2	describe Fog architectures and evaluate edge resource management and federation techniques.	Understanding (K2)
CO3	illustrate the orchestration and virtualization methods using SDN/NFV and containerized middleware	Applying(K3)
CO4	analyze performance optimization, data processing, and security strategies in Fog/Edge environments	Analyzing(K4)
CO5	summarize real-world Fog applications, testing methods, and legal/ethical considerations	Understanding (K2)

- Rajkumar Buyya and Satish Narayana Srirama, "Fog and Edge Computing: Principles and Paradigms", Wiley, 2019.
- Amir M. Rahmani et al., Fog Computing in the Internet of Things: Intelligence at the Edge, Springer, 2018.

REFERENCES

- 1. Flavio Bonomi et al., "Fog Computing and Its Role in the Internet of Things", MCC Workshop, 2012.
- John W. Rittinghouse, James F. Ransome, "Cloud Computing: Implementation, Management, and Security", 3rd Edition, CRC Press, 2017.
- 3. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.
- Mahmud H., Buyya R., Ramamohanarao K., "Latency-aware Application Module Management for Fog Computing Environments", ACM Transactions, 2019.

CO-PO MAPPING:

					Progr	amme	Outco	mes PC	o's		-		PS	O's
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	- 1	2	-	-	-	-	2	1
CO2	3	3	2	1	-	-	-	-	150	-	-	-	2	2
CO3	3	3	3	2	-	-	-	H	141	2	-	-	3	2
CO4	3	2	2	3	_	-	-	2	-	2	-	-	3	?
CO5	3	3	3	2	-	-		-	-	2	-		3	3



