ANNAPOORANA ENGINEERING COLLEGE

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DEPARTMENT OF INFORMATION TECHNOLOGY

4th Board of Studies Meeting

Venue: Board Room

Date & Time: 29.11.2025 & 11.00 AM

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AEC/IT/2025-2026/ BOS /C04 Date: 21.11.2025

CIRCULAR

The **Third Board of Studies Meeting** for the **Department of Information Technology** is scheduled to be held on **29th Nov2025 at 11:00 AM** in the **Board Room**, under the chairmanship of **Dr. S. Venkatesan**, Head of the Department, Information Technology, **Annapoorana Engineering College**. All faculty members are kindly requested to attend the meeting to discuss the following agenda.

AGENDA

1. Welcome note by Head of the Department
2. Introduction of the members
3. Proposal for Curriculum and Syllabi for various academic programs.

Dr.S.Venkatesan
HoD/IT

21/11
Dr.A.Anbuchezian
Principal

Copy to :

1. Director –Academics
2. Director-Administration
3. All HODs
4. All Faculty Members
5. Main Notice Board
6. File

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Minutes of Board of Studies Meeting on 29.11.2025

Minutes of Board of Studies Meeting, Department of Information Technology,
Held at 11.00 am on 29th NOV 2025(Saturday) at Board Room.

Members Present

SNO	NAME	POSITION	CATEGORY	SIGNATURE
1	Dr.S.Venkatesan	Professor/HoD	Chairman	
2	Dr.D.Indumathi	Associate Professor, Department of Computer Science and Engineering, PSG College of Technology, Coimbatore.	University Nominee	
3	Dr.S.Sivakumari	Professor & Head,Department of Computer Science and Engineering,School of Engineering Avinashilingam University,Coimbatore.	Academic Expert	29/11/25
4	Dr.R.Kanagaraj	Assistant Professor,Senior Grade 2 Department of Information Security,School of Computer Science and Engineering,Vellore Institute of Technology,Vellore.	Academic Expert	
5	Mr.S.A.Manikandan	Founder/Director Supporticon Strategies Private Limited,Salem	Industry Expert	
6	Mrs.N.Radha	Associate Professor	Faculty Member	
7	Mr.K.S.Mohankumar	Associate Professor	Faculty Member	
8	Mrs.A.Saranyadurai	Assistant Professor	Faculty Member	

9	Mr.S.Siva	Assistant Professor	Faculty Member	
10	Mrs.P.Nandini	Assistant Professor	Faculty Member	
11	Mrs.R.Suriya	Assistant Professor	Faculty Member	
12	Mrs.M.Renuka	Assistant Professor	Faculty Member	
13	Mr.R.Krishnan	Assistant Professor	Faculty Member	
14	Mr.R.Prakash	Assistant Professor	Faculty Member	

Principal

Dr.A.Anbuchezian

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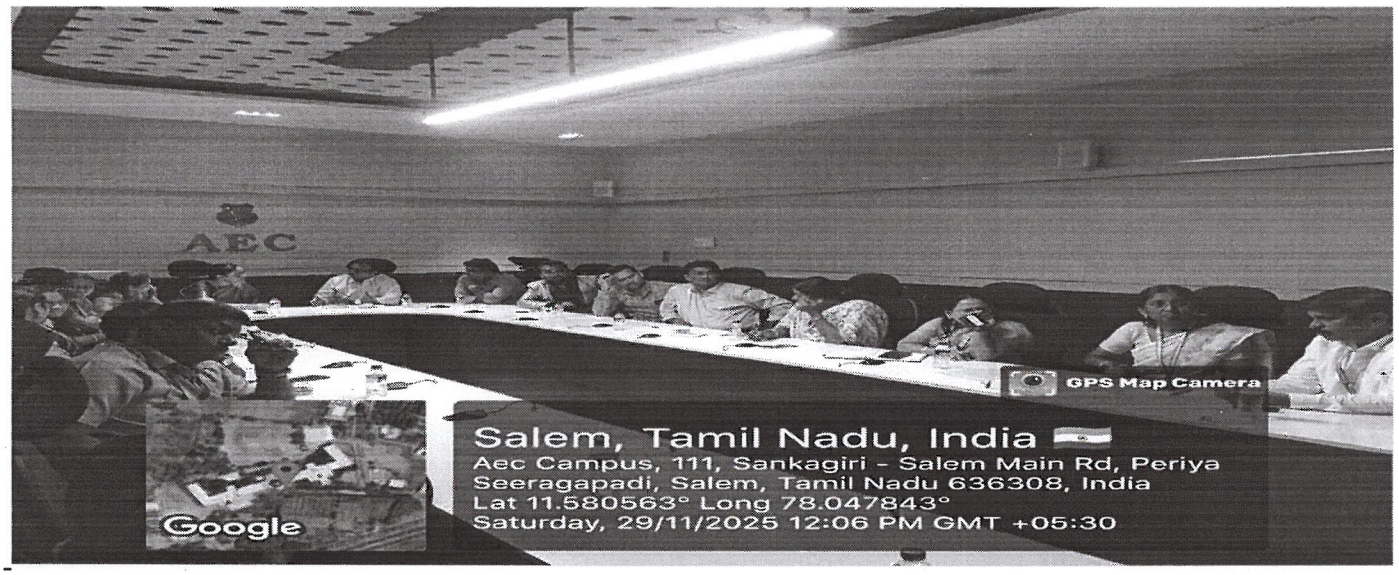
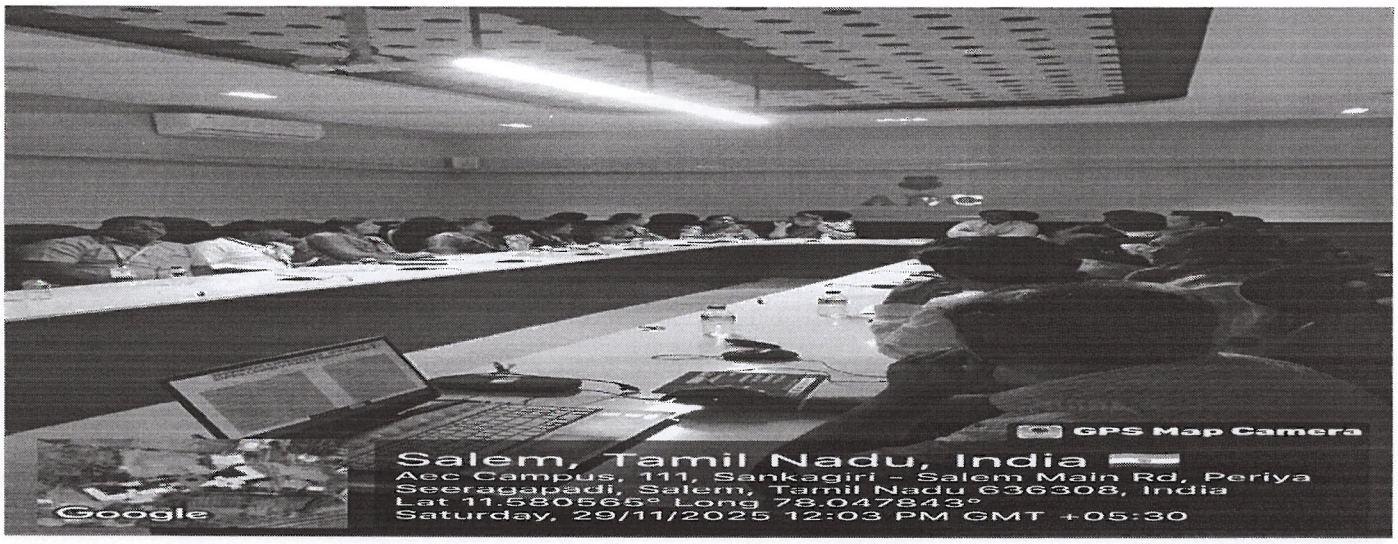
DEPARTMENT OF INFORMATION TECHNOLOGY

Venue: Board Room

Date & Time: 29.11.2025 & 11.00 a.m.





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DEPARTMENT OF INFORMATION TECHNOLOGY 29.11.2025

IT BOS MINUTES OF MEETING

The Board of Studies (BoS) Meeting of the **Department of Information Technology** was conducted on **Saturday, 29th November 2025, at 11:00 A.M.** in the **AEC Board Room**. The meeting was organized to discuss academic matters related to curriculum development, syllabus revision, and industry alignment.

The meeting commenced with a welcome address by the **Head of the Department and Chairman of the Board of Studies**. The Chairman extended a warm and respectful welcome to all the distinguished members, including the **University Nominee, Academic Experts, Industry Expert and Faculty Members of the IT Department.**

SUGGESTIONS AND RECOMMENDATIONS:

- Recommendations for Ad on Certification Credit Courses in Curriculum.
- More Weightage for Network and Communication Subjects.
- Faculty Mentorship for Research and Student Projects and enhancement of practical and project-based learning.
- Participations of Students in Events related to their Course in Various forums.
- Inclusion of emerging technologies such as Artificial Intelligence, Data Science, Cloud Computing, and Cyber Security,
- Proposal to introduce new elective courses to enhance student employability
- Increased focus on hands-on training
- Integration of industry tools and platforms

The meeting ended with a vote of thanks proposed by the Chairperson, expressing gratitude to all the members for their valuable suggestions and active participation with the assurance that the recommendations of the Board would be implemented effectively for the continuous improvement of the academic programs.

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Dr.D.Indumathi
Anna University Nominee

Dr.R.Kanagaraj
Academic Expert

DR.S.Sivakumari
29/11/25
Academic Expert

Mr.S.A.Manikandan
Industry Representative

Dr.S. Venkatesan
Chairman BOS

Dr.A. Anbuchezian
Principal

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SEMESTER-I

S. NO.	COURSE CODE	COURSETITLE	CATAGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22IP001	InductionProgram	-	-	-	-	-	0
THEORY								
2.	22HS101	ProfessionalEnglish-I	HSMC	3	0	0	3	3
3.	22MA101	Matricesand Calculus	BSC	3	0	0	3	3
4.	22PH101	EngineeringPhysics	BSC	3	0	0	3	3
5.	22CY101	EngineeringChemistry	BSC	3	0	0	3	3
6.	22GE101	ProblemSolvingand PythonProgramming	ESC	3	0	0	3	3
7.	22GE102	EngineeringGraphics	ESC	2	0	2	4	3
8.	22GE103	HeritageofTamil	HSMC	1	0	0	1	1
PRACTICALS								
9.	22GE104	Problem Solvingand PythonProgramming Laboratory	ESC	0	0	4	4	2
10.	22PC101	Physicsand Chemistry Laboratory	BSC	0	0	4	4	2
11.	22GE105	EnglishLaboratory	EEC	0	0	2	2	1
TOTAL				**18**	**0**	**12**	**30**	**24**

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SEMESTER-II

S. NO.	COURSE CODE	COURSETITLE	CATAGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	22HS201	ProfessionalEnglish-II	HSMC	3	0	0	3	3
2.	22MA202	Vectorsand Complex Function	BSC	3	0	0	3	3
3.	22PH203	PhysicsforInformation Science	BSC	3	0	0	3	3
4.	22CY201	Environmental Science and Sustainability	BSC	2	0	0	2	2
5.	22GE201	BasicElectrical and ElectronicsEngineering	ESC	3	0	0	3	3
6.	22CS201	ProgramminginC	ESC	3	0	0	3	3
7.	22GE202	TamilsandTechnology	HSMC	1	0	0	1	1
PRACTICALS								
8.	22GE203	Basic Electrical and ElectronicsEngineering Laboratory	ESC	0	0	4	4	2
9.	22CS202	ProgramminginC Laboratory	ESC	0	0	4	4	2
10.	22GE204	EngineeringPractices Laboratory	ESC	0	0	4	4	2
11.	22GE205	Communication Laboratory/Foreign Language	EEC	0	0	4	4	2
TOTAL				**18**	**0**	**16**	**34**	**26**

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SEMESTER-III

S. NO.	COURSE CODE	COURSETITLE	CATAGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	22MA301	Transformsand Partial DifferentialEquations	BSC	3	0	0	3	3
2.	22EC307	DigitalPrinciplesand computer Organization	ESC	3	0	2	5	4
3.	22IT301	DataStructuresAnd Algorithms	PC	3	0	0	3	3
4.	22IT302	Object Oriented Programming	PC	3	0	0	3	3
5.	22IT303	FoundationofData Science	PC	3	0	0	3	3
PRACTICALS								
6.	22IT304	DataStructuresAnd Algorithms Laboratory	PC	0	0	4	4	2
7.	22IT305	ObjectOriented Programming Laboratory	PC	0	0	4	4	2
8.	22IT306	DataScience Laboratory	PC	0	0	4	4	2
9.	22MC010	Physicaland Mental HealthUsingYoga	NCMC	1	0	0	1	0
TOTAL				**16**	**0**	**14**	**30**	**22**

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SEMESTER-IV

S. NO.	COURSE CODE	COURSETITLE	CATAGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	22MA401	NumericalMethods	BSC	3	0	0	3	3
2.	22IT401	TheoryofComputation	PC	3	0	0	3	3
3.	22IT402	Web Essentials	PC	3	0	2	5	4
4.	22IT403	DatabaseManagement Systems	PC	3	0	0	3	3
5.	22IT404	Introductionto OperatingSystems	PC	3	0	0	3	3
PRACTICALS								
6.	22IT405	OperatingSystems Laboratory	PC	0	0	4	4	2
7.	22IT406	DatabaseManagement Systems Laboratory	PC	0	0	4	4	2
8.	22MC003	EntrepreneurialSkill Development	NCMC	1	0	0	1	0
TOTAL				**16**	**0**	**10**	**26**	**20**

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SEMESTER-V

S. NO.	COURSE CODE	COURSETITLE	CATAGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	22IT501	ComputerNetworks	PC	3	0	2	5	4
2.	22IT502	FullStackWebDevelopment	PC	3	0	0	3	3
3.	22IT503	DistributedComputing	PC	3	0	0	3	3
4.	22EC408	EmbeddedSystemsandIoT	ESC	3	0	2	5	4
5.		ProfessionalElective-I	PE	3	0	0	3	3
6.		ProfessionalElective-II	PE	3	0	0	3	3
PRACTICALS								
7.	22IT504	FullStackWebDevelopment Laboratory	PC	0	0	4	4	2
8.	22MC004	Essence of Indian KnowledgeTradition (Seminar)	NCMC	1	0	0	1	0
TOTAL				**19**	**0**	**8**	**27**	**22**

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SEMESTER-VI

S. NO.	COURSE CODE	COURSETITLE	CATAGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	22IT601	ObjectOriented Software Engineering	PC	3	0	2	5	4
2.		OpenElective–I*	OE	3	0	0	3	3
3.		ProfessionalElective-III	PE	3	0	0	3	3
4.		ProfessionalElective-IV	PE	3	0	0	3	3
5.		ProfessionalElective-V	PE	3	0	0	3	3
6.		ProfessionalElective-VI	PE	3	0	0	3	3
PRACTICALS								
7.	22IT602	Mobile Applications DevelopmentLaboratory	PC	0	0	4	4	2
8.	22MC014	Time Management Presentation Skills	NCMC	1	0	0	1	0
TOTAL				**19**	**0**	**6**	**25**	**21**

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SEMESTER-VII

S. NO.	COURSE CODE	COURSETITLE	CATEGOR	PERIODS PERWEEK			TOTAL CONTAT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		HumanValues andEthics	HSMC	3	0	0	3	3
2.		PrinciplesofManagement	HSMC	3	0	0	3	3
3.		OpenElective–II**	OE	3	0	0	3	3
4.		OpenElective–III**	OE	3	0	0	3	3
5.		OpenElective–IV**	OE	3	0	0	3	3
PRACTICALS								
6.		Summerinternship	EEC	0	0	0	0	2
TOTAL				**15**	**0**	**0**	**15**	**17**

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SEMESTER-VIII

S. NO.	COURS ECODE	COURSETITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		SoftwareProject Management	PC	3	0	0	3	3
PRACTICALS								
2.		ProjectWork	EEC	0	0	20	20	10
TOTAL				**3**	**0**	**20**	**23**	**13**

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PROFESSIONALELECTIVECOURSES:VERTICALS

Vertical I DataScience	Vertical II Cloud Computing and Data Center Technologies	Vertical III Full Stack Development for IT	Vertical IV CyberSecurityand DataPrivacy	Vertical V CreativeMedia	Vertical VI Emerging Technologies	Vertical VII Artificial Intelligence and MachineLearning
Exploratory Data Analysis	Virtualization	Cloud Computing	EthicalHacking	Augmented Reality/Virtual Reality	NaturalLanguage Processing	Knowledge Engineering
Recommender Systems	Cloud Services Management	AppDevelopment	DigitalandMobile Forensics	Multimediaand Animation	RoboticProcess Automation	SoftComputing
Neural Networks and Deep Learning	DataWarehousing	UIandUXDesign	SocialNetwork Security	VideoCreation and Editing	ArtificialIntelligence	EthicsandAI
Text and SpeechAnalysis	Storage Technologies	SoftwareTesting and Automation	ModernCryptography	DigitalMarketing	CyberSecurity	GenerativeAI
BusinessAnalytics	SoftwareDefined Networks	Web Application Security	EngineeringSecure SoftwareSystems	VisualEffects	QuantumComputing	Optimization Techniques
Image and Video Analytics	StreamProcessing	DevOps	Cryptocurrencyand Block chain Technologies	Game Development	AIinIoT	GameTheory
Big Data Analytics	Security and Privacy In Cloud	Principlesof Programming Languages	NetworkSecurity	MultimediaData Compression and Storage	3DPrintingandDesign	CognitiveScience

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PROFESSIONALELECTIVECOURSES

VERTICALS

VERTICAL1:DATASCIENCE

S. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ITV01	Exploratory DataAnalysis	PE	2	0	2	4	3
2.	22ITV02	Recommender Systems	PE	2	0	2	4	3
3.	22ITV03	Neural Networks and DeepLearning	PE	2	0	2	4	3
4.	22ITV04	Text and Speech Analysis	PE	2	0	2	4	3
5.	22ITV05	Business Analytics	PE	2	0	2	4	3
6.	22ITV06	Imageand Video Analytics	PE	2	0	2	4	3
7.	22ITV07	Big Data Analytics	PE	2	0	2	4	3

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VERTICAL2:CLOUDCOMPUTINGANDDATACENTERTECHNOLOGIES

S. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ITV08	Virtualization	PE	2	0	2	4	3
2.	22ITV09	Cloud Services Management	PE	2	0	2	4	3
3.	22ITV10	Data Warehousing	PE	2	0	2	4	3
4.	22ITV11	Storage Technologies	PE	3	0	0	3	3
5.	22ITV12	Software Defined Networks	PE	2	0	2	4	3
6.	22ITV13	Stream Processing	PE	2	0	2	4	3
7.	22ITV14	Securityand Privacy in Cloud	PE	2	0	2	4	3

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VERTICAL3:FULLSTACKDEVELOPMENTFORIT

S. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ITV15	Cloud Computing	PE	2	0	2	4	3
2.	22ITV16	App Development	PE	3	0	0	3	3
3.	22ITV17	UIandUX Design	PE	2	0	2	4	3
4.	22ITV18	Software Testingand Automation	PE	2	0	2	4	3
5.	22ITV19	Web Application Security	PE	2	0	2	4	3
6.	22ITV20	DevOps	PE	2	0	2	4	3
7.	22ITV21	Principlesof Programming Languages	PE	3	0	0	3	3

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VERTICAL4:CYBERSECURITYANDDATAPRIVACY

S. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ITV22	Ethical Hacking	PE	2	0	2	4	3
2.	22ITV23	Digital and MobileForensics	PE	2	0	2	4	3
3.	22ITV24	SocialNetwork Security	PE	2	0	2	4	3
4.	22ITV25	Modern Cryptography	PE	2	0	2	4	3
5.	22ITV26	Engineering SecureSoftware Systems	PE	2	0	2	4	3
6.	22ITV27	Cryptocurrency andBlockchain Technologies	PE	2	0	2	4	3
7.	22ITV28	NetworkSecurity	PE	2	0	2	4	3

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VERTICAL5:CREATIVEMEDIA

S. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ITV29	Augmented Reality/Virtual Reality	PE	2	0	2	4	3
2.	22ITV30	Multimediaand Animation	PE	2	0	2	4	3
3.	22ITV31	VideoCreation and Editing	PE	2	0	2	4	3
4.	22ITV32	Digital marketing	PE	2	0	2	4	3
5.	22ITV33	VisualEffects	PE	2	0	2	4	3
6.	22ITV34	Game Development	PE	2	0	2	4	3
7.	22ITV35	MultimediaData Compressionand Storage	PE	2	0	2	4	3

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VERTICAL6:EMERGINGTECHNOLOGIES

S. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ITV36	Natural Language Processing	PE	2	0	2	4	3
2.	22ITV37	RoboticProcess Automation	PE	2	0	2	4	3
3.	22ITV38	Artificial Intelligence	PE	3	0	0	3	3
4.	22ITV39	CyberSecurity	PE	2	0	2	4	3
5.	22ITV40	Quantum Computing	PE	2	0	2	4	3
6.	22ITV41	AIinIoT	PE	3	0	0	3	3
7.	22ITV42	3DPrintingand Design	PE	2	0	2	4	3

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VERTICAL7:ARTIFICIALINTELLIGENCEANDMACHINELEARNING

S. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	22ITV43	Knowledge Engineering	PE	2	0	2	4	3
2.	22ITV44	SoftComputing	PE	2	0	2	4	3
3.	22ITV45	EthicsandAI	PE	2	0	2	4	3
4.	22ITV46	GenerativeAI	PE	3	0	0	3	3
5.	22ITV47	Optimization Techniques	PE	2	0	2	4	3
6.	22ITV48	GameTheory	PE	2	0	2	4	3
7.	22ITV49	CognitiveScience	PE	2	0	2	4	3

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OPENELECTIVES

S.NO	COURSE CODE	COURSETITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	22OEE01	IntroductiontoControlSystems	OE	3	0	0	3	3
2.	22OEE02	RenewableEnergySystems	OE	3	0	0	3	3
3.	22OEE03	Energyconservation and management	OE	3	0	0	3	3
4.	22OEE04	Renewableenergytechnologies	OE	3	0	0	3	3
5.	22OEE05	ElectricVehicleTechnology						
6.	22OME01	Applicationsof3Dprinting Techniques	OE	3	0	0	3	3
7.	22OME02	IntroductiontoNon-Destructive Testing	OE	3	0	0	3	3
8.	22OME03	Conceptsof Competitive manufacturing	OE	3	0	0	3	3
9.	22OME04	ProductionPlanningand Control	OE	3	0	0	3	3
10.	22OME05	SolarEnergyTechnologies						
11.	22OEC01	MEMSandNEMS	OE	3	0	0	3	3
12.	22OEC02	SpaceTimeWirelessCommunication	OE	3	0	0	3	3
13.	22OEC03	TelecommunicationNetwork Management	OE	3	0	0	3	3
14.	22OEC04	NanoTechnology	OE	3	0	0	3	3
15.	22OEC05	FoundationofRobotics	OE	3	0	0	3	3
16	22OEC06	RemoteSensingConcepts	OE	3	0	0	3	3
17	22OEC07	Sensors	OE	3	0	0	3	3
18	22OBM01	BasicsofMicrobialTechnology	OE	3	0	0	3	3
19	22OBM02	Basicsof Biomolecules	OE	3	0	0	3	3
20	22OBM03	FundamentalsofCellandMolecular Biology	OE	3	0	0	3	3
21	22OBM04	Nanomaterialsandapplications	OE	3	0	0	3	3
22	22OBM05	Food,NutritionandHealth	OE	3	0	0	3	3
23	22OCE01	Drinkingwatersupplyandtreatment	OE	3	0	0	3	3
24	22OCE02	Greenbuildingconcepts	OE	3	0	0	3	3
25	22OCE03	Disastermitigationandmanagement	OE	3	0	0	3	3
26	22OCE04	RoadsafetyandManagement	OE	3	0	0	3	3
27	22OIT01	ITinAgriculturalSystem	OE	3	0	0	3	3
28	22OAU01	VehicleTechnology	OE	3	0	0	3	3
29	22OAU02	AutomotivePowerTrainSystem	OE	3	0	0	3	3
30	22OAU03	AutonomousVehicleandSafety Systems	OE	3	0	0	3	3
31	22OAU04	Two-WheelerTechnology	OE	3	0	0	3	3

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HUMANITIESANDSOCIALSCIENCES &MANAGEMENTCOURSES(HSMC)

SL NO.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22HS101	ProfessionalEnglish-I	HSMC	3	3	0	0	3
2	22GE101	HeritageofTamil	HSMC	1	1	0	0	1
3	22HS201	ProfessionalEnglish-II	HSMC	3	3	0	0	3
4.	22GE202	TamilsandTechnology	HSMC	1	0	0	0	1
5.		HumanValues andEthics	HSMC	3	3	0	0	3
6.		PrinciplesofManagement	HSMC	3	3	0	0	3

NONCREDITABLEMANITARYCOURSE(NCMC)

SL NO.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1		PhysicalandMental HealthUsingYoga	NCMC	2	1	0	1	0
2		EntrepreneurialSkill Development	NCMC	2	2	0	0	0
3		EssenceofIndianKnowledgeTradition (Seminar)	NCMC	2	1	1	0	0
4.		EmployabilitySkills andPractices	NCMC	2	0	0	2	0

BASIC SCIENCES(BSC)

SL NO.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22MA101	Matricesand Calculus	BSC	3		0	0	3
2	22PH101	EngineeringPhysics	BSC	3		0	0	3
3	22CY101	EngineeringChemistry	BSC	3	3	0	0	3
4	22PC101	Physicsand ChemistryLaboratory	BSC	4		0	4	2
5	22MA202	VectorsandComplexFunction	BSC	3	3	0	0	3
6	22PH203	Physicsfor InformationScience	BSC	3	3	0	0	3
7	22CY201	EnvironmentalScience andSustainability	BSC	2	2	0	0	2
8	22MA301	TransformsandDifferentialEquations	BSC	3	0	0	3	3
9.	22MA401	NumericalMethods	BSC	3	0	0	3	3

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ENGINEERINGSCIENCES (ESC)

SL NO.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22GE101	ProblemSolvingandPython Programming	ESC	3	3	0	0	3
2	22GE102	EngineeringGraphics	ESC	4	0	0	2	3
3	22GE104	ProblemSolvingandPython Programming Laboratory	ESC	4	0	0	4	2
4	22GE201	BasicElectrical andElectronicsEngineering	ESC	3	3	0	0	3
5	22CS201	ProgramminginC	ESC	3	3	0	0	3
6	22GE203	BasicElectricalandElectronicsEngineering Laboratory	ESC	4	0	0	4	2
7	22CS202	ProgramminginCLaboratory	ESC	4	0	0	4	2
8	22GE204	EngineeringPractices Laboratory	ESC	4	0	0	4	2
9	22EC307	DigitalPrinciplesandcomputerOrganization	ESC	3	0	2	5	4
10	22EC408	EmbeddedSystemsandIoT	ESC	3	0	0	2	4

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PROFESSIONALCORE (PC)

SL NO.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22IT301	DatastructuresAndAlgorithms	PC	3	3	0	0	3
2	22IT302	ObjectOriented Programming	PC	3	3	0	0	3
3	22IT303	FoundationofDataScience	PC	3	0	0	3	3
4	22IT304	Datastructures AndAlgorithmsLaboratory	PC	4	0	0	4	2
5	22IT305	ObjectOrientedProgrammingwithLaboratory	PC	4	0	0	4	2
6	22IT306	DataScience Laboratory	PC	0	0	4	4	2
7	22IT401	TheoryofComputation	PC	3	3	0	0	3
8	22IT402	Web Essentials	PC	3	0	2	5	4
9	22IT403	DatabaseManagementSystems	PC	3	3	0	0	3
10	22IT404	IntroductiontoOperatingSystems	PC	3	3	0	0	3
11	22IT405	OperatingSystems Laboratory	PC	4	0	0	4	2
12	22IT406	DatabaseManagementSystems Laboratory	PC	4	0	0	4	2
13	22IT501	ComputerNetworks	PC	5	3	0	2	4
14	22IT502	Fullstackweb development	PC	3	3	0	0	3
15	22IT503	DistributedComputing	PC	3	3	0	0	3
16	22IT505	FullstackwebdevelopmentLaboratory	PC	4	0	0	4	2
17	22IT601	ObjectOrientedSoftwareEngineering	PC	3	0	2	5	4
18	22IT602	MobileApplicationsDevelopmentLaboratory	PC	4	0	0	4	2
19		SoftwareProjectManagement	PC	3	0	0	3	3

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PROFESSIONALELECTIVE(PE)

SL NO.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	22ITV01	ExploratoryDataAnalysis	PE	4	2	0	2	3
2	22ITV02	RecommenderSystems	PE	4	2	0	2	3
3	22ITV03	NeuralNetworks and DeepLearning	PE	4	2	0	2	3
4	22ITV04	TextandSpeechAnalysis	PE	4	2	0	2	3
5	22ITV05	BusinessAnalytics	PE	4	2	0	2	3
6	22ITV06	ImageandVideoAnalytics	PE	4	2	0	2	3
7	22ITV07	BigDataAnalytics	PE	4	2	0	2	3
8	22ITV08	Virtualization	PE	4	2	0	2	3
9	22ITV09	CloudServicesManagement	PE	4	2	0	2	3
10	22ITV10	DataWarehousing	PE	4	2	0	2	3
11	22ITV11	StorageTechnologies	PE	4	2	0	2	3
12	22ITV12	SoftwareDefined Networks	PE	4	2	0	2	3
13	22ITV13	StreamProcessing	PE	4	2	0	2	3
14	22ITV14	Securityand PrivacyinCloud	PE	3	3	0	0	3
15	22ITV15	Cloud Computing	PE	4	2	0	2	3
16	22ITV16	App Development	PE	3	3	0	0	3
17	22ITV17	UIand UXDesign	PE	4	2	0	2	3
18	22ITV18	SoftwareTestingandAutomation	PE	3	3	0	0	3
19	22ITV19	WebApplicationSecurity	PE	4	2	0	2	3
20	22ITV20	DevOps	PE	4	2	0	2	3
21	22ITV21	Principlesof ProgrammingLanguages	PE	4	2	0	2	3
22	22ITV22	Ethical Hacking	PE	4	2	0	2	3
23	22ITV23	DigitalandMobile Forensics	PE	4	2	0	2	3
24	22ITV24	SocialNetwork Security	PE	4	2	0	2	3
25	22ITV25	Modern Cryptography	PE	4	2	0	2	3
26	22ITV26	EngineeringSecure Software Systems	PE	4	2	0	2	3
27	22ITV27	CryptocurrencyandBlock chain Technologies	PE	4	2	0	2	3
28	22ITV28	NetworkSecurity	PE	4	2	0	2	3
29	22ITV29	AugmentedReality/VirtualReality	PE	4	2	0	2	3
30	22ITV30	Multimediaand Animation	PE	4	2	0	2	3
31	22ITV31	VideoCreationandEditing	PE	4	2	0	2	3

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32	22ITV32	Digitalmarketing	PE	4	2	0	2	3
33	22ITV33	VisualEffects	PE	4	2	0	2	3
34	22ITV34	GameDevelopment	PE	4	2	0	2	3
35	22ITV35	MultimediaDataCompressionand Storage	PE	4	2	0	2	3
36	22ITV36	NaturalLanguageProcessing	PE	4	2	0	2	3
37	22ITV37	RoboticProcess Automation	PE	4	2	0	2	3
38	22ITV38	Artificial Intelligence	PE	3	3	0	0	3
39	22ITV39	CyberSecurity	PE	4	2	0	2	3
40	22ITV40	Quantum Computing	PE	4	2	0	2	3
41	22ITV41	AIinIoT	PE	3	3	0	0	3
42	22ITV42	3DPrintingand Design	PE	4	2	0	2	3
43	22ITV43	KnowledgeEngineering	PE	4	2	0	2	3
44	22ITV44	SoftComputing	PE	4	2	0	2	3
45	22ITV45	EthicsandAI	PE	4	2	0	2	3
46	22ITV46	GenerativeAI	PE	3	3	0	0	3
47	22ITV47	OptimizationTechniques	PE	4	2	0	2	3
48	22ITV48	GameTheory	PE	4	2	0	2	3
49	22ITV49	CognitiveScience	PE	4	2	0	2	3

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EMPLOYABILITYENHANCEMENT COURSES (EEC)

SL NO.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	22GE105	EnglishLaboratory	EEC	2	0	0	2	1
2.	22GE205	CommunicationLaboratory/Foreign Language	EEC	4	0	0	4	2
3.		Summer Internship	EEC	0	0	0	0	2
5.		Projectwork	EEC	12	0	0	12	6
6.		TechnicalSeminar	EEC	2	0	0	2	0
7.		Training&PlacementProgram	EEC	2	1	1	0	0
8.		IndustrialTrainingandInternship	EEC	2	0	0	2	1
9.		Softskills Training	EEC	2	1	1	0	1
10.		ValueAdded Courses	EEC	2	1	0	1	0
11.		NPTELCourse –II	EEC	2	0	0	2	0

SUMMARY

Nameofthe Programme:B.Tech.-InformationTechnology									
S.No	Subject Area	Creditsper Semester							Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	4	4					6		14
2	BSC	11	8	4	3					25
3	ESC	8	12	4		1				25
4	PC			15	17	15	6		3	56
5	PE					6	12			18
6	OE						3	9		12
7	EEC	1	2					2	10	15
Total		24	26	22	20	2 2	21	17	13	165

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22ITV16	APPDEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives:	• Tolearndevelopmentofnativeapplications withbasicGUIComponents • Todevelopcross-platformapplications witheventhandling • Todevelopapplications withlocationanddatastorage capabilities • Todevelopwebapplications withdatabaseaccess

UNITI	**FUNDAMENTALSOFMOBILE&WEBAPPLICATION DEVELOPMENT**	**9**
BasicsofWebandMobileapplicationdevelopment,NativeApp,HybridApp,Cross-platformApp, WhatisProgressiveWebApp,ResponsiveWebdesign		
UNITII	**NATIVEAPPDEVELOPMENTUSINGJAVA**	**9**
NativeWebApp,BenefitsofNativeApp, ScenariostocreateNativeApp,ToolsforcreatingNative App, Cons of Native App, Popular Native App Development Frameworks, Java &Kotlin for Android,Swift&Objective-CforiOS,BasicsofReactNative,NativeComponents,JSX,State, Props		
UNITIII	**HYBRIDAPPDEVELOPMENT**	**9**
HybridWebApp,BenefitsofHybridApp,CriteriaforcreatingNativeApp,Toolsforcreating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova		
UNITIV	**CROSS-PLATFORMAPPDEVELOPMENTUSINGREACT-NATIVE**	**9**
What is Cross-platform App, Benefits of Cross-platformApp, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross-platformAppDevelopmentFrameworks,Flutter,Xamarin,React-Native,BasicsofReactNative,NativeComponents,JSX,State,Props		
UNITV	**NON-FUNCTIONALCHARACTERISTICSOFAPP FRAMEWORKS**	**9**
ComparisonofdifferentAppframeworks,BuildPerformance,AppPerformance,Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability		
	TOTAL:45PERIODS	

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SEMESTER I

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22GE101	PROBLEMSOLVINGANDPYTHONPROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

- Tounderstandthebasicsofcomputationalproblemsolving.
- TolearntosolveproblemsusingPythonconditionalsand loops.
- TodefinePythonfunctionsandusefunctioncallstosolve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- Todoinput/outputwithfilesinPython.

UNITI	FUNDAMENTALSOFCOMPUTATIONALPROBLEMSOLVING	9

Fundamentals of Computing –Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, Towers of Hanoi.

UNIT II	DATATYPES,EXPRESSIONS,STATEMENTS	9

Python interpreter, interactive and script mode, values and types: int, float, boolean, string, and list; variables, expressions, statements, tupleassignment, precedenceofoperators, comments; Illustrative programs: exchangethe valuesoftwovariables,circulatethevaluesof nvariables,distancebetween two points.

UNIT III	CONTROLFLOW,FUNCTIONS,STRINGS	9

Conditionals: Boolean values and operators, Input and Output, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion;Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV	LISTS,TUPLES, DICTIONARIES	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, Students marks statement, Retail bill preparation.