C123654		DEEP LEARNING		3	0	0	3
COUR	SE OBJECTIVES						
To enal	ble the students to						
1.	introduce the basic	concepts of machine learning.					
2.	study the concepts	of deep Networks.		- 20 - 20	31.12.00.0		
3.	understand dimensions.	ionality reduction techniques, autoencoders, and	modern co	nvolut	ional i	netwo	rk
4.		methods and generalization techniques of deep lea	rning.				
5.	analyze the case st	idies of deep learning techniques.	- Waren				
UNIT	I INTRODUC	TION					9
Introdu	ction to Machine L	arning - Linear models (SVMs, Perceptrons, and lo	ogistic regre	ession)	– Intro	oducti	on to
Neural	Nets: What a shall	low network computes- Training a network: loss	s functions.	, back	propa	gation	and
s'achas	stic gradient descent	Neural networks as universal function approxima	tes.				
UNIT	II DEEP NET	WORKS	-				9
History	of Deep Learning	A Probabilistic Theory of Deep Learning- Back pr	opagation a	ind reg	ulariza	ation,	batch
		nsion and Neural Nets - Deep Vs Shallow Netv					
		tworks (GAN), Semi-supervised Learning.					
UNIT		NALITY REDUCTION					9
	AND THE STREET STREET STREET STREET	anifolds, metric learning - Auto encoders and dim	ensionality	reduc	tion in	netwo	
		Architectures - AlexNet, VGG, Inception, ResN					
		ization, hyper parameter optimization.	3.5.5			70.7 <i>6</i> °C 300.97	0
							9
	IV OF ILVIIZA						
UNIT	ization in Doon L	TION AND GENERALIZATION	stworks- St	tochas	tie On	timiza	
Optimi		arning - Non-convex optimization for deep no					tion-
Optimi Genera	ilization in neural	arning - Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurr	ent networ	ks, LS	STM -	Recu	ation- arrent
Optimi Genera Neural	alization in neural Network Languag	arning - Non-convex optimization for deep no	ent networ	ks, LS	STM -	Recu	ation- arrent
Optimi Genera Neural Artific	nlization in neural Network Languag ial Neuroscience.	arning - Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforcer	ent networ	ks, LS	STM -	Recu	ation- arrent
Optimi Genera Neural Artific	Network Languagial Neuroscience. V CASE STU	arning – Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforced DY AND APPLICATIONS	rent networ	ks, LS	STM - Compi	- Recu	ation- urrent nal &
Optimi General Neural Artific UNIT Imager	Network Languagial Neuroscience. V CASE STU	arning – Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforced DY AND APPLICATIONS Indio WaveNet - Natural Language Processing	ment Learn	ks, LS	STM - Compi	- Recu	ation- urrent nal &
Optimi General Neural Artific UNIT Imager	Network Languagial Neuroscience. V CASE STU	arning – Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforced DY AND APPLICATIONS	ment Learn	ks, LS	STM - Compi	- Recu	ation- urrent nal &
Optimi General Neural Artific UNIT Imager	Network Languagial Neuroscience. V CASE STU	arning – Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforced DY AND APPLICATIONS Indio WaveNet - Natural Language Processing	ment Learn g Word2V aptions.	ks, LS	STM - Compi	- Recu	ation- urrent nal &
Optimi Genera Neural Artific UNIT Imager Bioinfo	Network Languagial Neuroscience. V CASE STU	arning – Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforced DY AND APPLICATIONS Indio WaveNet - Natural Language Processing	ment Learn g Word2V aptions.	ks, LS	STM - Compu	- Recu	ation- arrent nal &
Optimi Genera Neural Artific UNIT Imager Bioinfo	Network Language ial Neuroscience. V CASE STUDIEST - Detection-A cormatics- Face Recordance of this course, seemed of this course, seeme	arning – Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforced DY AND APPLICATIONS Idio WaveNet - Natural Language Processing gnition- Scene Understanding- Gathering Image Control of tudents will be able to	ment Learn g Word2V aptions.	ks, LS ing - ec - DTAL	Joint PERI BT Maighest	Detection Detect	9 45
Optimi Genera Neural Artific UNIT Imager Bioinfo	Network Language ial Neuroscience. V CASE STURNET - Detection-A cormatics- Face Recordance rend of this course, such as a course, such as a course of the cours	arning — Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforced DY AND APPLICATIONS Indio WaveNet - Natural Language Processing gnition- Scene Understanding- Gathering Image Control of the	ment Learn g Word2V aptions.	ks, LS ing - ec - DTAL H (H Unde	Joint PERI BT Maighest	Detection Detection (King (Kin	9 etion-
Optimi Genera Neural Artific UNIT Imager Bioinfo	Network Language ial Neuroscience. V CASE STURNET - Detection-A cormatics- Face Recordance rend of this course, such as a course, such as a course of the cours	arning – Non-convex optimization for deep nonetworks- Spatial Transformer Networks- Recurred Models- Word-Level RNNs & Deep Reinforced DY AND APPLICATIONS Idio WaveNet - Natural Language Processing gnition- Scene Understanding- Gathering Image Control of tudents will be able to	ment Learn g Word2V aptions.	ks, LS ing - ec - DTAL H (H Unde	Joint PERI BT Maighest	Detection Detection (King (Kin	9 etion-

CO3	use dimensionality reduction and convolutional architectures like AlexNet, VGG, ResNet	Applying (K3)
CO4	implement optimization and regularization techniques in deep learning, including RNNs and LSTM.	Applying (K3)
CO5	distinguish various case studies and its applications.	Analyzing (K4)

- 1. Cosma Rohilla Shalizi, "Advanced Data Analysis from an Elementary Point of View", 2015.
- 2. Deng and Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.

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- Sudharsan Ravichandiran, "Hands-On Deep Learning Algorithms with Python", Packt Publishing, 2019.
- 4. Ian Good fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	Programme Outcomes PO's												PSO's	
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	1	-	-	-	-		2	2	2
CO2	3	2	1	2	-	2	ж	-	-	-	-	2	2	2
CO3	3	3	2	1	-	2	-	-	-	-	-	2	2	3
CO4	3	1	1	1		3	-	-	-	-	-	2	3	2
CO5	2	3	2	1	-	1				-	2	. 2	2	2 .



C123655 M		1	MACHINE LEARNING TECHNIQUES	3	0	0	3
COU	RSE OB	JECTIVES					
To en	able the	students to					
1.	120000000000000000000000000000000000000	uce the foundationations.	onal concepts of human and machine learning, types of learning	earning	, and p	oractica	1
2.			pre-processing, transformation, and dimensionality reduct	ion in N	AL.		
3.	valida	tion methods.	ning models, their selection, training, evaluation, and				
4.	constr	uct meaningful f	eatures, select relevant attributes, and manage high-dimen	sional o	data pr	oblem	3.
5.	introd learnii		earning paradigms such as rule-based, reinforcement, a	nd exp	lanatio	n-base	d
UNIT	I	INTRODUCTION	ON TO MACHINE LEARNING				9
			and Intelligence Introduction to Machine Learning: defi ing and machine learning - Types of Machine Learning: S				
and R	einforce	ment Learning –	Applications of Machine Learning - Tools and Technolog	gy for N	lachin	e Leari	ning.
							JOSEPH TAN
	ine Lear	ning activities: I	ODEL PREPARATION Data Collection, Preprocessing, Modeling, Evaluation - Ty of Data — Data quality and remediation — Data Pre-pro	7-			
Mach and Q Reduc	ine Lear Quantitat	ning activities: I ive – Structure (A) – Feature Sul	Data Collection, Preprocessing, Modeling, Evaluation - To of Data — Data quality and remediation — Data Pre-pro- b set selection.	7-			ative
Mach and Q Reduc	ine Lear Quantitatetion(PC	ning activities: I ive – Structure (A) – Feature Sul	Data Collection, Preprocessing, Modeling, Evaluation - Tropic of Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION	ocessing	g: Dim	ension	ative ality
Mach and Q Reduct UNIT	ine Lear Quantitatetion(PC	ning activities: I ive – Structure (A) – Feature Sul MODELLING Iodel: Predictive	Data Collection, Preprocessing, Modeling, Evaluation - Troof Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorit	thms (C	: Dim	ension	ative ality 9 and
Mach and C Reduct UNIT Select Regre	ine Lear Quantitat etion(PC III 1	ning activities: I ive — Structure A) — Feature Sul MODELLING Iodel: Predictive Training Techn	Data Collection, Preprocessing, Modeling, Evaluation - Tool Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorithms in the second seco	thms (C	: Dim	ication	ative ality 9 and and
Mach and Q Reduct UNIT Select Regree	ine Lear Quantitat etion(PC III ting a M ssion) -	ning activities: I ive — Structure (A) — Feature Sul MODELLING Model: Predictive Training Techn y - Underfitting	Data Collection, Preprocessing, Modeling, Evaluation - Troof Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorithms: Holdout method, Cross-validation, Bootstrap - No g and Overfitting, Bias-Variance Trade-off- Evaluating	thms (C	: Dim	ication	ative ality 9 and and
Mach and Q Reduct UNIT Select Regree	ine Lear Quantitat etion(PC III ling a M ssion) - retability pervised	ning activities: I ive — Structure (A) — Feature Sul MODELLING Iodel: Predictive Training Techn y - Underfitting Learning: Cluste	Data Collection, Preprocessing, Modeling, Evaluation - Troof Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorithms: Holdout method, Cross-validation, Bootstrap - No g and Overfitting, Bias-Variance Trade-off- Evaluating	thms (C	: Dim	ication	ative ality 9 and and
Mach and Q Reduct UNIT Select Regree interp Unsup UNIT	ine Lear Quantitat etion(PC III ting a M ssion) - retability bervised	ning activities: It ive — Structure (A) — Feature Sulmodel: Predictive Training Techn y - Underfitting Learning: Cluste FEATURE EN	Data Collection, Preprocessing, Modeling, Evaluation - Tool Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algoritations: Holdour method, Cross-validation, Bootstrap - Normalization, Bias-Variance Trade-off- Evaluating ering.	thms (Calodel real Model	Classificepreser	ication ntation	9 and and ce -
Mach and C Reduct UNIT Select Regre interp Unsup UNIT Featur	ine Lear Quantitat etion(PC III ling a M ssion) - retability pervised IV	ning activities: I ive — Structure (A) — Feature Sul MODELLING Iodel: Predictive Training Techn y - Underfitting Learning: Cluste FEATURE ENG	Data Collection, Preprocessing, Modeling, Evaluation - Troof Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorithms: Holdout method, Cross-validation, Bootstrap - May and Overfitting, Bias-Variance Trade-off- Evaluating tering. GINEERING AND SELECTION	thms (C Model reg Mode	Classificepreser	ication ntation orman	9 and and cee –
Mach and C Reduce UNIT Select Regree interp Unsup UNIT Featur select	ine Lear Quantitat etion(PC III 1 ling a M ssion) - retability pervised IV 1 re - Fea ion: Issu	ning activities: I ive — Structure (A) — Feature Sul MODELLING Iodel: Predictive Training Techn y - Underfitting Learning: Cluste FEATURE ENG	Data Collection, Preprocessing, Modeling, Evaluation - Tool Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algoritations: Holdout method, Cross-validation, Bootstrap - Normalist and Overfitting, Bias-Variance Trade-off- Evaluating tering. GINEERING AND SELECTION g Techniques - feature Transformation - Construction is a particular to the property of the proper	thms (C Model reg Mode	Classificepreser	ication ntation orman	9 and and cee –