UNIT V	FILES,MODULES, PACKAGES	9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL:45PERIODS

TEXTBOOKS:	
1	AllenB.Downey,"ThinkPython:HowtoThinklikeaComputerScientist",2nd Edition,O"ReillyPublishers,2016.
2	KarlBeecher,"ComputationalThinking:ABeginner'sGuidetoProblemSolving and Programming",1stEdition,BCSLearning&Development Limited, 2017.
3	MartinC.Brown,"Python:TheCompleteReference",4thEdition,Mc-GrawHill, 2018.
REFERENCES:	
1	PaulDeitelandHarveyDeitel,"PythonforProgrammers",PearsonEducation,1st Edition, 2021.
2	GVenkateshandMadhavanMukund,"ComputationalThinking:APrimerfor ProgrammersandDataScientists",1stEdition,NotionPress,2021.
3	John V Guttag, "Introduction to Computation and Programming Using Python: With ApplicationstoComputationalModelingandUnderstandingData,,,,,ThirdEdition, MITPress,2021.
4	https://www.py4e.com/book

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CourseName:PROBLEMSOLVINGANDPYTHON PROGRAMMING		Coursecode: 22GE101			
CO	**CourseOutcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Developalgorithmicsolutionstosimplecomputational problems	I	K1	1,2,3,4 ,5,11,1 2	1,2
CO2	Developand executesimplePythonprograms	II	K1, K2	1,2,3,4 ,5, 11,12	1
CO3	WritesimplePythonprogramsusingconditionalsand loopsforsolving problems	III	K1, K3	1,2,3,4 ,5,11	1
CO4	DecomposeaPython programinto functions	IV	K5	1,2,3,5 ,11	1
CO5	RepresentcompounddatausingPythonlists, tuples, dictionariesetc	V	K4	1,2,5,1 1	1

CO-PO-PSOMapping

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

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22GE104	PROBLEMSOLVINGANDPYTHONPROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- Towrite,test,anddebugsimplePythonprograms
- ToimplementPythonprogramswithconditionalsandloops.
- Usefunctions forstructuringPythonprograms.
- RepresentcompounddatausingPythonlists,tuples, and dictionaries.
- Readandwritedata from/tofilesinPython.

LISTOFPROGRAMS

1) Computethe Greatest CommonDivisorusingn numbers.
2) Findthesquareroot ofa numbers.
3) Writethepythonprogramtofindthe exponentiation.
4) Findthemaximumvalueof agiven n numbersusingpython program.
5) Writeapythonprogramtofindfactorialusingfunction
6) Writeapythonprogram tofindpalindromeusing Strings.
7) Toimplementbinarysearchtechniqueusingpython program.
8) Toimplementlinearsearchtechniqueusingpythonprogram.
9) Writepythonprogramtoimplementinsertion sort.
10) Writepythonprogramtoimplementselectionsort.
11) Writepythonprogramtoimplementmergesort.
12) Tofindthefirstnprimenumbersusingpython program.
13) Computemultiplytwomatrices usingpython program.
14) Writethepythonprogramthattakescommand lineargument(word count).
15) Tofindthemostfrequent wordsinatextreadfromafileusingpythonprogram.

TOTAL:60PERIODS

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TEXTBOOKS:	
1	AllenB.Downey,"ThinkPython:HowtoThinklikeaComputerScientist",2nd Edition,O"ReillyPublishers,2016.
2	KarlBeecher,"ComputationalThinking:ABeginner'sGuidetoProblemSolving and Programming",1stEdition,BCSLearning&Development Limited, 2017.
3	MartinC.Brown,"Python:TheCompleteReference",4thEdition,Mc-GrawHill, 2018.
REFERENCES:	
1	PaulDeitelandHarveyDeitel,"PythonforProgrammers",PearsonEducation,1st Edition, 2021.
2	GVenkateshandMadhavanMukund,"ComputationalThinking:APrimerfor ProgrammersandDataScientists",1stEdition,NotionPress,2021.
3	John V Guttag, "Introduction to Computation and Programming Using Python: With ApplicationstoComputationalModelingandUnderstandingData,,,,,ThirdEdition, MITPress,2021.
4	https://www.py4e.com/book

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CourseName:PROBLEMSOLVINGANDPYTHON PROGRAMMINGLABORATORY		Coursecode: 22GE102			
CO	**CourseOutcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Developalgorithmicsolutionstosimplecomputational problems	I	K1	1,2,3,4 ,5,11,1 2	1,2
CO2	Developand executesimplePythonprograms	II	K1, K2	1,2,3,4 ,5, 11,12	1
CO3	WritesimplePythonprogramsusingconditionalsand loopsforsolving problems	III	K1, K3	1,2,3,4 ,5,11	1
CO4	DecomposeaPythonprogramintofunctions	IV	K5	1,2,3,5 ,11	1
CO5	RepresentcompounddatausingPythonlists, tuples, dictionariesetc	V	K4	1,2,5,1 1	1

CO-PO-PSOMapping

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

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SEMESTER II

22CS201	PROGRAMMINGIN C	L	T	P	C
		3	0	0	3

Course Objectives:

- TounderstandtheconstructsofCLanguage.
- TodevelopCProgramsusingbasicprogrammingconstructs
- TodevelopCprogramsusingarraysandstrings
- TodevelopmodularapplicationsinCusingfunctions
- TodevelopapplicationsinCusingpointersand structures
- Todoinput/outputandfilehandlinginC

UNITI	BASICS OFCPROGRAMMING	9

Introductiontoprogrammingparadigms -ApplicationsofCLanguage -StructureofCprogram -C programming: Data Types - Constants - Enumeration Constants - Keywords - Operators: Types of Operator andOperatorPrecedence-Expressions-Input/Output statements,Assignmentstatements -Decision makingstatements-Switch statement - Loopingstatements-Compilation process.

UNIT II	ARRAYSANDSTRINGS	9

Introduction to Arrays: Declaration, Initialization - One dimensional array - Two dimensional arrays - String operations: length, compare, concatenate, copy - Selection sort, linear and binary search.

UNIT III	FUNCTIONSAND POINTERS	9

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) - Recursion, Binary Search using recursive functions - Pointers - Pointeroperators -Pointerarithmetic -Arrays and pointers -Arrayofpointers -Parameterpassing: Pass by value, Pass by reference.

UNIT IV	STRUCTURESAND UNION	9

Structure-Nestedstructures-PointerandStructures-Arrayofstructures–Selfreferentialstructures - Dynamic memory allocation - typedef - Union - Storage classes and Visibility.

UNIT V	FILEPROCESSING	9

Files-Typesoffileprocessing:Sequentialaccess,Randomaccess-Sequentialaccessfile-Randomaccessfile-Commandlinearguments.

TOTAL:45PERIODS

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TEXTBOOKS:	
1	ReemaThareja,"ProgramminginC",Oxford UniversityPress,SecondEdition, 2016.
2	Kernighan,B.WandRitchie,D.M,"TheCProgramminglanguage",SecondEdition, PearsonEducation,2015.
3	AnitaGoelandAjayMittal,"ComputerFundamentalsandProgramminginC",1st Edition,PearsonEducation, 2013.
REFERENCES:	
1	PaulDeitelandHarveyDeitel,"CHowtoProgramwithanIntroductiontoC++",Eighth edition,PearsonEducation, 2018.
2	YashwantKanetkar,LetusC,17thEdition,BPBPublications,2020.
3	ByronS.Gottfried,"Schaum'sOutlineofTheoryandProblemsofProgrammingwithC", McGraw-HillEducation,1996.
4	TheCProgrammingLanguage,2ndEdition©1988(BrianW.Kernighan,DennisM. Ritchie)

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Coursename:PROGRAMMINGIN C		Coursecode: 22CS201			
CO	**CourseOutcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	DemonstrateknowledgeonCProgrammingconstructs	**I**	K1	1,2,3,4,5, 6,7,8,9,11 ,12	1,2
CO2	Developsimpleapplications inC usingbasic constructs	**II**	K1,K 2,K3	1,2,3,4,5, 6,7,8,9,11 ,12	1,2
CO3	Designandimplementapplicationsusingarraysand strings	**III**	K1, K3	1,2,3,4,5, 6,7,8,9,11 ,12	1,2
CO4	Developandimplementmodularapplicationsin Cusing functions	**IV**	K4, K6	1,2,3,4,5, 6,7,8,9,11 ,12	1,2
CO5	DevelopapplicationsinCusingstructuresandpointers	**V**	K4, K5	1,2,3,4,5, 6,7,8,9,11 ,12	1,2
CO6	Designapplicationsusingsequentialandrandomaccess file processing	**V**	K6	1,2,3,4,5, 6,9,10, 11,12	1,2

CO-PO-PSOMapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	2	1	2	1	1	1	2	-	3	2	1	2
CO2	2	2	2	1	2	1	1	1	2	-	3	3	2	2
CO3	2	3	2	1	2	1	1	1	2	-	3	2	2	2
CO4	3	2	2	1	3	1	1	1	2	-	3	3	2	2
CO5	2	3	3	1	2	1	2	1	2	-	3	2	2	3
CO6	2	2	3	2	1	2	-	-	2	1	2	2	2	2
CO	2	2	2	1	2	1	1	1	2	-	3	2	2	2

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22CS202	PROGRAMMINGIN CLABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- TofamiliarizewithCprogrammingconstructs.
- TodevelopprogramsinCusingbasic constructs.
- TodevelopprogramsinCusingarrays.
- TodevelopapplicationsinCusingstrings,pointers, functions.
- TodevelopapplicationsinCusingstructures.
- TodevelopapplicationsinCusingfileprocessing.

LISTOFPROGRAMS

1. I/Ostatements,operators, expressions
2. Decision-makingconstructs:if-else,goto,switch-case,break-continue
3. Loops:for,while,do-while
4. Arrays:1D and2D,Multi-dimensionalarrays
5. Strings:operations
6. Functions:call, return, passingparameters (call byvalue, call byreference)
7. Recursion
8. Pointers:Pointerstofunctions,Arrays,Strings,ArrayofPointers
9. Structures:NestedStructures,PointerstoStructures,ArraysofStructuresandUnions.
10. Files:readingandwriting, Filepointers,file operations

TOTAL:60PERIODS

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TEXTBOOKS:	
1	ReemaThareja,"ProgramminginC",Oxford UniversityPress,SecondEdition, 2016.
2	Kernighan,B.WandRitchie,D.M,"TheCProgramminglanguage",SecondEdition, PearsonEducation,2015.
3	AnitaGoelandAjayMittal,"ComputerFundamentalsandProgramminginC",1st Edition,PearsonEducation, 2013.
REFERENCES:	
1	PaulDeitelandHarveyDeitel,"CHowtoProgramwithanIntroductiontoC++", Eighthedition,PearsonEducation,2018.
2	YashwantKanetkar,LetusC,17thEdition,BPBPublications,2020.
3	Byron S.Gottfried,"Schaum'sOutline ofTheoryandProblemsof Programming with C",McGraw-HillEducation,1996.
4	The CProgrammingLanguage,2ndEdition©1988(BrianW.Kernighan,DennisM. Ritchie)

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Coursename: PROGRAMMINGIN C LABORATORY		**Coursecode: 22CS202**			
CO	**CourseOutcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	DemonstrateknowledgeonCProgrammingconstructs	**I**	K1	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO2	Developsimpleapplications inC usingbasic constructs	**II**	K1,K 2,K3	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO3	Designandimplementapplicationsusingarraysand strings	**III**	K1,K 3	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO4	DevelopandimplementmodularapplicationsinCusing functions	**IV**	K4,K 6	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO5	DevelopapplicationsinCusingstructuresandpointers	**V**	K4,K 5	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO6	Designapplicationsusingsequentialandrandomaccess file processing	**V**	K6	1,2,3,4, 5,6,9,1 0, 11,12	1,2

CO-PO-PSOMapping

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

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SEMESTER III

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22MA301	TRANSFORMSAND PARTIALDIFFERENTIAL EQUATIONS	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce Fourier series analysis which is central to many applications inengineering apart from its use in solving boundary value problems
- ToacquaintthestudentwithFourierseriestechniquesinsolvingheatflow problems used in various situations.
- TodevelopZtransformtechniquesDifferenceEquations.
- TointroducethebasicconceptsofPDEforsolvingstandardpartialdifferential equations.
- Tointroducetheeffectivemathematicaltoolsforthesolutionsofpartialdifferential equations that model several physical processes

UNITI	FOURIERSERIES	9

Dirichlet"sconditions–GeneralFourierseries–Oddandevenfunctions–Halfrangesineseries–Halfrangecosineseries–Harmonicanalysis.

UNIT II	FOURIERTRANSFORMS	9

StatementofFourierintegraltheorem–Fouriertransformpair–Fouriersineandcosine transforms–Properties–Transformsofsimplefunctions –Convolutiontheorem

UNIT III	Z-TRANSFORMSANDDIFFERENCEEQUATIONS	9

Z-transforms-Elementaryproperties–InverseZ-transform–Initialandfinalvaluetheorems-Convolutiontheorem-Formationofdifferenceequations–Solutionofdifferenceequationsusing Z– transform.

UNIT IV	PARTIALDIFFERENTIALEQUATIONS	9

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange"s linear equation - Linear partial differential equations of second and higher order with constant coefficients homogeneous.

UNIT V	APPLICATIONSOFPARTIALDIFFERENTIALEQUATIONS	9

ClassificationofPDE–MethodofseparationofvariablesFourierSeriesSolutionsofone Dimensionalwaveequation –Onedimensionalequationofheat conduction.

TOTAL:45PERIODS

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TEXTBOOKS:	
1	GrewalB.S.,"HigherEngineeringMathematics",43rdEdition,KhannaPublishers,New Delhi, 2014.
2	NarayananS.,ManicavachagomPillay.T.KandRamanaiah.G"AdMathematicsforEngineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
REFERENCES:	
1	Andrews,L.CandShivamoggi,B,"IntegralTransformsforEngineers"SPIEPress, 1999.
2	Bali.N.PandManishGoyal,"ATextbookofEngineeringMathematics",9thEdition,Laxmi Publications Pvt. Ltd, 2014.
3	Erwin Kreyszig,"Advanced Engineering Mathematics ", 10thEdition, John Wiley,India, 2016.
4	James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6	Wylie,R.C.andBarrett,L.C.,"AdvancedEngineeringMathematics"TataMcGrawHill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

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CourseName:TRANSFORMSAND PARTIAL DIFFERENTIALEQUATIONS		Coursecode: 22MA301			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Applyvariousmethodsofsolvingdifferentialequation whichariseinmanyapplication problems.	I	K3	1,2,5,9 ,12	-
CO2	Calculategrad,divandcurlanduseGauss,Stokesand Greenstheoremstosimplifycalculationsof integrals.	II	K3	1,2,5,9 ,12	-
CO3	Examineanalyticfunctionsanditsproperties,conformal mappingand its applications.	III	K3	1,2,5,9 ,12	-
CO4	EvaluaterealandcomplexintegralsusingtheCauchy"s integralformulaand residue theorem.	IV	K3	1,2,5,9 ,12	-
CO5	UseknowledgeofLaplacetransformanditsproperties, inverseLaplacetransformtosolvelineardifferential equations.	V	K4	1,2,5,9 ,12	-

CO-PO-PSOMapping

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

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22EC307	DIGITALPRINCIPLESAND COMPUTER ORGANIZATION	L	T	P	C
		3	0	2	4

Course Objectives:

- Toanalyzeanddesigncombinationalcircuits.
- Toanalyzeanddesignsequentialcircuits
- Tounderstandthebasicstructureandoperationofadigital computer.
- Tostudythedesignofdatapathunit,controlunitforprocessorandto familiarize with the hazards.
- Tounderstandtheconceptofvariousmemoriesand I/Ointerfacing.

UNITI	COMBINATIONALLOGIC	9

Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers – Demultiplexers

UNIT II	SYNCHRONOUSSEQUENTIALLOGIC	9

Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters.

UNIT III	COMPUTERFUNDAMENTALS	9

FunctionalUnitsofaDigitalComputer:VonNeumannArchitecture –OperationandOperandsof Computer Hardware Instruction – Instruction SetArchitecture (ISA): Memory Location,Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High-Level Language.

UNIT IV	PROCESSOR	9

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control,Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

UNIT V	MEMORYANDI/O	9

MemoryConceptsandHierarchy–MemoryManagement–CacheMemories:Mapping andReplacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface-Interrupt I/O – Interconnection Standards: USB, SATA

TOTAL:45PERIODS

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PRACTICAL EXERCISES:	**30 PERIODS**
1. VerificationofBooleantheoremsusinglogicgates. 2. Designandimplementationof combinationalcircuitsusinggatesfor arbitraryfunctions. 3. Implementationof4-bitbinaryadder/subtractor circuits. 4. Implementationofcode converters. 5. ImplementationofBCDadder,encoderanddecoder circuits 6. ImplementationoffunctionsusingMultiplexers. 7. Implementationofthesynchronouscounters 8. ImplementationofaUniversalShift register. 9. Simulatorbased studyofComputerArchitecture	
	TOTAL:75PERIODS

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TEXTBOOKS:	
1	M. Morris Mano, Michael D. Ciletti, "Digital Design :With an Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Pearson Education, 2018.
2	DavidA.Patterson,JohnL.Hennessy,"ComputerOrganizationandDesign,The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020.
3	
REFERENCES:	
1	Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, "Computer OrganizationandEmbeddedSystems",SixthEdition,TataMcGraw-Hill,2012.
2	William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016.
3	M.MorrisMano,"DigitalLogicandComputer Design",PearsonEducation,2016.