Mach and C Reduct UNIT Select Regre interp Unsup UNIT Featur select	ine Lear Quantitat etion(PC III ting a M ssion) - retability pervised IV re - Fea ion: Issue e selecti	ning activities: In ive — Structure (A) — Feature Sulum MODELLING MODELLING Training Techn y - Underfitting Learning: Cluster FEATURE ENG ture engineering tes in high-dimen	Data Collection, Preprocessing, Modeling, Evaluation - Troof Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorithms: Holdout method, Cross-validation, Bootstrap - Normaliques: Holdout method, Cross-validation, Bootstrap - Normaliques: And Overfitting, Bias-Variance Trade-off- Evaluating tering. GINEERING AND SELECTION g Techniques - feature Transformation - Construction is ansional data - key drivers - measure of feature relevance approaches.	thms (C Model reg Mode	Classificepreser	ication ntation orman	9 and and cee –
Mach and C Reduce UNIT Select Regree interp Unsup UNIT Featur select featur UNIT	ine Lear Quantitat etion(PC III ling a M ssion) - retability pervised IV re - Fea ion: Issue re selecti	ning activities: It ive — Structure (A) — Feature Sulmodel: Predictive Training Techn y - Underfitting Learning: Cluste FEATURE ENC ture engineering tes in high-diment on process and a ADVANCED L	Data Collection, Preprocessing, Modeling, Evaluation - Troof Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorithms: Holdout method, Cross-validation, Bootstrap - Normaliques: Holdout method, Cross-validation, Bootstrap - Normaliques: And Overfitting, Bias-Variance Trade-off- Evaluating tering. GINEERING AND SELECTION g Techniques - feature Transformation - Construction is ansional data - key drivers - measure of feature relevance approaches.	thms (C Model reg Mode	Classificepreser	ication ntation orman	9 and and and errall
Mach and C Reduct UNIT Select Regree interp Unsup UNIT Feature select feature UNIT Regul	ine Lear Quantitat etion(PC III ting a M ssion) - retability pervised IV re - Fea ion: Issue e selecti	ning activities: It ive — Structure (A) — Feature Sulmodel: Predictive Training Technicy — Underfitting Learning: Cluster EATURE ENGINEER IN high-dimental process and a ADVANCED Line — L1 (Lasso), I	Data Collection, Preprocessing, Modeling, Evaluation - Troof Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorithms: Holdout method, Cross-validation, Bootstrap - May and Overfitting, Bias-Variance Trade-off- Evaluating tering. GINEERING AND SELECTION g Techniques - feature Transformation - Construction is a misional data - key drivers - measure of feature relevance approaches. EARNING	thms (Continued of the continued of the	Classificepresent Performantion	ication ntation orman	9 and and ce - 9 ature
Mach and C Reduct UNIT Select Interpretation UNIT Feature Select feature UNIT Regul optim	ine Lear Quantitat etion(PC III ling a M ssion) - retability pervised IV re - Fea ion: Issue e selecti V arization	ning activities: In ive — Structure (A) — Feature Sulum MODELLING MODELLING Model: Predictive Training Techn y - Underfitting Learning: Cluste ture engineering tes in high-diment on process and a ADVANCED L n - L1 (Lasso), I SVM and Kern	Data Collection, Preprocessing, Modeling, Evaluation - To of Data - Data quality and remediation - Data Pre-prob set selection. AND EVALUATION e vs Descriptive Models - Supervised Learning Algorithms: Holdout method, Cross-validation, Bootstrap - May and Overfitting, Bias-Variance Trade-off- Evaluating ering. GINEERING AND SELECTION g Techniques - feature Transformation - Construction in a sional data - key drivers - measure of feature relevance approaches. EARNING L2 (Ridge), ElasticNet - Preventing Overfitting - Convey	thms (C Model reg Mode and ext and red	Classificepreser Performance Proving Proving Proving —F	ication ntation orman n - Fea	9 and and cce – 9 and serial s
Mach and C Reduct UNIT Select Interpretation UNIT Feature Select feature UNIT Regul optim	ine Lear Quantitatetion(PC III 1 ting a M ssion) - retability pervised IV 1 tre - Feation: Issue the selection 1 tre - Teation 1 t	ning activities: In ive — Structure (A) — Feature Sulum MODELLING MODELLING Model: Predictive Training Techn y - Underfitting Learning: Cluste ture engineering tes in high-diment on process and a ADVANCED L n - L1 (Lasso), I SVM and Kern	Data Collection, Preprocessing, Modeling, Evaluation - Tropic of Data - Data quality and remediation - Data Pre-problems set selection. AND EVALUATION Evaluation - Supervised Learning Algorithms: Holdout method, Cross-validation, Bootstrap - Note and Overfitting, Bias-Variance Trade-off- Evaluating tering. GINEERING AND SELECTION General Transformation - Construction in the second process of the second process. EARNING L2 (Ridge), ElasticNet - Preventing Overfitting - Convey the Methods - Boosting Algorithm - VC dimension - PARTICLE AND SELECTION - PARTICLE TRANSION - PARTI	thms (C Model reg Mode and ext and red	Classificepreser Performance Proving Proving Proving —F	ication ntation orman n - Fea	9 and and cce – 9 and serial s

COUL	RSE OUTCOMES	
At the	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain the fundamental concepts of machine learning, types of learning paradigms, and their real-world applications.	Understanding (K2)
CO2	organize and prepare raw data through preprocessing, dimensionality reduction, and feature selection techniques.	Applying(K3)
CO3	select and train appropriate supervised or unsupervised models and evaluate model performance effectively.	Analyzing(K4)
CO4	describe engineer features and select relevant subsets from high-dimensional datasets to improve learning accuracy.	Understanding (K2)
CO5	explain core theoretical principles including PAC learning, VC dimension, reinforcement, and rule-based learning.	Understanding (K2)

- 1. I.A.Dhotre, "Machine Learning", Technical Publication, first edition, July 2021.
- Shai Shalev, Shwartz and Shai Ben-David "Understanding Machine Learning: From Theory to Algorithms", Cambridge University press, 2014

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- Saikat Dutt, Subramanian Chandramouli and Amit Kumar Das, "Machine Learning", 1st Edition, Pearson Education, 2019.
- Deepak Khemani, "A First Course in Artificial Intelligence", 1st Edition, McGraw Hill Education, India, 2017.
- 4. Tom M. Mitchell, "Machine Learning", Indian Edition, McGraw Hill Education, 2017

CO-PO MAPPING:

	Programme Outcomes PO's												PSO's	
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-			-	2	1
CO2	3	3	3	2	2	#	-	-		-	-	-	3	2
CO3	3	3	3	2	2	-	-	-	-	-		-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	4.50	-	3	3
CO5	3	2	3	2	2	-	-	-	-	-		-	3	3