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CourseName:DIGITALPRINCIPLESANDCOMPUTER ORGANIZATION		**Coursecode: 22EC307**			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Design various combinational digital circuits using logic gates	I	K1	1,2,3,4,5,6,7,8,9,10,11,12	1,2
CO2	Design sequential circuits and analyze the design procedures.	II	K2,K3	1,2,3,4,5,6,7,8,9,10,11,12	1,2
CO3	State the fundamentals of computer systems and analyze the execution of an instruction	III	K3,K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2
CO4	Analyzedifferenttypesofcontroldesignandidentify hazards	IV	K4,K5	1,2,3,4,5,6,7,8,9,10,11,12	1,2
CO5	Identifythecharacteristicsofvariousmemorysystems and I/O communication	V	K5,K6	1,2,3,4,5,6,7,8,9,10,11,12	1,2

CO-PO-PSOMapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	2	1	1	1	1	2	3	2	3
CO2	3	3	3	3	2	1	1	1	1	1	2	3	1	2
CO3	3	3	3	3	2	2	1	1	1	1	2	3	2	3
CO4	3	3	3	3	1	1	1	1	1	1	1	2	1	3
CO5	3	3	3	3	1	2	1	1	1	1	1	2	1	2
CO	3	3	3	3	1.8	1.6	1	1	1	1	1.6	2.6	1.4	2.6

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22IT301	DATASTRUCTURESANDALGORITHMS	L	T	P	C
		3	0	0	3
Course Objectives:	• TounderstandtheconceptsofADTs. • Todesignlineardatastructures–lists,stacks,andqueues. • Tounderstandsorting,searching,andhashingalgorithms. • ToapplyTreestructures. • ToapplyGraphstructures.				
UNITI	**ABSTRACTDATATYPES**				**9**
Abstract Data Types (ADTs) – ADTs and classes – introduction to OOP – classes in Python – inheritance – namespaces – shallow and deep copying Introduction to analysis of algorithms – asymptotic notations – divide & conquer – recursion – analyzing recursive algorithms					
UNIT II	**LINEAR STRUCTURES**				**9**
List ADT – array-based implementations – linked list implementations – singly linked lists – circularly linked lists – doubly linked lists – Stack ADT – Queue ADT – double ended queues – applications					
UNIT III	**SORTINGANDSEARCHING**				**9**
Bubble sort – selection sort – insertion sort – merge sort – quick sort – analysis of sorting algorithms – linear search – binary search – hashing – hash functions – collision handling – load factors, rehashing, and efficiency					
UNIT IV	**TREE STRUCTURES**				**9**
TreeADT – Binary TreeADT – tree traversals – binary search trees –AVLtrees – heaps – multi- way search trees					
UNIT V	**GRAPHSTRUCTURES**				**9**
Graph ADT – representations of graph – graph traversals – DAG – topological ordering – greedy algorithms – dynamic programming – shortest paths – minimum spanning trees – introduction to complexity classes and intractability					
					TOTAL:45PERIODS

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TEXTBOOKS:	
1	MichaelT.Goodrich,RobertoTamassia,andMichaelH.Goldwasser,"DataStructures& AlgorithmsinPython", anIndianAdaptation,JohnWiley&Sons Inc.,2021
2	ThomasH.Cormen,CharlesE. Leiserson,RonaldL.Rivest,andClifford Stein, "IntroductiontoAlgorithms",SecondEdition,McGrawHill, 2002.
3	MarkAllenWeiss,"DataStructuresandAlgorithmAnalysisinC++",FourthEdition, PearsonEducation,2014
REFERENCES:	
1	Lee,KentD., Hubbard,Steve,"DataStructuresandAlgorithmswithPython"Springer Edition 2015
2	RanceD.Necaise,"DataStructuresandAlgorithmsUsingPython",JohnWiley&Sons, 2011
3	Aho,Hopcroft, andUllman,"DataStructuresandAlgorithms",PearsonEducation,1983.
4	https://archive.org/details/data-structures-and-algorithms-narasimha-karumanchi

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CourseName:DATASTRUCTURESANDALGORITHMS		Coursecode: 22IT301			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Explainabstractdatatypes.	I	K1	1,2,3,4 ,5,,9,,1 1,12	1,2
CO2	Design,implement,andanalyzelineardatastructures,such as lists, queues, and stacks, according to the needs of differentapplications.	II	K1,K 2,K3	1,2,3,4 ,5,9,,1 1,12	1,2
CO3	Design, implement, and analyze efficient tree structures to meetrequirementssuchassearching,indexing,andsorting	III	K3,K 4	1,2,3,4 ,5,,9,,1 1,12	1,2
CO4	Modelproblemsas graphproblems.	IV	K4,K 5	1,2,3,4 ,5,,9,,1 1,12	1,2
CO5	Implementefficientgraphalgorithmstosolve them.	V	K4,K 6	**1,2**	1,2

CO-PO-PSOMapping

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

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22IT302	OBJECTORIENTEDPROGRAMMING	L	T	P	C
		3	0	0	3
Course Objectives:	• TounderstandObjectOrientedProgrammingconceptsandbasicsofJava programming language • Toknowtheprinciplesofpackages,inheritanceand interfaces • Todevelopajavaapplicationwiththreadsandgenericsclasses • Todefineexceptionsanduse I/Ostreams • TodesignandbuildGraphicalUserInterfaceApplicationusingJAVAFX				
UNITI	**INTRODUCTIONTOOOPANDJAVA**				**9**
Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members- JavaDoc comments					
UNIT II	**INHERITANCE,PACKAGESANDINTERFACES**				**9**
Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes.Inheritance:Basics–TypesofInheritance-Superkeyword-MethodOverriding–Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.					
UNIT III	**EXCEPTIONHANDLINGAND MULTITHREADING**				**9**
Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java‟s Built-in Exceptions – Userdefined Exception. Multithreaded Programming: Java Thread Model–Creatinga Thread and Multiple Threads – Priorities – Synchronization – Inter Thread CommunicationSuspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.					
UNIT IV	**I/O,GENERICS,STRINGHANDLING**				**9**
I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.					
UNIT V	**JAVAFXEVENTHANDLING,CONTROLSAND COMPONENTS**				**9**
JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox,Toggle Button –Radio Buttons –List View–Combo Box –Choice Box –TextControls– ScrollPane. Layouts – Flow Pane– HBox andVBox –Border Pane –Stack Pane– Grid Pane. Menus – Basics – Menu – Menu bars – Menu Item.					
					TOTAL:45PERIODS

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TEXTBOOKS:	
1	HerbertSchildt,"Java:TheCompleteReference", 11thEdition,McGrawHill Education, NewDelhi,2019
2	HerbertSchildt,"IntroducingJavaFX8Programming",1stEdition,McGrawHill Education,NewDelhi,2015
3	"ThinkinginJava"Author:BruceEckel
REFERENCES:	
1	CayS.Horstmann,"CoreJavaFundamentals",Volume1,11thEdition,PrenticeHall, 2018.
2	"EffectiveJava"Author: Joshua Bloch
3	"Java:HowtoProgram"Authors:Paul Deiteland HarveyDeitel
4	https://www.ms.sapientia.ro/~manyi/teaching/oop/oop_java.pdf

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CourseName:OBJECTORIENTEDPROGRAMMING		Coursecode:22IT302			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Applytheconceptsofclassesandobjectstosolvesimple problems	I	K1,K 2	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	Developprogramsusinginheritance,packagesand interfaces	II	K3	1,2,3,4 ,5,6,9, 10,11, 12	1,2
CO3	Make use of exception handling mechanisms and multithreadedmodeltosolverealworld problems	III	K3,K 4	1,2,3,4 ,5,6,7, 8,9,10, 11,12	1,2
CO4	BuildJavaapplicationswithI/Opackages,stringclasses, Collections and generics concepts	IV	K4,K 5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	Integratetheconceptsofeventhandlingand JavaFX componentsandcontrolsfordevelopingGUIbased applications	V	K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSOMapping

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

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22IT303	FOUNDATIONOFDATASCIENCE	L	T	P	C
		3	0	0	3
Course Objectives:	• Tounderstandthedatasciencefundamentalsandprocess. • Tolearntodescribethedataforthedatascienceprocess. • Tolearntodescribetherelationshipbetweendata. • ToutilizethePythonlibrariesforDataWrangling. • Topresentandinterpretdatausingvisualizationlibrariesin Python				

UNITI	INTRODUCTION	9

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals–Retrieving data –Data preparation- Exploratory Data analysis –build the model–presentingfindings and buildingapplications - Data Mining- DataWarehousing – Basic Statistical descriptions of Data

UNIT II	DESCRIBINGDATA	9

TypesofData-Typesof Variables-DescribingDatawithTablesandGraphs–DescribingData withAverages - Describing Variability - Normal Distributions and Standard (z) Scores

UNIT III	DESCRIBINGRELATIONSHIPS	9

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

UNIT IV	PYTHONLIBRARIESFORDATAWRANGLING	9

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

UNIT V	DATAVISUALIZATION	9

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – threedimensional plotting - Geographic Data with Basemap - Visualization with Seaborn

TOTAL:45PERIODS

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TEXTBOOKS:	
1	DavidCielen,ArnoD.B.Meysman,andMohamedAli,"IntroducingDataScience", ManningPublications, 2016.(UnitI)
2	RobertS.WitteandJohnS.Witte,"Statistics",EleventhEdition,WileyPublications, 2017.(UnitsIIandIII)
3	JakeVanderPlas,"PythonDataScienceHandbook",O"Reilly,2016.(UnitsIVandV)
REFERENCES:	
1	AllenB.Downey,"ThinkStats:ExploratoryDataAnalysisinPython",GreenTeaPress,2014.
2	"FoundationsofDataScience"Authors:AvrimBlum,JohnHopcroft,andRavindran Kannan
3	"DataScienceforBusiness:WhatYouNeedtoKnowaboutDataMiningand Data-AnalyticThinking"Authors:FosterProvostandTomFawcett
4	https://www.cs.cornell.edu/jeh/book.pdf

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CourseName:FOUNDATION OFDATASCIENCE		Coursecode:22IT303			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Definethedatascience process	I	K1	1,2,3,4,5 ,9,10	1,2
CO2	Understanddifferenttypesofdatadescriptionfordata scienceprocess	II	K2	1,2,3,4,9 ,10	1,2
CO3	Gainknowledgeon relationshipsbetweendata	III	K3,K4	1,2,3,4,6 ,7,9,10	1,2
CO4	UsethePython LibrariesforDataWrangling	IV	K4,K5	1,2,3,4,9 ,10	1,2
CO5	ApplyvisualizationLibrariesinPythontointerpret and exploredata	V	K6	1,2,3,4,9 ,10	1,2

CO-PO-PSOMapping

	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	2	-	-	-	1	1	2	2	3	3
CO5	2	2	1	2	2	-	-	-	1	1	1	2	2	2
CO	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**2**	**2**	**2**

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22IT304	DATASTRUCTURESANDALGORITHMSLABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- ToimplementADTsinPython
- Todesignandimplementlineardatastructures–lists,stacks,and queues
- Toimplementsorting,searchingandhashingalgorithms
- Tosolveproblemsusingtreeandgraphstructures

LISTOFPROGRAMS

1. ImplementsimpleADTsasPythonclasses
2. Implementrecursivealgorithmsin Python
3. ImplementListADTusingPython arrays
4. LinkedlistimplementationsofList
5. ImplementationofStackandQueueADTs
6. ApplicationsofList,StackandQueueADTs
7. Implementationofsortingandsearchingalgorithms
8. ImplementationofHash tables
9. Treerepresentationandtraversalalgorithms
10. ImplementationofBinarySearch Trees
11. ImplementationofHeaps
12. GraphrepresentationandTraversalalgorithms
13. Implementationofsinglesourceshortestpathalgorithm
14. Implementationofminimumspanningtree algorithms

TOTAL:60PERIODS

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TEXTBOOKS:	
1	MichaelT.Goodrich,RobertoTamassia,andMichaelH.Goldwasser,"DataStructures& AlgorithmsinPython", anIndianAdaptation,JohnWiley&Sons Inc.,2021
2	ThomasH.Cormen,CharlesE. Leiserson,RonaldL.Rivest,andClifford Stein, "IntroductiontoAlgorithms",SecondEdition,McGrawHill, 2002.
3	MarkAllenWeiss,"DataStructuresandAlgorithmAnalysisinC++",FourthEdition, PearsonEducation,2014
REFERENCES:	
1	Lee,KentD., Hubbard,Steve,"DataStructuresandAlgorithmswithPython"Springer Edition 2015
2	RanceD.Necaise,"DataStructuresandAlgorithmsUsingPython",JohnWiley&Sons, 2011
3	Aho,Hopcroft, andUllman,"DataStructuresandAlgorithms",PearsonEducation,1983.

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Course Name: DATA STRUCTURES AND ALGORITHMS			**Course code: 22IT304**		
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Implement ADTs as Python classes.	I	K1	1,2,3,4, 5,,9,,11 ,12	1,2
CO2	Design, implement, and analyze linear data structures, such as lists, queues, and stacks, according to the needs of different applications.	II	K1,K2, K3	1,2,3,4, 5,9,,11, 12	1,2
CO3	Design, implement, and analyze efficient tree structures to meet requirements such as searching, indexing, and sorting.	III	K3,K4	1,2,3,4, 5,,9,,11 ,12	1,2
CO4	Model problems as graph problems and implement efficient graph algorithms to solve them	IV	K4,K5	1,2,3,4, 5,,9,,11 ,12	1,2
CO5	Implement ADTs as Python classes.	V	K4,K6	**1,2**	1,2

CO-PO-PSO Mapping

	PO1	**PO 2**	**PO3**	**P O 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	-	-	-	2	3	1	2	1	2
CO2	3	3	2	-	1	-	-	-	2	3	1	2	2	2
CO3	2	2	2	1	1	-	-	-	2	3	1	2	1	3
CO4	3	1	2	1	1	-	-	-	2	3	1	2	1	3
CO5	-	-	-	-	-		-	-	-	-	-	-	-	-
CO	**2.75**	**2**	**1.75**	**1**	**1**				**2**	**3**	**1**	**2**	**1.25**	**2.5**

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22IT305	OBJECT ORIENTED PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, inheritance,exception handling and file processing.
- To develop applications using generic programming and event handling

LIST OF PROGRAMS

1. Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion)
2. Develop stack and queue data structures using classes and objects.
3. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.
5. Solve the above problem using an interface.
6. Implement exception handling and creation of user defined exceptions.
7. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
8. Write a program to perform file operations.
9. Develop applications to demonstrate the features of generics classes.
10. Develop applications using JavaFX controls, layouts and menus.
11. Develop a mini project for any application using Java concepts.

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Herbert Schildt, "Java: The Complete Reference", 11 th Edition, McGraw Hill Education, New Delhi, 2019
2	Herbert Schildt, "Introducing JavaFX 8 Programming", 1 st Edition, McGraw Hill Education, New Delhi, 2015
3	"Thinking in Java" Author: Bruce Eckel
REFERENCES:	
1	Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018.
2	"Effective Java" Author: Joshua Bloch
3	"Java: How to Program" Authors: Paul Deitel and Harvey Deitel
4	https://www.ms.sapientia.ro/~manyi/teaching/oop/oop_java.pdf

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Course Name: OBJECT ORIENTED PROGRAMMING LABORATORY		**Course code: 22IT305**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Design and develop java programs using object oriented programming concepts	I	K1,K2	1,2,3,4,5,9,10,11,12	1,2
CO2	Develop simple applications using object oriented concepts such as package, exceptions	II	K3	1,2,3,4,5,6,9,10,11,12	1,2
CO3	Implement multithreading, and generics concepts	III	K3,K4	1,2,3,4,5,6,7,8,9,10,11,12	1,2
CO4	Create GUIs and event driven programming applications for real world problems	IV	K4,K5	1,2,3,4,5,9,10,11,12	1,2
CO5	Implement and deploy web applications using Java	V	K6	1,2,3,4,5,9,10,11,12	1,2

CO-PO-PSO Mapping

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

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22IT306	DATA SCIENCE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, inheritance, exception handling and file processing.
- To develop applications using generic programming and event handling

LIST OF PROGRAMS

1. Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion)
2. Develop stack and queue data structures using classes and objects.
3. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.
5. Solve the above problem using an interface.
6. Implement exception handling and creation of user defined exceptions.
7. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
8. Write a program to perform file operations.
9. Develop applications to demonstrate the features of generics classes.
10. Develop applications using JavaFX controls, layouts and menus.
11. Develop a mini project for any application using Java concepts.

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2	Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.(Units II and III)
3	JakeVanderPlas,"PythonDataScienceHandbook",O'Reilly,2016.(UnitsIVand V)
REFERENCES:	
1	AllenB.Downey,"ThinkStats: ExploratoryDataAnalysisinPython",GreenTeaPress,2014.
2	"Foundations of Data Science"Authors: Avrim Blum, John Hopcroft, and Ravindran Kannan
3	"Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking"Authors: Foster Provost and Tom Fawcett
4	https://www.cs.cornell.edu/jeh/book.pdf

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Course Name: DATA SCIENCE LABORATORY		**Course code: 22IT306**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Define the data science process	I	K1	1,2,3,4,5 ,9,10	1,2
CO2	Understand different types of data description for data science process	II	K2	1,2,3,4,9 ,10	1,2
CO3	Gain knowledge on relationships between data	III	K3,K4	1,2,3,4,6 ,7,9,10	1,2
CO4	Use the Python Libraries for Data Wrangling	IV	K4,K5	1,2,3,4,9 ,10	1,2
CO5	Apply visualization Libraries in Python to interpret and explore data	V	K6	1,2,3,4,9 ,10	1,2

CO-PO-PSO Mapping

	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	2	-	-	-	1	1	2	2	3	3
CO5	2	2	1	2	2	-	-	-	1	1	1	2	2	2
CO	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**2**	**2**	**2**

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SEMESTER–IV

22MA401	NUMERICALMETHODS	L	T	P	C
		3	0	0	3
Course Objectives:	• To introduce the basic concepts of solving algebraic and transcendental equations. • To introduce the numerical techniques of interpolation in various intervals in real life situations. • To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines. • To acquaint the knowledge of various techniques and methods of solving ordinary differential equations. • To understand the knowledge of various techniques and methods of solving various types of partial differential equations.				
UNITI	**SOLUTIONOFEQUATIONSANDEIGENVALUEPROBLEMS**				**9**
Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method.					
UNIT II	**INTERPOLATIONANDAPPROXIMATION**				**9**
Lagrange's interpolation – Newton"s divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton"s forward and backward difference formulae.					
UNIT III	**NUMERICALDIFFERENTIATIONANDINTEGRATION**				**9**
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson"s 1/3 rule and 3/8 rule – Romberg"s Method –Two point Gaussian quadratureformulae–EvaluationofdoubleintegralsbyTrapezoidalandSimpson"s1/3rules.					
UNIT IV	**INITIALVALUEPROBLEMSFORORDINARY DIFFERENTIALEQUATIONS**				**9**
Taylor"s series method - Euler"s method - Modified Euler"s method - Fourth order Runge - Kutta method for solving first order equations -Milne"s predictor corrector methods for solving first order equations.					
UNIT V	**BOUNDARYVALUEPROBLEMSFORPARTIAL DIFFERENTIALEQUATIONS**				**9**
Finite difference methods for solving second order two - point linear boundary value problems - Finitedifferencetechniquesforthesolutionoftwodimensional Laplace"s andPoisson"sequations onrectangulardomain–Onedimensionalheatflowequationbyexplicitandimplicit(Crank Nicholson) methods.					
					TOTAL:45PERIODS

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Course Name: NUMERICAL METHODS		**Course code: 22MA401**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Apply the basic concepts and techniques of solving algebraic and transcendental equations.	I	K3	1,2,5,12	-
CO2	Solve the numerical techniques of interpolation and error approximations in various intervals in real life situations	II	K3	1,2,5,12	-
CO3	Apply the numerical techniques of differentiation and integration for engineering problems.	III	K3	1,2,5,12	-
CO4	Evaluate the knowledge of various techniques and methods for solving first and second order ordinary differential equations.	IV	K4	1,2,5,12	-
CO5	Solve the partial differential equations with initial and boundary conditions by using certain techniques with engineering applications.	V	K3	1,2,5,12	-

CO-PO-PSO Mapping

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

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22IT401	THEORY OF COMPUTATION	L	T	P	C
		3	0	0	3

Course Objectives:	• To understand foundations of computation including automata theory • To construct models of regular expressions and languages. • To design context free grammar and push down automata • To understand Turing machines and their capability • To understand Undesirability and NP class problems

UNIT I	AUTOMATA	9

Introduction to formal proof – Additional forms of proof – Inductive proofs –Finite Automata (FA)– Deterministic Finite Automata (DFA)– Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon transitions.

UNIT II	REGULAR EXPRESSIONS AND LANGUAGES	9

Regular expression – Regular Languages- Equivalence of Finite Automata and regular expressions – Proving languages to be not regular (Pumping Lemma) – Closure properties of regular languages.

UNIT III	CONTEXT FREE GRAMMAR AND LANGUAGES	9

Context-Free Grammar (CFG) – Parse Trees – Ambiguity in grammars and languages –Closure Properties of CFL.Simplifying Context Free Grammars-Normal forms-Chomsky Normal Form and Greibach Normal Form – Pumping Lemma for CFL.

UNIT IV	TURING MACHINES AND PUSHDOWN AUTOMATA	9

Languages of a Pushdown Automata –Equivalence of Pushdown automata and CFG– Deterministic Pushdown Automata- Turing Machines – Programming Techniques for TM.

UNIT V	UNDECIDABILITY	9

Unsolvable Problems and Computable Functions –PCP-MPCP- Recursive and recursively enumerable languages – Properties - Universal Turing machine -Tractable and Intractable problems - P and NP completeness – Kruskal"s algorithm – Travelling Salesman Problem- 3-CNF SAT problems.

TOTAL: 45 PERIODS

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TEXT BOOKS:	
1	Hopcroft J.E., Motwani R. & Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2008
2	John C Martin, "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw Hill, 2011.
3	"Automata Theory, Languages, and Computation" by John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman
REFERENCES:	
1	Harry R Lewis and Christos H Papadimitriou , "Elements of the Theory of Computation", 2nd Edition, Prentice Hall of India, 2015.
2	Peter Linz, "An Introduction to Formal Language and Automata", 6th Edition, Jones & Bartlett, 2016.
3	K.L.P.Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata Languages and Computation", 3rd Edition, Prentice Hall of India, 200
4	https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf

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Course Name: THEORY OF COMPUTATION		**Course code: 22IT401**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Construct automata theory using Finite Automata	I	K1,K2	1,2,3,4,5,9, 10,11,12	1,2
CO2	Write regular expressions for any pattern	II	K1,K2 K3	1,2,3,4,5,6, 9,10,11,12	1,2
CO3	Design context free grammar and Pushdown Automata	III	K1,K4	1,2,3,4,5,6, 7,8,9,10,11, 12	1,2
CO4	Design Turing machine for computational functions	IV	K4,K5	1,2,3,4,5,9, 1011,12	1,2
CO5	Differentiate between decidable and un decidable problems	V	K6	1,2,3,4,5,9, 1011,12	1,2

CO-PO-PSO Mapping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO 11**	**PO1 2**	**PSO1**	**PSO2**
CO1	1	3	2	3	-	-	-	-	1	1	2	3	1	3
CO2	2	2	3	2	1	-	-	-	3	3	2	3	3	1
CO3	2	2	3	2	1	-	-	-	1	3	1	2	1	2
CO4	2	2	2	1	-	-	-	-	1	3	3	2	1	3
CO5	2	2	2	1	1	-	-	-	1	1	3	2	3	1
CO	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**2**	**2**	**2**	**2**	**2**

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22IT402	WEB ESSENTIALS	L	T	P	C
		3	0	2	4

Course Objectives:

- To comprehend and analyze the basic concepts of web programming and internet protocols.
- To describe how the client-server model of Internet programming works.
- To demonstrate the uses of scripting languages
- To write simple scripts for the creation of web sites
- To create database applications

UNIT I	WEBSITE BASICS	9

Internet Overview - Fundamental computer network concepts - Web Protocols - URL – Domain Name- Web Browsers and Web Servers- Working principle of a Website –Creating a Website - Client-side and server-side scripting

UNIT II	WEB DESIGNING	9

HTML – Form Elements - Input types and Media elements - CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.

UNIT III	CLIENT-SIDE PROCESSING AND SCRIPTING	9

JavaScript Introduction – Variables and Data Types-Statements – Operators - Literals-FunctionsObjects-Arrays-Built-in Objects- Regular Expression, Exceptions, Event handling, Validation -JavaScript Debuggers.

UNIT IV	SERVER SIDE PROCESSING AND SCRIPTING-PHP	9

PHP - Working principle of PHP - PHP Variables - Constants - Operators – Flow Control and Looping - Arrays - Strings - Functions - File Handling - File Uploading – Email Basics - Email with attachments - PHP and HTML - Simple PHP scripts - Databases with PHP

UNIT V	SERVLETS AND DATABASE CONNECTIVITY	9

Servlets: Java Servlet Architecture – Servlet Life cycle- Form GET and POST actions -Sessions – Cookies – Database connectivity – JDBC Creation of simple interactive applications - Simple database applications

TOTAL: 45 PERIODS

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PRACTICAL EXERCISES:	**30 PERIODS**
1. Creationofinteractivewebsites-Design usingHTMLandauthoring tools 2. FormvalidationusingJavaScript 3. Creationofsimple PHPscripts 4. Handlingmultimediacontentin web sites 5. WriteprogramsusingServlets: i. ToinvokeservletsfromHTMLforms ii. Sessiontrackingusinghiddenformfields and Session trackingforahitcount 6. Creationofinformationretrieval systemusingweb, PHPand MySQL 7. Creationofpersonal InformationSystem	
	TOTAL:75PERIODS

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TEXT BOOKS:	
1	Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'Reilly publishers, 2014.
2	Paul Deitel, Harvey Deitel, Abbey Deitel, "Internet & World Wide Web - How to Program", 5th edition, Pearson Education, 2012.
3	Fritz Schneider, Thomas Powell , "JavaScript – The Complete Reference", 3rd Edition, McGraw Hill Publishers, 2017
REFERENCES:	
1	Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.
2	James F. Kurose, "Computer Networking: A Top-Down Approach", Sixth Edition, Pearson Education, 2012
3	Steven Holzener , "PHP – The Complete Reference", 1st Edition, Mc-Graw Hill, 2017.
4	Bates, "Developing Web Applications", Wiley Publishers, 2006
5	**https://www.site.uottawa.ca/~gvj/Courses/CSI3140/lectures/WebEssentials.pdf**

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Course Name: WEB ESSENTIALS		**Course code: 22IT402**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Apply JavaScript, HTML and CSS effectively to create interactive and dynamic websites.	**I**	K1	1,2,3,4,5,6,9,10,11,12	1,2
CO2	Create simple PHP scripts	**II**	K4	1,2,3,4,5,6,9,11,12	1,2
CO3	Design and deploy simple web-applications.	**III**	K2,K4	1,2,3,4,5,6,9,10,11,12	1,2
CO4	Create simple database applications.	**IV**	K4	1,2,3,4,5,6,9,10,11,12	1,2
CO5	Handle multimedia components	**V**	K5,K6	1,2,3,4,5,6,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2	3	2	0	0	2	2	2	3	3	2
CO2	3	3	3	3	3	2	0	0	2	0	2	3	3	2
CO3	3	3	3	2	3	2	0	0	2	2	2	3	3	2
CO4	3	3	3	3	3	1	0	0	1	1	2	3	3	2
CO5	3	3	3	3	3	1	0	0	0	0	2	3	3	2
CO	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**2**	**1**	**2**	**3**	**3**	**2**

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22IT403	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn the fundamentals of data models, relational algebra and SQL
- To represent a database system using ER diagrams and to learn normalization techniques
- To understand the fundamental concepts of transaction, concurrency and recovery processing
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design
- To have an introductory knowledge about the Distributed databases, NOSQL and database security

UNIT I	RELATIONAL DATABASES	9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT II	DATABASE DESIGN	9

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III	TRANSACTIONS	9

Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling–Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm

UNIT IV	IMPLEMENTATION TECHNIQUES	9

RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for Selection, Sorting and join operations – Query optimization using Heuristics - Cost Estimation.

UNIT V	ADVANCED TOPICS	9

Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. Database Security: Security issues – Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges

TOTAL: 45 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS

TEXT BOOKS:	
1	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020
2	Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017
3	"An Introduction to Database Systems"Author: C.J. Date
REFERENCES:	
1	C.J.Date, A.Kannan, S.Swamynathan , "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2	"Modern Database Management"Authors: Jeffrey A. Hoffer, V. Ramesh, and Heikki Topi
3	"Database Management Systems"Author: Raghu Ramakrishnan and Johannes Gehrke
4	https://artifex.com/samples/pdf/db-systems.pdf

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TEXTBOOKS:	
1	Burden,R.Land Faires,J.D,"NumericalAnalysis",9thEdition,CengageLearning, 2016
2	Grewal,B.S.,andGrewal,J.S.,"NumericalMethodsinEngineeringandScience", KhannaPublishers,10th Edition,NewDelhi,2015.
3	P. Kandasamy .K. Thilagavathi and K Gunavathi , "Numerical Methods" , S.Chand Co.Ltd.,NewDelhi,2003.,"NumericalMethods",S.ChandCo.Ltd.,NewDelhi, 2003.
REFERENCES:	
1	BrianBradie,"AFriendlyIntroductiontoNumericalAnalysis",Pearson Education, Asia,NewDelhi,2007
2	Gerald.C.F.andWheatley.P.O.,"AppliedNumericalAnalysis",PearsonEducation, Asia,6thEdition, NewDelhi, 2006.
3	Mathews,J.H."NumericalMethodsforMathematics,ScienceandEngineering",2nd Edition,PrenticeHall,1992.
4	SankaraRao.K., "NumericalMethodsforScientistsandEngineers",PrenticeHallof IndiaPvt.Ltd,3rdEdition,NewDelhi,2007.
5	Sastry,S.S,"IntroductoryMethodsofNumericalAnalysis",PHILearningPvt.Ltd, 5th Edition, 2015

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Course Name: DATABASEMANAGEMENTSYSTEMS		**Coursecode: 22IT403**			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	ConstructSQLQueriesusingrelational algebra	**I**	K1	1,2,3,4,5,6, 9,10,11,12	1,2
CO2	DesigndatabaseusingERmodelandnormalizethe database	**II**	K4	1,2,3,4,5,6, 9,11,12	1,2
CO3	Constructqueriestohandletransactionprocessingand maintain consistencyofthe database	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Compareandcontrastvariousindexingstrategiesand apply the knowledge to tune the performance of the database	**IV**	K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO5	AppraisehowadvanceddatabasesdifferfromRelational Databases and find a suitable database for the given requirement.	**V**	K5,K6	1,2,3,4,5,6, 11, 12	1,2

CO-PO-PSOMapping

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

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

22IT404	INTRODUCTIONTOOPERATINGSYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:	•Tounderstandthebasicsandfunctionsofoperatingsystems. •Tounderstandprocessesandthreads •Toanalyzeschedulingalgorithmsandprocesssynchronization. •Tounderstandtheconceptofdeadlocks. •Toanalyzevariousmemorymanagementschemes.

UNITI	INTRODUCTION	9

Computer System - Elements and organization; Operating System Overview - Objectives and Functions - Evolution of Operating System; Operating System Structures – Operating System Services - User Operating System Interface - System Calls – System Programs - Design and Implementation - Structuring methods.

UNIT II	PROCESSMANAGEMENTANDDEADLOCK	9

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Threads - Multithread Models – Threading issues; Process Synchronization - The Critical-Section problem - Synchronization hardware – Semaphores – Mutex - Classical problems of synchronization - Monitors; Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT III	MEMORYMANAGEMENT	9

Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table- Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – Copy on Write - Page Replacement -Allocation of Frames –Thrashing.

UNIT IV	FILESYSTEMS	9

File-System Interface:Fileconcept –Accessmethods–Directorystructure –Filesystemmounting –File sharing- Protection. File-System Implementation:Directory implementation–Allocation methods–Free-spacemanagement–efficiencyandperformance–recovery– Networkfilesystems. Case studies: File systemin Windows XP.

UNIT V	I/OSYSTEMSANDSTORAGE MANAGEMENT	9

I/O Systems – I/O Hardware –Application I/O interface – kernel I/O subsystem –streams – Performance.Mass-StorageStructure:Diskattachment-Diskscheduling–Diskmanagement– Swap-space management – RAID –stable storage.

TOTAL:45PERIODS

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TEXTBOOKS:	
1	AbrahamSilberschatz,PeterBaerGalvinandGregGagne,"OperatingSystemConcepts", 10thEdition,JohnWileyandSons Inc.,2018.
2	AndrewSTanenbaum,"ModernOperatingSystems",Pearson,5thEdition,2022New Delhi
3	"OperatingSystems: PrinciplesandPractice"Authors:ThomasAndersonand Michael Dahlin
REFERENCES:	
1	RamazElmasri,A. GilCarrick,DavidLevine, "OperatingSystems –ASpiralApproach", TataMcGrawHillEdition,2010.
2	WilliamStallings,"OperatingSystems:InternalsandDesignPrinciples",7thEdition, PrenticeHall, 2018.
3	AchyutS.Godbole,AtulKahate, "OperatingSystems",McGrawHillEducation,2016
4	https://www.mbit.edu.in/wp-content/uploads/2020/05/Operating_System_Concepts_8th_EditionA4.pdf

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Course Name: INTRODUCTION TO OPERATING SYSTEMS		**Course code: 22IT404**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Analyze various scheduling algorithms and process synchronization.	**I**	K1,K2	1,2,3,4,6,9,10,11,12	1,2
CO2	Explain deadlock prevention and avoidance algorithms.	**II**	K3	1,2,3,4,5,6,9,10,11,12	1,2
CO3	Compare and contrast various memory management schemes.	**III**	K2,K4	1,2,3,4,5,6,9,10,11,12	1,2
CO4	Explain the functionality of file systems.	**IV**	K5	1,2,3,4,6,9,10, 11,12	1,2
CO5	Explain I/O system and storage Management	**V**	K5,K6	1,2,3,4,5,6,10, 11,12	1,2

CO-PO-PSO Mapping

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

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

22IT405	OPERATINGSYSTEMSLABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- Toinstallwindowsoperatingsystems.
- TounderstandthebasicsofUnixcommandandshell programming.
- ToimplementvariousCPUschedulingalgorithms.
- ToimplementDeadlockAvoidanceandDeadlockDetectionAlgorithms
- ToimplementPageReplacementAlgorithms
- Toimplementvariousmemoryallocationmethods.
- TobefamiliarwithFileOrganizationandFileAllocationStrategies.

LISTOFPROGRAMS

1. Installationofwindowsoperatingsystem
2. IllustrateUNIX commandsandShellProgramming
3. ProcessManagementusingSystemCalls:Fork,Exit,Getpid,Wait, Close
4. WriteCprogramstoimplementthevariousCPUSchedulingAlgorithms
5. Illustratetheinterprocesscommunicationstrategy
6. Implementmutualexclusionby Semaphore
7. WriteCprogramstoavoidDeadlockusingBanker'sAlgorithm
8. WriteaCprogramtoImplementDeadlockDetectionAlgorithm
9. WriteCprogramtoimplementThreading
10. ImplementthepagingTechniqueusingCprogram
11. WriteCprogramstoimplementthefollowingMemoryAllocationMethods
    a. a.FirstFit b.WorstFit c.BestFit
12. WriteCprogramstoimplementthevariousPageReplacementAlgorithms

TOTAL:45PERIODS

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TEXTBOOKS:	
1	AbrahamSilberschatz,PeterBaerGalvinandGregGagne,"OperatingSystemConcepts", 10thEdition,JohnWileyandSons Inc., 2018.
2	AndrewSTanenbaum,"ModernOperatingSystems",Pearson,5thEdition,2022New Delhi
3	"OperatingSystems: PrinciplesandPractice"Authors:ThomasAndersonand Michael Dahlin
REFERENCES:	
1	RamazElmasri,A.GilCarrick,David Levine, "OperatingSystems–ASpiralApproach", TataMcGrawHillEdition,2010.
2	WilliamStallings,"OperatingSystems:InternalsandDesignPrinciples",7thEdition, PrenticeHall, 2018.
3	AchyutS.Godbole,Atul Kahate, "OperatingSystems",McGrawHillEducation,2016
4	https://www.mbit.edu.in/wp-content/uploads/2020/05/Operating_System_Concepts_8th_EditionA4.pdf

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CourseName: OPERATINGSYSTEMSLABORATORY		**Coursecode:22IT405**			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	DefineandimplementUNIXCommands.	**I**	K1,K2	1,2,3,4,6,9, 10,11,12	1,2
CO2	ComparetheperformanceofvariousCPU Scheduling Algorithms.	**II**	K3	1,2,3,4,5,6, 9,10,11,12	1,2
CO3	Compareand contrast various MemoryAllocation Methods	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	DefineFileOrganizationandFileAllocation Strategies.	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	ImplementvariousDiskSchedulingAlgorithms	**V**	K5,K6	1,2,3,4,5,6, 10, 11,12	1,2

CO-PO-PSOMapping

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

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22IT406	DATABASEMANAGEMENT SYSTEMSLABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- TolearnandimplementimportantcommandsinSQL.
- Tolearntheusageofnestedandjoint queries.
- Tounderstandfunctions,proceduresandproceduralextensionsof databases.
- Tounderstanddesignandimplementationoftypicaldatabase applications.
- Tobefamiliarwiththeuseofafrontendtool forGUIbasedapplication development.