CI236	56 NATURAL LANGUAGE PROCESSING 3 0	0	3
COURSI	E OBJECTIVES		
To enable	e the students to		
1. u	understand the fundamentals of language models,		
2. u	understand and implement word embeddings		
3. d	develop an understanding of deep learning architectures		
4. 1	earn how machine translation systems work		
5. e	explore the ethical implications of NLP technologies		
UNIT I	WORDS AND THEIR STATISTICAL MODELS		9
Smoothir	 N-Grams - Evaluating Language Models - Generalizations and Zeros - Smoothing - For the Property of the Property o	ers –Na	ive-
UNIT II			
Lexical S weighing	VECTORS AND EMBEDDINGS Semantics - Vector Semantics - Words and Vectors - Cosine for measuring similarity terms in vectors - pointwise Mutual Information (PMI) - Applications of TF-IDF at ec - Visualizing embeddings - Bias and Embeddings - Evaluating vector models. Neur	nd PPN	1I –
Lexical S weighing Word2Ve	Semantics - Vector Semantics - Words and Vectors - Cosine for measuring similarity terms in vectors - pointwise Mutual Information (PMI) - Applications of TF-IDF and	nd PPN al Netv	DF:
Lexical S weighing Word2Vo Language	Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity g terms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and ec – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neur e Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – SeQUENCE LABELING AND DEEP LEARNING ARCHITECTURES	nd PPM al Netw ts.	DF: 4I - work
Lexical S weighing Word2Vo Language UNIT II English v PoS – Co	Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity geterms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and ee – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neural Media – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – Training Neural Network semantics – Visualizing embeddings – Sequence Labeling and Deep Learning Architectures word classes – Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging and Italian problems – Evaluation of Named Entity Recognition. Deep Learning Architecture emodeling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRU	nd PPM al Netw ts. ng - H tecture	DF: MI - 9 MMM s for
Lexical Sweighing Word2Ve Language UNIT II English v PoS – Co sequence	Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity geterms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and etc. – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neur e Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – Training Neural Network Sequence Labeling And Deep Learning Architectures word classes – Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging and Entitional Random Fields – Evaluation of Named Entity Recognition. Deep Learning Architecture modeling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRUM MACHINE TRANSLATION (MT) AND ENCODER-DECODER MODELS	nd PPM al Netv ts. ng – H itecture	DF: MI - vork
Lexical S weighing Word2Vo Language UNIT II English v PoS – Co sequence UNIT IV Language – Beam	Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity geterms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and ee – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neural Media – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – Training Neural Network semantics – Visualizing embeddings – Sequence Labeling and Deep Learning Architectures word classes – Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging and Italian problems – Evaluation of Named Entity Recognition. Deep Learning Architecture emodeling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRU	nd PPM al Netw ts. ng - H ttecture	DF: MI – 9 MMM S for
Lexical S weighing Word2Vo Language UNIT II English v PoS – Co sequence UNIT IV Language – Beam evaluation	Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity geterms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and ec – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neur e Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – Sequence Labeling And Deep Learning Architectures word classes – Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging on Maintain Random Fields – Evaluation of Named Entity Recognition. Deep Learning Architecture emodeling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRUM MACHINE TRANSLATION (MT) AND ENCODER-DECODER MODELS are divergences and Typology – The Encode-Decoder model – Encoder-Decoder with RNNs Search – Encoder-Decoder with Transformers – Practical details on building MT system – Bias and ethical issues.	nd PPM al Netw ts. ng - H itecture s - Atter tems -	MMM S for
Lexical S weighing Word2Vo Language UNIT II English v PoS – Co sequence UNIT IV Languag – Beam evaluatio UNIT V Question Knowled – Evalua	Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity geterms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and ec – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neurole Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – Word classes – Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging and Italian Random Fields – Evaluation of Named Entity Recognition. Deep Learning Archive modeling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRUW MACHINE TRANSLATION (MT) AND ENCODER-DECODER MODELS are divergences and Typology – The Encode-Decoder model – Encoder-Decoder with RNNs Search – Encoder-Decoder with Transformers – Practical details on building MT systom – Bias and ethical issues. PRACTICAL NLP SYSTEMS Answering: Information Retrieval – IR based Factoid Question Answering – Entity dage based Question Answering – Using Language Models for Question Answering – Classic ation of factoid answers. Chatbots and Dialogue systems – Chatbots – GUS: a simple factor of the content of the property of t	nd PPM al Netw ts. ng - H tecture ts - Atter tems - Linkin	DF: MI - york 9 MM MM MT MT
Lexical S weighing Word2Vo Language UNIT II English v PoS – Co sequence UNIT IV Languag – Beam evaluatio UNIT V Question Knowled – Evalua	Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity geterms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and ec – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neurone Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – Units – XOR problem – Feed Forward Neural Networks – Training Neural Networks – Cosine for models. Neurone Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Network of Classes – Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging on Modeling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRUM MACHINE TRANSLATION (MT) AND ENCODER-DECODER MODELS are divergences and Typology – The Encode-Decoder model – Encoder-Decoder with RNNs Search – Encoder-Decoder with Transformers – Practical details on building MT system – Bias and ethical issues. PRACTICAL NLP SYSTEMS PRACTICAL NLP SYSTEMS Answering: Information Retrieval – IR based Factoid Question Answering – Entity dige based Question Answering – Using Language Models for Question Answering – Classic	nd PPM al Netw ts. ng - H itecture is - Atter tems - Linkin QA mc frame-b	DF MI - world MMM MM MT