LISTOFPROGRAMS

1. Createadatabasetable,addconstraints(primarykey,unique,check,Notnull),insertrows, update and delete rows using SQL DDL and DML commands.
2. Createaset oftables, add foreignkeyconstraintsandin corporate referential integrity.
3. Querythedatabasetablesusingdifferent,,where"clauseconditionsandalsoimplement aggregate functions.
4. Querythe databasetables and exploresub queries andsimple join operations.
5. Querythe databasetables and explorenatural, equi and outer joins.
6. Writeuserdefined functionsandstoredproceduresinSQL.
7. ExecutecomplextransactionsandrealizeDCLandTCLcommands.
8. WriteSQLTriggersforinsert,delete,andupdateoperationsinadatabasetable.
9. CreateViewandindexfordatabasetableswith alargenumberof records.
10. CreateanXMLdatabaseand validateit usingXMLschema.
11. CreateDocument, column and graph based datausingNOSQLdatabasetools.
12. DevelopasimpleGUIbaseddatabaseapplicationandincorporatealltheabove-mentioned features
13. CaseStudyusinganyofthereal lifedatabase applications from thefollowinglist

a) InventoryManagement fora E mart Grocery Shop
b) SocietyFinancialManagement
c) CopFriendlyApp– Eseva
d) PropertyManagement–eMall
e) StarSmallandMediumBankingandFinance

•BuildEntityModeldiagram.Thediagramshouldalignwiththebusinessandfunctional goals stated in the application.

•ApplyNormalization rulesin designingthetablesin scope.

•Preparedapplicableviews,triggers(forauditingpurposes),functionsforenabling enterprise grade features.

•BuildPLSQL/StoredProceduresforComplexFunctionalities,exEODBatchProcessing for calculating the EMI for Gold Loan for each eligible Customer.

TOTAL:45PERIODS

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TEXTBOOKS:	
1	AbrahamSilberschatz,HenryF.Korth,S.Sudharshan,"DatabaseSystemConcepts", SeventhEdition,McGrawHill,2020
2	RamezElmasri,ShamkantB.Navathe,"FundamentalsofDatabaseSystems",Seventh Edition,PearsonEducation, 2017
3	"An IntroductiontoDatabaseSystems"Author:C.J. Date
REFERENCES:	
1	C.J.Date,A.Kannan,S.Swamynathan,"AnIntroductiontoDatabaseSystems",Eighth Edition,PearsonEducation, 2006.
2	"ModernDatabaseManagement"Authors:JeffreyA.Hoffer,V.Ramesh,andHeikkiTopi
3	"DatabaseManagementSystems"Author:Raghu RamakrishnanandJohannesGehrke
4	https://artifex.com/samples/pdf/db-systems.pdf

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Course Name: DATABASEMANAGEMENTSYSTEMS LABORATORY		**Coursecode: 22IT406**			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Createdatabaseswithdifferenttypesofkeyconstraints.	**I**	K1,K2	1,2,3,4,6,9, 10,11,12	1,2
CO2	ConstructsimpleandcomplexSQLqueriesusing DML And DCLcommands.	**II**	K3	1,2,3,4,5,6, 9,10,11,12	1,2
CO3	Useadvancedfeaturessuchasstoredproceduresand triggers and incorporate in GUI based application Development.	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	CreateanXMLdatabaseandvalidatewithmeta-data (XMLschema).	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	CreateandmanipulatedatausingNOSQLdatabase.	**V**	K5,K6	1,2,3,4,5,6, 10, 11,12	1,2

CO-PO-PSOMapping

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

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SEMESTER V

22IT501	COMPUTERNETWORKS	L	T	P	C
		3	0	2	4

Course Objectives:

- Tounderstandtheconceptoflayeringinnetworks.
- Toknowthefunctions ofprotocolsofeachlayerofTCP/IPprotocol suite.
- Tovisualizetheend-to-endflowofinformation.
- Tolearnthefunctionsofnetworklayerandthevariousroutingprotocols
- TofamiliarizethefunctionsandprotocolsoftheTransportlayer

UNITI	INTRODUCTIONANDAPPLICATIONLAYER	10

Data Communication - Networks – NetworkTypes – Protocol Layering – TCP/IPProtocol suite – OSIModel–IntroductiontoSockets-ApplicationLayerprotocols:HTTP–FTP–Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP

UNIT II	TRANSPORTLAYER	9

Introduction-Transport-LayerProtocols:UDP–TCP:ConnectionManagement–Flowcontrol-Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service

UNIT III	NETWORKLAYER	7

Switching:PacketSwitching-Internetprotocol-IPV4–IPAddressing–Subnetting-IPV6,ARP, RARP, ICMP, DHCP

UNIT IV	ROUTING	7

Routingandprotocols:Unicastrouting-DistanceVectorRouting-RIP-LinkStateRouting– OSPF – Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.

UNIT V	DATALINKANDPHYSICALLAYERS	12

DataLinkLayer–Framing–Flowcontrol–Errorcontrol–Data-LinkLayerProtocols–HDLC– PPP-MediaAccess Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching

TOTAL:45PERIODS

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PRACTICALEXERCISES:	**TOTAL:30PERIODS**
1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine. 2. WriteaHTTPwebclientprogramtodownloadawebpageusingTCPsockets. 3.Applications using TCP sockets like: a) Echo client and echo server b) Chat 4. SimulationofDNSusingUDPsockets. 5. UseatoollikeWiresharktocapturepackets and examinethe packets 6. WriteacodesimulatingARP/RARPprotocols. 7. StudyofNetworksimulator(NS)andSimulation ofCongestionControlAlgorithmsusingNS. 8. StudyofTCP/UDPperformanceusingSimulation tool. 9. SimulationofDistanceVector/LinkStateRoutingalgorithm. 10.Simulation of an error correction code (like CRC)	
	TOTAL:75PERIODS

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TEXTBOOKS:	
1	JamesF.Kurose,KeithW.Ross,ComputerNetworking,ATop-DownApproachFeaturing theInternet,EighthEdition,PearsonEducation,2021
2	BehrouzA.Forouzan,DataCommunicationsandNetworkingwithTCP/IPProtocolSuite, Sixth Edition TMH, 2022
3	WilliamStallings,DataandComputerCommunications,TenthEdition,Pearson Education, 2013.
REFERENCES:	
1	LarryL.Peterson,BruceS.Davie,ComputerNetworks:ASystemsApproach,Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2	NaderF.Mir,ComputerandCommunicationNetworks,SecondEdition,PrenticeHall, 2014.
3	Ying-DarLin,Ren-HungHwang,FredBaker,"ComputerNetworks:AnOpenSource Approach",McGrawHill,2012.
4	https://open.umn.edu/opentextbooks/textbooks/771

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CourseName:COMPUTERNETWORKS		**Coursecode: 22IT407**			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Explainthebasiclayersanditsfunctionsincomputer networks.	**I**	K1	1,2,3,4,6,9, 10,11,12	1,2
CO2	Understandthebasicsofhowdataflowsfromonenode to another.	**II**	K2,K3	1,2,3,4,5,6, 9,10,11	1,2
CO3	Analyzeroutingalgorithms.	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Describeprotocols for variousfunctions in the network.	**IV**	K5,K7	1,2,3,4,6,9, 11,12	1,2
CO5	Analyzetheworkingofvariousapplicationlayer protocols.	**V**	K5,K6	1,2,3,4,5,6, 10, 11,12	1,2

CO-PO-PSOMapping

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

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22IT502	FULLSTACKWEBDEVELOPMENT	L	T	P	C
		3	0	0	3
Course Objectives:	•Tounderstandthevariouscomponentsoffullstack development •TolearnNode.jsfeaturesand applications •Todevelopapplications withMongoDB •TounderstandtheroleofAngularandExpressinweb applications •TodevelopsimplewebapplicationswithReact				
UNITI	**BASICSOFFULLSTACK**				**9**
Understanding the Basic Web Development Framework - User - Browser – Webserver - Backend Services – MVCArchitecture - Understanding the different stacks –The role of Express –Angular Node – Mongo DB – React					
UNIT II	**NODE JS**				**9**
Basics of Node JS – Installation –Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers - Callbacks – Handling Data I/O – Implementing HTTP services in Node.js					
UNIT III	**MONGODB**				**9**
Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control –Administeringdatabases –Managingcollections –ConnectingtoMongoDBfrom Node.js – simple applications					
UNIT IV	**EXPRESSANDANGULAR**				**9**
ImplementingExpressinNode.js-Configuringroutes-UsingRequestandResponseobjects- Angular - Typescript -Angular Components - Expressions - Data binding - Built-in directives					
UNIT V	**REACT**				**9**
MERNSTACK–BasicReactapplications–ReactComponents–ReactState–ExpressREST APIs - Modularization and Webpack - Routing with React Router – Server-side rendering					
					TOTAL:45PERIODS

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TEXTBOOKS:	
1	BradDayley,BrendanDayley,CalebDayley,,,Node.js,MongoDBandAngularWeb Development", Addison-Wesley, Second Edition, 2018
2	ChrisNorthwood,,,TheFullStackDeveloper:YourEssentialGuidetotheEverydaySkills Expected of a Modern Full Stack Web Developer",Apress; 1st edition, 2018
3	VasanSubramanian,,,ProMERNStack,FullStackWebAppDevelopmentwithMongo, Express, React, and Node", Second Edition, Apress, 2019.
REFERENCES:	
1	"FullStack Development withSpringBoot3andReact"Author:SharonJ.Moore
2	KirupaChinnathambi,,,LearningReact:AHands-OnGuidetoBuildingWebApplications Using React and Redux",Addison-Wesley Professional, 2nd edition, 2018
3	"FullStackQuarkusandReact:Hands-onFullStackWebDevelopmentwithJava,React, and Kubernetes" Author: Marc Nuri San Felix
4	https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
5	https://www.coursera.org/specializations/full-stack-react
6	https://www.udemy.com/course/the-full-stack-web-development/

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CourseName:FULLSTACKWEBDEVELOPMENT		**Coursecode: 22IT408**			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Understandthevariousstacksavailableforweb application development.	**I**	K1,K2	1,2,3,4,6,9, 10,11,12	1,2
CO2	UseNode.jsfor application development.	**II**	K3,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO3	DevelopapplicationswithMongoDB.	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	UsethefeaturesofAngularand Express.	**IV**	K5	1,2,4,6,9,10 , 11,12	1,2
CO5	DevelopReact applications.	**V**	K6,K7	1,2,3,4,5,6, 10, 11,12	1,2

CO-PO-PSOMapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	0	0	0	0	0	0	1	1	1	1	1	1
CO2	3	3	3	3	2	1	0	0	2	0	2	3	2	2
CO3	3	3	2	2	2	2	0	0	2	2	2	3	2	2
CO4	3	3	2	2	2	1	0	0	1	1	2	2	2	1
CO5	3	3	3	3	3	1	0	0	0	0	2	2	2	2
CO	3	3	2	2	2	1	0	0	1	1	2	2	2	2

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22IT503	DISTRIBUTED COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the computation and communication models of distributed systems
- To illustrate the issues of synchronization and collection of information in distributed systems
- To describe distributed mutual exclusion and distributed deadlock detection techniques
- To elucidate agreement protocols and fault tolerance mechanisms in distributed systems
- To explain the cloud computing models and the underlying concepts

UNIT I	INTRODUCTION	8

Introduction: Definition-Relation to Computer System Components – Motivation – Message - Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.

UNIT II	LOGICAL TIME AND GLOBAL STATE	10

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT III	DISTRIBUTED MUTEX AND DEADLOCK	10

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport"s algorithm – Ricart- Agrawala"s Algorithm — Token-Based Algorithms – Suzuki-Kasami"s Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.

UNIT IV	CONSENSUS AND RECOVERY	10

Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing

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Algorithm-- Algorithm for Asynchronous Checkpointing and Recovery		
UNIT V	**CLOUD COMPUTING**	**7**
Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization – Load Balancing – Scalability and Elasticity – Replication – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Application Services		
		TOTAL: 45 PERIODS

TEXT BOOKS:

1	Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011.
2	Mukesh Singhal, Niranjan G Shivaratri, "Advanced Concepts in Operating systems", Mc- Graw Hill Publishers, 1994.
3	Liu M L, "Distributed Computing: Principles and Applications", Pearson Education, 2004.

REFERENCES:

1	George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2	Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3	Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
4	Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, 2003.
5	Arshdeep Bagga, Vijay Madisetti, " Cloud Computing: A Hands-On Approach", Universities Press, 2014.
6	https://eclass.uoa.gr/modules/document/file.php/D245/2015/DistrComp.pdf

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Course Name: DISTRIBUTED COMPUTING		**Course code: 22IT409**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain the foundations of distributed systems (K2)	**I**	K1	1,2,3,4,6,9, 10,11,12	1,2
CO2	Solve synchronization and state consistency problems (K3)	**II**	K3,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO3	Use resource sharing techniques in distributed systems (K3)	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Apply working model of consensus and reliability of distributed systems (K3)	**IV**	K5,K6	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Explain the fundamentals of cloud computing (K2)	**V**	K7	1,2,3,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	3	1	-	-	-	2	1	3	3	2	1
CO2	1	3	2	1	2	-	-	-	2	2	2	2	1	3
CO3	2	2	1	3	3	-	-	-	3	2	1	1	1	2
CO4	1	2	2	3	1	-	-	-	3	3	2	1	3	1
CO5	3	3	1	2	3	-	-	-	3	3	3	1	3	2
CO	1.8	2.4	1.8	2.4	2	-	-	-	2.6	2.2	2.2	1.6	2	1.8

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22EC408	EMBEDDED SYSTEMS AND IOT	L	T	P	C
		3	0	2	4

Course Objectives:	• To learn the internal architecture and programming of an embedded processor. • To introduce interfacing, I/O devices to the processor. • To introduce the evolution of the Internet of Things (IoT). • To build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform. • To apply the concept of Internet of Things in real world scenario.

UNIT I	**8-BIT EMBEDDED PROCESSOR**	**9**
8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling		
UNIT II	**EMBEDDED C PROGRAMMING**	**9**
Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.		
UNIT III	**IOT AND ARDUINO PROGRAMMING**	**9**
Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.		
UNIT IV	**IOT COMMUNICATION AND OPEN PLATFORMS**	**9**
IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.		
UNIT V	**APPLICATIONS DEVELOPMENT**	**9**
Complete Design of Embedded Systems – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare.		
	TOTAL: 45 PERIODS	

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PRACTICAL EXERCISES:	**TOTAL:30PERIODS**
1. Write8051 Assembly Language experiments using simulator. 2. Test data transfer between registers and memory. 3. Perform ALU operations. 4. Write Basic and arithmetic Programs Using Embedded C. 5. Introduction to Arduino platform and programming 6. Explore different communication methods with IoT devices (Zigbee, GSM,Bluetooth) 7. Introduction to Raspberry PI platform and python programming 8. Interfacing sensors with Raspberry PI 9. Communicate between Arduino and Raspberry PI using any wireless medium 10. Setup a cloud platform to log the data 11. Log Data using Raspberry PI and upload to the cloud platform 12. Design an IOT based system	
	TOTAL: 75 PERIODS

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TEXT BOOKS:	
1	Muhammed Ali Mazidi,Janice Gillispie Mazidi,RolinD.McKinlay,"The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014
2	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
3	Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
REFERENCES:	
1	Michael J. Pont, "Embedded C", Pearson Education, 2007.
2	Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.
3	Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
4	https://dlib.hust.edu.vn/bitstream/HUST/21763/1/OER000001386-1.pdf

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Course Name: EMBEDDED SYSTEMS AND IOT		**Course code: 22IT504**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain the architecture of embedded processors.	**I**	K1,K2	1,2,3,4,6,9, 10,11,12	1,2
CO2	Write embedded C programs.	**II**	K3	1,2,3,4,5,6, 9,10,11,12	1,2
CO3	Design simple embedded applications.	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Compare the communication models in IOT	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Design IoT applications using Arduino/Raspberry Pi /open platform.	**V**	K7	1,2,3,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	1	2	3	3	2	1
CO2	2	1	3	2	2	-	-	-	1	2	2	3	3	1
CO3	3	1	3	3	1	-	-	-	1	2	1	1	1	3
CO4	3	2	3	2	1	-	-	-	1	2	2	3	2	2
CO5	2	3	3	2	2	-	-	-	1	3	3	2	3	1
CO	2.6	2	3	2.4	1.5	-	-	-	1	2.2	2.2	2.4	2.2	1.6

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22IT505	FULL STACK WEB DEVELOPMENT LAB	L	T	P	C
		0	0	4	2

Course Objectives:

- To develop full stack applications with clear understanding of user interface, business logic and data storage.
- To design and develop user interface screens for a given scenario
- To develop the functionalities as web components as per the requirements
- To implement the database according to the functional requirements
- To integrate the user interface with the functionalities and data storage.

LIST OF PROGRAMS

1. Develop a portfolio website for yourself which gives details about yourself for a potential recruiter.
2. Create a web application to manage the TO-DO list of users, where users can login and manage their to-do items
3. Create a simple micro blogging application (like twitter) that allows people to post their content which can be viewed by people who follow them.
4. Create a food delivery website where users can order food from a particular restaurant listed in the website.
5. Develop a classifieds web application to buy and sell used products.
6. Develop a leave management system for an organization where users can apply different types of leaves such as casual leave and medical leave. They also can view the available number of days.
7. Develop a simple dashboard for project management where the statuses of various tasks are available. New tasks can be added and the status of existing tasks can be changed among Pending, InProgress or Completed.
8. Develop an online survey application where a collection of questions is available and users are asked to answer any random 5 questions.

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Brad Dayley, Brendan Dayley, Caleb Dayley, „Node.js, MongoDB and Angular Web Development", Addison-Wesley, Second Edition, 2018
2	Chris Northwood, „The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer", A press; 1st edition, 2018
3	Vasan Subramanian, „Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node", Second Edition, Apress, 2019.
REFERENCES:	
1	"Full Stack Development with Spring Boot 3 and React" Author: Sharon J. Moore
2	Kirupa Chinnathambi, „Learning React: A Hands-On Guide to Building Web Applications Using React and Redux", Addison-Wesley Professional, 2nd edition, 2018
3	"Full Stack Quarkus and React: Hands-on Full Stack Web Development with Java, React, and Kubernetes" Author: Marc Nuri San Felix
4	https://www.tutorialspoint.com/the_full_stack_web_development/index.asp

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Course Name: FULL STACK WEB DEVELOPMENT LABORATORY		**Course code: 22IT505**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Design full stack applications with clear understanding of user interface, business logic and data storage.	**I**	K1,K2	1,2,3,4,6,9, 10,11,12	1,2
CO2	Design and develop user interface screens	**II**	K3	1,2,3,4,5,6, 9,10,11,12	1,2
CO3	Implement the functional requirements using appropriate tool	**III**	K2,K4	1,2,3,4,5,6, 9,10,11,12	1,2
CO4	Design and develop database based on the requirements	**IV**	K5	1,2,3,4,6,9, 10, 11,12	1,2
CO5	Integrate all the necessary components of the application	**V**	K5,K6	1,2,3,4,5,6, 10, 11,12	1,2

CO-PO-PSO Mapping

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

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SEMESTER VI

22IT601	OBJECTORIENTEDSOFTWAREENGINEERING	L	T	P	C
		3	0	2	4
Course Objectives:	• TounderstandSoftwareEngineeringLifecycleModels • ToPerformsoftwarerequirementsanalysis • TogainknowledgeoftheSystemAnalysisand DesignconceptsusingUML. • Tounderstandsoftwaretestingandmaintenanceapproaches • Toworkonprojectmanagementschedulingusing DevOps				
UNITI	**SOFTWAREPROCESSANDAGILEDEVELOPMENT**				**9**
Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models–IntroductiontoAgility-Agileprocess-Extremeprogramming-XPProcess-CaseStudy.					
UNIT II	**REQUIREMENTSANALYSISANDSPECIFICATION**				**9**
Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets-ObjectmodellingusingUML–UsecaseModel –Classdiagrams–Interactiondiagrams–Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram- CASE TOOLS.					
UNIT III	**SOFTWAREDESIGN**				**9**
Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe –Adapter – Command–Strategy–Observer–Proxy–Facade–Architecturalstyles–Layered-ClientServer -Tiered-Pipeandfilter-Userinterfacedesign-CaseStudy.					
UNIT IV	**SOFTWARETESTINGANDMAINTENANCE**				**9**
Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regressiontesting–Debugging-Programanalysis–Symbolicexecution–ModelChecking-Case Study					
UNIT V	**PROJECTMANAGEMENT**				**9**
Software Project Management- Software Configuration Management - Project Scheduling-DevOps:Motivation-Cloudasaplatform-Operations-DeploymentPipeline:OverallArchitecture Building and Testing-Deployment- Tools- Case Study					
					TOTAL:45PERIODS

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PRACTICAL EXERCISES:	**30 PERIODS**
1. Identifyasoftwaresystem thatneeds to bedeveloped. 2. DocumenttheSoftware RequirementsSpecification(SRS)fortheidentifiedsystem. 3. Identifyuse cases anddevelop theUseCasemodel. 4. Identifytheconceptualclassesanddevelopa DomainModelandalso derive a Class Diagram from that. 5. Usingtheidentifiedscenarios,findtheinteractionbetweenobjectsand represent them using UML Sequence and Collaboration Diagrams 6. Drawrelevant StateChartand ActivityDiagramsforthe same system. 7. Implementthesystemasperthedetaileddesign 8. Testthesoftwaresystem forall thescenarios identifiedas perthe usecasediagram 9. Improvethereusabilityandmaintainabilityofthesoftwaresystem by applying appropriate design patterns. 10. Implementthe modified system andtest itforvarious scenarios	
	TOTAL:75PERIODS

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TEXTBOOKS:	
1	Bernd Bruegge andAllen H. Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Third Edition, Pearson Education, 2009.
2	Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology,FirstEdition,McGraw-HillInternationalEdition,2014.
3	StephenSchach,Object-OrientedandClassicalSoftwareEngineering,8thed,McGraw- Hill, 2010.
REFERENCES:	
1	CarloGhezzi,MehdiJazayeri,DinoMandrioli,FundamentalsofSoftwareEngineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
2	CraigLarman,ApplyingUMLandPatterns,3rded,PearsonEducation,2005.
3	LenBass, Ingo Weber and Liming Zhu, —DevOps: A Software Architect,,s Perspectivel, Pearson Education, 2016
4	RajibMall,FundamentalsofSoftwareEngineering,3rdedition,PHILearningPvt.Ltd., 2009.
5	https://www.ivarjacobson.com/publications/books/object-oriented-software-engineering-book

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CourseName:OBJECTORIENTEDSOFTWARE ENGINEERING		**Coursecode: 22IT601**			
CO	**CourseOutcomes**	Unit	K-CO	POs	PSOs
CO1	Compare various Software Development Lifecycle Models.	**I**	K1,K3	1,2,3,4,6,9,10,11,12	1,2
CO2	Evaluateprojectmanagementapproachesaswellascost Andschedule estimationstrategies.	**II**	K4	1,2,3,4,5,6,9,10,11,12	1,2
CO3	Performformalanalysisonspecifications.	**III**	K3,K4	1,2,3,4,5,6,9,10,11,12	1,2
CO4	UseUMLdiagrams for analysisand design.	**IV**	K5,k6	1,2,3,4,6,9,10,11,12	1,2
CO5	Architectanddesignusingarchitecturalstylesanddesign patterns,andtestthesystem	**V**	K7	1,2,3,4,5,6,10,11,12	1,2

CO-PO-PSOMapping

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

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22IT602	MOBILEAPPLICATIONS DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- Use Flutter/Kotlin multi-platform environment for building cross-platform mobile applications.
- Demonstrate the knowledge of differentprogramming techniques and patterns for mobile application development.
- Identifythecomponentsandstructureofmobileapplication development frameworks.
- Understandthecapabilitiesandlimitationsofdifferent platforms.
- Design anddevelopreal-timemobile applications.

LISTOFPROGRAMS

1. Studyandinstallationof Flutter/Kotlinmulti-platformenvironment
2. DevelopanapplicationthatusesWidgets,GUIcomponents,Fonts,andColors.
3. Developanativecalculator application.
4. Developa gamingapplicationthatuses 2-Danimationsand gestures.
5. Developamovieratingapplication(similartoIMDB)
6. Developan applicationtoconnect toawebserviceand toretrievedata with HTTP.
7. Developa simple shoppingapplication.
8. Designawebserver supportingpush notifications.
9. Developan applicationbyintegratingGooglemaps
10. MiniProjectsinvolvingFlutter/Kotlin multi-platform

TOTAL:45PERIODS

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TEXTBOOKS:	
1	SimoneAlessandria,FlutterProjects:Apracticalproject-based guide tobuildingreal-world cross-platformmobileapplicationsandgames,Packtpublishing.
2	CarmineZaccagnino,ProgrammingFlutter:Native,Cross-PlatformAppstheEasyWay (ThePragmaticProgrammers),Packt publishing.
3	AntonioLeiva,KotlinforAndroidDevelopersLearnKotlinthe easywaywhile developing anAndroidApplications
REFERENCES:	
1	GergelyOrosz,BuildingMobileApplicationsatScale:39EngineeringChallenges
2	SouvikBiswas&Codemagic,FlutterLibrarieswelove
3	EDFreitas,DanielJebaraj,FlutterSuccinctly

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Coursename:MOBILEAPPLICATIONSDEVELOPMENT LABORATORY		**Coursecode: 22IT602**			
CO	**CourseOutcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Designandbuildsimplemobileapplicationssupporting multiple platforms	**I**	K1	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO2	Applyvariousprogrammingtechniquesandpatternsto build mobile applications.	**II**	K1,K 2,K3	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO3	Buildreal-timemobileapplicationsfor society/environment	**III**	K1,K 3	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO4	Buildgamingandmultimediabasedmobileapplications	**IV**	K4,K 6	1,2,3,4, 5,6,7,8, 9,11,12	1,2
CO5	Build AI based mobile applications for society/environmentfollowingethicalpractices	**V**	K4,K 5	1,2,3,4, 5,6,7,8, 9,11,12	1,2

CO-PO-PSOMapping

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

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22ITV01	EXPLORATORY DATA ANALYSIS	L	T	P	C
		2	0	2	3

. Course Objectives:	• To outline an overview of exploratory data analysis. • To implement data visualization using Matplotlib. • To perform univariate data exploration and analysis. • To apply bivariate data exploration and analysis. • To use Data exploration and visualization techniques for multivariate and time series data.

UNIT I	EXPLORATORY DATA ANALYSIS	6

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT II	EDA USING PYTHON	6

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT III	UNIVARIATE ANALYSIS	6

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread- Scaling and Standardizing – Inequality.

UNIT IV	BIVARIATE ANALYSIS	6

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

UNIT V	MULTIVARIATE AND TIME SERIES ANALYSIS	6

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS

1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI.
2. Perform exploratory data analysis (EDA) with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
3. Working with Numpy arrays, Pandas data frames , Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
5. Perform Time Series Analysis and apply the various visualization techniques.
6. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc..
7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
8. Perform EDA on Wine Quality Data Set.
9. Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report.

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packet Publishing, 2020. (Unit 1)
2	Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017. (Unit 2)
3	Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)
REFERENCES:	
1	Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2	Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3	Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015
4	https://archive.org/details/exploratorydataa0000tuke_7616

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Course Name: EXPLORATORY DATAANALYSIS		Course code: 22ITV01			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the fundamentals of exploratory data analysis.	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Implement the data visualization using Matplotlib.	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Perform univariate data exploration and analysis	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Apply bivariate data exploration and analysis.	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Use Data exploration and visualization techniques for multivariate and time series data	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3	-	-	-	2	2	3	2	3	3
CO2	2	2	2	3	3	-	-	-	3	2	2	2	1	2
CO3	2	3	2	2	3	-	-	-	2	2	2	1	2	3
CO4	2	2	2	2	3	-	-	-	3	2	2	1	2	2
CO5	2	2	3	2	1	-	-	-	1	2	2	1	2	2
CO	2.2	2.2	2.4	2.4	2.6	-	-	-	2.2	2	2.2	1.4	2	2.4

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22ITV02	RECOMMENDER SYSTEMS	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering.

UNIT I	INTRODUCTION	6

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

Suggested Activities:

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

Suggested Evaluation Methods:

- Quiz on Recommender systems.

Quiz of python tools available for implementing Recommender systems

UNIT II	CONTENT-BASED RECOMMENDATION SYSTEMS	6

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

Suggested Activities:

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

Suggested Evaluation Methods:

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

UNIT III	COLLABORATIVE FILTERING	6

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

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and neighborhood selection.

Suggested Activities:

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

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.

Quiz of content-based filtering

UNIT IV	ATTACK-RESISTANT RECOMMENDER SYSTEMS	6

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

Suggested Activities:

- Group Discussion on attacks and their mitigation
- Study of the impact of group attacks
- External Learning – Use of CAPTCHAs

Suggested Evaluation Methods:

- Quiz on attacks on recommender systems

Seminar on preventing attacks using the CAPTCHAs

UNIT V	EVALUATING RECOMMENDER SYSTEMS	6

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design- Design Issues – Accuracy metrics – Limitations of Evaluation measures

Suggested Activities

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

Suggested Evaluation Methods:

- Quiz on evaluation design

Problems on accuracy measures

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Implement Data similarity measures using Python 2. Implement dimension reduction techniques for recommender systems 3. Implement user profile learning 4. Implement content-based recommendation systems 5. Implement collaborative filter techniques 6. Create an attack for tampering with recommender systems 7. Implement accuracy metrics like Receiver Operated Characteristic curves	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2	Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3	Francesco Ricci ,LiorRokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011),
REFERENCES:	
1	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.
2	"Building Recommendation Engines"Author: Suresh K. Gorakala and Michele Usuelli
3	"Hands-On Recommendation Systems with Python"Authors: RounakBanik
4.	https://www.charuaggarwal.net/Recommender-Systems.pdf

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Course Name: RECOMMENDER SYSTEMS		**Course code: 22ITV02**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basic concepts of recommender systems.	**I**	K3	1,2,3,4,5,9, 12,	-
CO2	Implement machine-learning and data-mining algorithms in recommender systems data sets.	**II**	K4	1,2,,5,12,	-
CO3	Implementation of Collaborative Filtering in carrying out Performance evaluation of recommender systems based on various metrics.	**III**	K5	1,2,3,4,5,9, 12,	-
CO4	Design and implement a simple recommender system.	**IV**	K5	1,2,3,4,5,9, 12,	-
CO5	Learn about advanced topics of recommender systems.	**V**	K6	1,2,3,4,5,9, 12,	-

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	2	1	-	-	-	1	-	-	1	-	-
CO2	1	2	-	-	1	-	-	-	-	-	-	1	-	-
CO3	2	3	1	-	1	-	-	-	2	-	-	-	-	-
CO4	3	2	2	2	1	-	-	-	2	-	-	2	-	-
CO5	1	1	-	2	1	-	-	-	-	-	-	1	-	-
CO	1.83	2	0.83	1.16	1	-	-	-	0.83	-	-	1	-	-

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22ITV03	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	INTRODUCTION	6

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

UNIT II	ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS	6

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

UNIT III	THIRD-GENERATION NEURAL NETWORKS	6

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

UNIT IV	DEEP FEEDFORWARD NETWORKS	6

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

UNIT V	RECURRENT NEURAL NETWORKS	6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Auto encoder, Stochastic Encoders and Decoders, Contractive Encoders.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Implement simple vector addition in Tensor Flow.	
2. Implement a regression model in Keras.	
3. Implement a perceptron in Tensor Flow/Keras Environment.	
4. Implement a Feed-Forward Network in Tensor Flow/Keras.	
5. Implement an Image Classifier using CNN in Tensor Flow/Keras.	
6. Improve the Deep learning model by fine tuning hyper parameters.	
7. Implement a Transfer Learning concept in Image Classification.	
8. Using a pre trained model on Keras for Transfer Learning	
9. Perform Sentiment Analysis using RNN	
10. Implement an LSTM based Auto encoder in Tensor Flow/Keras.	
11. Image generation using GAN	
	TOTAL: 60 PERIODS

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22ITV04	TEXT AND SPEECH ANALYSIS	L	T	P	C
		2	0	2	3
Course Objectives:	• Understand natural language processing basics • Apply classification algorithms to text documents • Build question-answering and dialogue systems • Develop a speech recognition system • Develop a speech synthesizer				

UNITI	NATURAL LANGUAGE BASICS	6

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

SuggestedActivities:

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

Suggested Evaluation Methods:

- Quiz on NLPBasics

DemonstrationofPrograms

UNITII	TEXTCLASSIFICATION	6

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

SuggestedActivities:

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

Suggested Evaluation Methods:

- Assignment on above topics
- Quiz on RNN, Transformers

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- Implementing NLP with RNN and Transformers

UNIT III	QUESTION ANSWERING AND DIALOGUE SYSTEMS	6

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

Suggested Activities:

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

Suggested Evaluation Methods

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

UNIT IV	TEXT-TO-SPEECH SYNTHESIS	6

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

Suggested Activities:

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

Suggested Evaluation Methods

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

UNIT V	AUTOMATIC SPEECH RECOGNITION	6

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

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Suggested Activities:

- Flipped classroom on Speech recognition.
- Exploring Feature extraction

Suggested Evaluation Methods:

- Assignment on the above topics

Quiz on acoustic modelling

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Create Regular expressions in Python for detecting word patterns and tokenizing text	
2. Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams	
3. Accessing Text Corpora using NLTK in Python	
4. Write a function that finds the 50 most frequently occurring words of a text that are not stop words.	
5. Implement the Word2Vec model	
6. Use a transformer for implementing classification	
7. Design a chatbot with a simple dialog system	
8. Convert text to speech and find accuracy	
9. Design a speech recognition system and find the error rate	
	TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.
2	Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.
3	**Text Mining and Analysis: Practical Methods, Examples, and Case Studies Using SAS"**Author: Dr. Goutam Chakraborty
REFERENCES:	
1	Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2	Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4	https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf

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Course Name: TEXT AND SPEECH ANALYSIS		**Course code: 22ITV04**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain existing and emerging deep learning architectures for text and speech processing	**I**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO2	Apply deep learning techniques for NLP tasks, language modelling and machine translation	**II**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO3	Build question-answering systems, chatbots and dialogue systems	**III**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO4	Apply deep learning models for building speech recognition and text-to-speech systems	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Apply state-of-the-art machine learning techniques, such as Tacotron, WaveNet, or FastSpeech, to design and optimize neural TTS systems.	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	1	3	-	-	-	1	2	1	2	1	1
CO2	3	1	2	1	3	-	-	-	2	2	1	3	3	2
CO3	2	2	1	3	1	-	-	-	3	3	1	2	3	3
CO4	2	1	1	1	2	-	-	-	2	1	2	2	3	1
CO5	1	3	2	2	1	-	-	-	3	2	1	1	2	3
CO	2.2	1.8	1.8	1.6	2	-	-	-	2.2	2	1.2	2	2.4	2

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22ITV05	BUSINESS ANALYTICS	L	T	P	C
		2	0	2	3

Course Objectives:	• To understand the Analytics Life Cycle. • To comprehend the process of acquiring Business Intelligence • To understand various types of analytics for Business Forecasting • To model the supply chain management for Analytics. • To apply analytics for different functions of a business

UNIT I	**INTRODUCTION TO BUSINESS ANALYTICS**	**6**

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modelling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II	**BUSINESS INTELLIGENCE**	**6**

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions.

UNIT III	**BUSINESS FORECASTING**	**6**

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV	**HR & SUPPLY CHAIN ANALYTICS**	**6**

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V	**MARKETING & SALES ANALYTICS**	**6**

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS

Use MS-Excel and Power-BI to perform the following experiments using a Business data set, and make presentations.