COUI	RSE OUTCOMES	
	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain formal and statistical models for word processing	Understanding (K2)
CO2	develop word vector embeddings for a given language.	Applying (K3)
CO3	utilize deep learning architectures for modeling sequences in NLP	Applying (K3)
CO4	make use of encoder-decoders models to build Machine Translation systems.	Applying (K3)
CO5	build question answering and chatbots for practical applications	Applying (K3)

- 1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 3rd Edition, Pearson Education, New Delhi, 2020.
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- 2. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, T Chapman and Hall/CRC Press, 2010.
- Ewan Steven Bird, Klein and Edward Loper. "Natural Language Processing with Python", First Edition, O_Reilly Media, 2009.
- Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's

	Programme Outcomes PO's												PSO's	
CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	2	-	-	3	2
CO2	3	2	1	-	-	-	-	-	-	2	-		3	2
CO3	3	2	1		-	-	-	-	-	2			3	3
CO4	3	2	1		-	-	-	_	-	2		-	3	3
CO5	3	2	1		-,-	-	_	-	-	3	-	-	3	. 2



CI23657	:	OCIAL NETWORK SECURI	TY		3 0	0	3
COURSE C	BJECTIVES						
Γo enable th	e students to						
1. und	erstand the fundamenta	ls of the Semantic Web and the e	evolution of th	e Social W	eb.		
2. lear	various models and r	epresentations of social network	data using sen	nantic techr	iques.		
3. app	y ontological framewo	rks to aggregate and reason over	social data.				
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		ols and technologies for building			cial fea	tures	
5. ana		tific and community-based sema		works.			
UNIT I	FUNDAMENTAL	S OF SOCIAL NETWORKING	G				9
		sis- Development of Social Networks, The Mac					
			Control of the Contro				9
Electronic s based netwo	purces for network and rks, Knowledge Repre	SEMANTICS IN SOCIAL NE lysis: Electronic discussion networks sentation on the Semantic Web:	orks, Blogs an	d online co	ommun e in the	e Sema	Veb- antic
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	end of this course, students will be able to	BT Mapped (Highest Level)
CO1	understand the concepts of the Semantic Web, Social Web, and key principles of social network analysis.	Understanding (K2)
CO2	apply ontology languages (OWL, RDF) and Semantic Web principles to represent social networks.	Applying (K3)
CO3	discuss the model, aggregate process, and reason over social data using ontological representation.	Applying (K3)
CO4	develop semantic-based social web applications using tools such as Sesame. Elmo, and GraphUtil.	Applying (K3)
CO5	analyze semantic-based social network data in academic and web-based case studies.	Analyzing(K4)

- 1. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
- David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning about a Highly Connected World". First Edition, Cambridge University Press, 2010

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- 1. Jérôme Baton, Rik Van Bruggen, "Learning Neo4j 3.x Second Edition" Packt publishing, 2017.
- BorkoFurht, "Handbook of Social Network Technologies and Application", First Edition, Springer, 2010.
- Easley D. Kleinberg J., "Networks, Crowds, and Markets, Reasoning about a Highly Connected World", Cambridge University Press, 2010.
- 4. Jackson, Matthew O., Social and Economic Networks, Princeton University Press, 2008.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

Programme Outcomes PO's PSO's CO's PO1 PO2 PO₃ PO₄ PO5 PO₆ PO7 PO8 PO9 PO10 PO11 **PO12** PSO₁ PSO₂ CO1 2 1 -3 2 CO₂ 2 2 2 3 2 3 2 CO₃ 3 3 2 3 3 2 2 3 CO4 3 2 3 2 3 2 2 3 CO5 2 2 2 2 2 2