Students may be encouraged to bring their own real-time socially relevant data set.

I Cycle – MS Excel

1. Explore the features of Ms-Excel.
2. (i) Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND)
   ii) Perform data import/export operations for different file formats.
3. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance, Skewness, Kurtosis
4. Perform Z-test, T-test & ANOVA
5. Perform data pre-processing operations i) Handling Missing data ii) Normalization
6. Perform dimensionality reduction operation using PCA, KPCA & SVD
7. Perform bivariate and multivariate analysis on the dataset.
8. Apply and explore various plotting functions on the data set.

II Cycle – Power BI Desktop

9. Explore the features of Power BI Desktop
10. Prepare & Load data
11. Develop the data model
12. Perform DAX calculations
13. Design a report
14. Create a dashboard and perform data analysis
15. Presentation of a case study

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017.
2	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
REFERENCES:	
1	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
2	Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.
3	"Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett.
4	https://ptgmedia.pearsoncmg.com/images/9780133552188/samplepages/0133552187.pdf

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Course Name: BUSINESS ANALYTICS		Course code: 22ITV05			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Explain the real world business problems and model with analytical solutions.	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Identify the business processes for extracting Business Intelligence	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Apply predictive analytics for business fore-casting	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Apply analytics for supply chain and logistics management	**IV**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO5	Use analytics for marketing and sales.	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	1	-	-	-	1	2	1	1	3	2
CO2	3	3	3	2	3	-	-	-	1	2	2	2	3	1
CO3	2	2	3	3	2	-	-	-	3	1	1	3	3	1
CO4	2	1	1	2	2	-	-	-	3	3	2	1	1	3
CO5	2	3	2	3	2	-	-	-	3	3	1	3	3	1
CO	2.2	2.2	2.4	2.2	2	-	-	-	2.2	2.2	1.4	2	2.6	1.6

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22ITV06	IMAGE AND VIDEO ANALYTICS	L	T	P	C
		2	0	2	3
Course Objectives:	• To understand the basics of image processing techniques for computer vision. • To learn the techniques used for image pre-processing. • To discuss the various object detection techniques. • To understand the various Object recognition mechanisms. • To elaborate on the video analytics techniques.				
UNIT I	**INTRODUCTION**				**6**
Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.					
UNIT II	**IMAGE PRE-PROCESSING**				**6**
Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration.					
UNIT III	**OBJECT DETECTION USING MACHINE LEARNING**				**6**
Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures					
UNIT IV	**FACE RECOGNITION AND GESTURE RECOGNITION**				**6**
Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition- Deep Face solution by Face book-Face Net for Face Recognition-Implementation using Face Net- Gesture Recognition.					
UNIT V	**VIDEO ANALYTICS**				**6**
Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-Res Net and Inception v3.					
					TOTAL: 30 PERIODS

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

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TEXT BOOKS:	
1	Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013.
2	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)
3	D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
REFERENCES:	
1	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London.
2	Limited,2011.
3	Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.
4.	https://archive.org/details/realtimeanalytic0000elli/mode/2up

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Course Name: IMAGE AND VIDEO ANALYTICS		Course code: 22ITV06			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the basics of image processing techniques for computer vision and video analysis.	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Explain the techniques used for image pre-processing.	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Develop various object detection techniques.	**III**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO4	Understand the various face recognition mechanisms	**IV**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO5	Elaborate on deep learning-based video analytics.	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	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	2	1	3	2	-	-	-	2	1	1	3	3	2
CO	2	1.8	2.2	2.4	2.6	-	-	-	2.2	2	1.4	2	2	1.6

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22ITV07	BIG DATAANALYTICS	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand big data.
- To learn and use No SQL big data management.
- To learn map reduce analytics using Hadoop and related tools.
- To work with map reduce applications
- To understand the usage of Hadoop related tools for Big Data Analytics

UNIT I	UNDERSTANDING BIG DATA	6

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

UNIT II	NOSQL DATA MANAGEMENT	6

IntroductiontoNoSQL–aggregatedatamodels–key-valueanddocumentdatamodels–relationships– graph databases– schema less databases– materialized views–distribution models– master- slavereplication–consistency-Cassandra–Cassandradatamodel–Cassandraexamples– Cassandra clients

UNIT III	MAP REDUCE APPLICATIONS	6

MapReduceworkflows–unittestswithMRUnit–testdataandlocaltests–anatomyofMapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN –job scheduling – shuffle and sort – task execution – Map Reduce types – input formats – output formats.

UNIT IV	BASICS OF HADOOP	6

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

UNIT V	HADOOP RELATED TOOLS	6

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis.Pig–Grunt– pigdatamodel–PigLatin–developingandtestingPigLatinscripts.Hive–datatypesandfileformats– HiveQLdatadefinition–HiveQLdatamanipulation–HiveQLqueries.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting 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.

Software Requirements:

Cassandra, Hadoop, Java, Pig, Hive and HBase.

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3	Sadalage, Pramod J. "NoSQL distilled", 2013
REFERENCES:	
1	E.Capriolo,D.Wampler,andJ. Rutherglen,"ProgrammingHive",O'Reilley, 2012.
2	LarsGeorge,"HBase:TheDefinitiveGuide",O'Reilley,2011.
3	EbenHewitt,"Cassandra:TheDefinitiveGuide",O'Reilley, 2010.
4	AlanGates,"ProgrammingPig",O'Reilley,2011.
5	https://archive.org/details/bigdatanalytcsparjbr0028

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Course Name: BIG DATAANALYTICS		Course code: 22ITV07			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Describe big data and use cases from selected business domains.	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Explain NoSQL big data management.	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Install, configure, and run Hadoop and HDFS.	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Perform map-reduce analytics using Hadoop..	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.	**V**	K7	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	2	2	3	1	1	3
CO2	3	3	2	3	2	-	-	-	2	2	3	3	2	3
CO3	3	3	3	2	3	-	-	-	2	2	1	2	2	3
CO4	2	3	3	3	3	-	-	-	2	2	3	2	3	3
CO5	3	3	3	3	3	-	-	-	3	1	3	2	3	2
CO	2.8	3	2.8	2.8	2.8	-	-	-	2.2	1.8	2.6	2	2.2	2.8

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22ITV08	VIRTUALIZATION	L	T	P	C
		2	0	2	3

Course Objectives:	• To Learn the basics and types of Virtualization • To understand the Hypervisors and its types • To Explore the Virtualization Solutions • To Experiment the virtualization platforms • To Explore the installation, configuration, and management of Popular virtualization tools such as VMware, Virtual Box, and Hyper-V.

UNIT I	**INTRODUCTION TO VIRTUALIZATION**	**6**
Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization – Para virtualization-Types of Hypervisors		
UNIT II	**SERVER AND DESKTOP VIRTUALIZATION**	**6**
Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization		
UNIT III	**NETWORK VIRTUALIZATION**	**6**
Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization-VLAN-WAN Architecture-WAN Virtualization		
UNIT IV	**STORAGE VIRTUALIZATION**	**6**
Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID		
UNIT V	**VIRTUALIZATION TOOLS**	**6**
VM Ware-Amazon AWS-Microsoft Hyper V- Oracle VM Virtual Box - IBM Power VM- Google Virtualization- Case study.		
	TOTAL: 30 PERIODS	

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

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TEXT BOOKS:	
1	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3	"Virtualization Essentials" by Matthew Portnoy
REFERENCES:	
1	David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
2	Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress, 2005.
3	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
4	https://archive.org/details/virtualizationbe0000rues

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Course Name: VIRTUALIZATION		**Course code: 22ITV08**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Analyze the virtualization concepts and Hypervisor	**I**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO2	Apply the Virtualization for real-world applications	**II**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO3	Install & Configure the different VM platforms	**III**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO4	Experiment with the VM with various software	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Explore the installation, configuration, and management of popular virtualization tools such as VMware, Virtual Box, and Hyper-V.	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	1	3	2	-	-	-	1	1	3	1	2	3
CO2	3	2	2	1	2	-	-	-	1	2	2	3	3	2
CO3	3	2	1	3	1	-	-	-	2	2	1	3	3	3
CO4	1	1	2	3	3	-	-	-	3	3	1	1	3	2
CO5	1	3	2	3	1	-	-	-	2	1	3	3	1	1
CO	1.8	2.2	1.6	2.6	1.8	-	-	-	1.8	1.8	2	2.2	2.4	2.2

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22ITV09	CLOUD SERVICES MANAGEMENT	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	6

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

UNIT II	CLOUD SERVICES STRATEGY	6

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III	CLOUD SERVICE MANAGEMENT	6

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT IV	CLOUD SERVICE ECONOMICS	6

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models

UNIT V	CLOUD SERVICE GOVERNANCE & VALUE	6

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership

TOTAL: 30 PERIODS

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

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TEXT BOOKS:	
1	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour
REFERENCES:	
1	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. ThamaraiSelvi
3	"Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)" by Michael J. Kavis
4	https://www.ibm.com/cloud-computing/files/cloud-for-dummies.pdf

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Course Name: CLOUD SERVICES MANAGEMENT		**Course code: 22ITV09**			
CO	**COURSE OUTCOMES**	Unit	K-CO	POs	PSOs
CO1	Exhibit cloud-design skills to build and automate business solutions using cloud technologies	**I**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO2	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Solve the real world problems using Cloud services and technologies	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Analyse and differentiate between various cloud deployment (Public, Private, Hybrid, Multi-Cloud) and service models (IaaS, PaaS, SaaS) based on business requirements.	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Assess real-world business scenarios and identify opportunities where cloud-based services can improve operations, reduce costs, or enhance customer experiences.	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1	1	-	-	-	2	1	3	2	2	1
CO2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO3	1	1	3	1	3	-	-	-	3	3	1	1	3	2
CO4	1	1	1	2	3	-	-	-	2	3	3	1	1	1
CO5	1	3	3	2	2	-	-	-	1	3	1	2	1	3
CO	1.8	1.8	2	1.8	2.2	-	-	-	1.8	2.4	2.2	1.4	1.8	1.8

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22ITV10	DATA WARE HOUSING	L	T	P	C
		2	0	2	3

Course Objectives:

- To know the details of data warehouse Architecture
- To understand the OLAP Technology
- To understand the partitioning strategy
- To differentiate various schema
- To understand the roles of process manager & system manager

UNIT I	INTRODUCTION TO DATA WAREHOUSE	6

Data ware house Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse

UNIT II	ETL AND OLAP TECHNOLOGY	6

What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.

UNIT III	META DATA, DATA MART AND PARTITION STRATEGY	6

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting Horizontal Partition

UNIT IV	DIMENSIONAL MODELING AND SCHEMA	6

Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Data ware house Tools

UNIT V	SYSTEM & PROCESS MANAGERS	6

Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Data exploration and integration with WEKA 2. Apply weka tool for data validation 3. Plan the architecture for real time application 4. Write the query for schema definition 5. Design data ware house for real time applications 6. Analyse the dimensional Modeling 7. Case study using OLAP 8. Case study using OTLP 9. Implementation of warehouse testing.	
	TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2	Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013.
3	"The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball and Margy Ross
REFERENCES:	
1	Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.
2	K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
3	"Data Warehousing Fundamentals for IT Professionals" by PaulrajPonniah
4	https://anuradhasrinivas.wordpress.com/wp-content/uploads/2013/03/data-warehousing-fundamentals-by-paulraj-ponniah.pdf

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Course Name:DATA WAREHOUSING		**Course code: 22ITV10**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Design data warehouse architecture for various Problems	**I**	K5	1,2,3,4,5,9, 12	-
CO2	Apply the OLAP Technology	**II**	K5	1,2,3,4,5,9, 11,12	-
CO3	Analyse the partitioning strategy	**III**	K5	1,2,3,4,12	-
CO4	Critically analyse the differentiation of various schema for given problem	**IV**	K6	1,2,3,4,12	-
CO5	Frame roles of process manager & system manager	**V**	K6	1,2,3,4,6,11 ,12	-

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	-	-	-	3	-	-	3	-	-
CO2	3	2	2	2	3	-	-	-	2	-	2	2	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	3	-	-
CO5	3	2	2	2	-	2	-	-	-	-	2	2	-	-
CO	3	2.6	2.6	1.2	2.5	1	-	-	2.5	-	2	2.6	-	-

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22ITV11	STORAGE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

UNIT I	STORAGE SYSTEMS	9

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

UNIT II	INTELLIGENT STORAGE SYSTEMS AND RAID	9

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

UNIT III	STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION	9

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

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UNIT IV	**BACKUP, ARCHIVE AND REPLICATION**	**9**
Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).		
UNIT V	**SECURING STORAGE INFRASTRUCTURE**	**9**
Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.		
		TOTAL: 45 PERIODS

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TEXT BOOKS:	
1	EMC Corporation, Information Storage and Management, Wiley, India
2	Jon Tate, Pall Beck, Hector Hugo Ibarra, ShanmuganathanKumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017
3	"Storage Networks Explained: Basics and Application of Storage Systems" by Ulf Troppens, Rainer Erkens, and Hauke G. Schoning
REFERENCES:	
1	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein,Storage Networks Explained, Second Edition, Wiley, 2009
2	"Digital Storage in Consumer Electronics: The Essentials" by Nina C. Jablonski and W. Richard Stevens
3	"Fundamentals of Storage Systems" by Mark S. Poole
4	https://www.collegesidekick.com/study-docs/14054573

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Course Name:STORAGE TECHNOLOGIES		Course code: 22ITV11			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment	**I**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO2	Illustrate the usage of advanced intelligent storage systems and RAID	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Examine the different role in providing disaster recovery and remote replication technologies	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Infer the security needs and security measures to be employed in information storage management	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	3	-	-	-	1	1	1	3	1	2
CO2	3	1	2	3	3	-	-	-	3	2	3	2	2	3
CO3	1	1	3	2	2	-	-	-	3	1	1	2	2	3
CO4	3	2	1	2	2	-	-	-	1	1	3	1	3	2
CO5	1	3	2	1	2	-	-	-	1	2	3	1	3	2
CO	1.8	1.8	1.8	2.2	2.4	-	-	-	1.8	1.4	2.2	1.8	2.2	2.4

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22ITV12	SOFTWARE DEFINED NETWORKS	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

UNIT I	SDN: INTRODUCTION	6

Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane

UNIT II	SDN DATA PLANE AND CONTROL PLANE	6

Data Plane functions and protocols – Open FLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, Open Daylight, ONOS - Distributed Controllers

UNIT III	SDN APPLICATIONS	6

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking

UNIT IV	NETWORK FUNCTION VIRTUALIZATION	6

Network Virtualization - Virtual LANs – Open Flow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture

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PRACTICAL EXCERCISES	30 PERIODS

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

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015.
2	Paul Goransson,Chuck Black Timothy Culver,"Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
3	Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.
REFERENCES:	
1	Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.
2	Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
4	https://www.cse.wustl.edu/~jain/cse570-18/ftp/m_16sdn.pdf

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Course Name:SOFTWARE DEFINED NETWORKS		Course code: 22ITV12			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Describe the motivation behind SDN	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Identify the functions of the data plane and control plane	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Design and develop network applications using SDN	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Orchestrate network services using NFV	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Explain various use cases of SDN and NFV	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	1	3	-	-	-	2	3	1	3	1	2
CO2	2	1	2	2	3	-	-	-	2	2	2	2	1	3
CO3	2	2	2	3	3	-	-	-	3	1	1	2	1	3
CO4	2	2	2	3	1	-	-	-	1	3	1	2	2	2
CO5	3	3	1	1	3	-	-	-	1	2	1	2	2	1
CO	2	2	2	2	2.6	-	-	-	1.8	2.2	1.2	2.2	1.4	2.2

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22ITV13	STREAM PROCESSING	L	T	P	C
		2	0	2	3

Course Objectives:

- Introduce Data Processing terminology, definition & concepts
- Define different types of Data Processing
- Explain the concepts of Real-time Data processing
- Select appropriate structures for designing and running real-time data services in a business environment
- Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

UNIT I	FOUNDATIONS OF DATA SYSTEMS	6

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges

UNIT II	REAL-TIME DATA PROCESSING	6

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing, Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage

UNIT III	DATA MODELS AND QUERY LANGUAGES	6

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many- to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL

UNIT IV	EVENT PROCESSING WITH APACHE KAFKA	6

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API

UNIT V	REAL-TIME PROCESSING USING SPARK STREAMING	6

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication

TOTAL: 30 PERIODS

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

TEXT BOOKS:	
1	Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2	Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media
3	Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing
REFERENCES:	
1	"Streaming Data: Understanding the Real-Time Pipeline" Author: Andrew G. Psaltis
2	Kafka.apache.org
3	"Fundamentals of Stream Processing: Application Design, Systems, and Analytics" Authors: Yu Sun, Min Luo, and ShlomoZilberstein
4	https://spark.apache.org/docs/latest/streaming-programming-guide.html

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Course name: STREAM PROCESSING											**Course code: 22ITV13**			
CO	**Course Outcomes**										**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the applicability and utility of different streaming algorithms										**I**	K3	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	Describe and apply current research trends in data-stream processing.										**II**	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Analyze the suitability of stream mining algorithms for data stream systems										**III**	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Program and build stream processing systems, services and applications.										**IV**	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	Solve problems in real-world applications that process data streams.										**V**	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO-PO-PSO Mapping														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	1	-	-	-	2	3	1	2	1	3
CO2	2	1	1	2	2	-	-	-	3	2	2	3	1	2
CO3	3	1	2	3	3	-	-	-	2	2	1	1	2	2
CO4	2	1	3	3	3	-	-	-	3	3	1	1	1	2
CO5	3	3	1	2	2	-	-	-	3	3	2	3	2	3
CO	2.6	1.8	1.8	2.6	2.2	-	-	-	2.6	2.6	1.4	2	1.4	2.4

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22ITV14	SECURITY AND PRIVACY IN CLOUD	L	T	P	C
		2	0	2	3

Course Objectives:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

UNIT I	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	6

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non-Repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT II	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	6

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies – Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III	ACCESS CONTROL AND IDENTITY MANAGEMENT	6

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT IV	CLOUD SECURITY DESIGN PATTERNS	6

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V	MONITORING, AUDITING AND MANAGEMENT	6

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

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

TEXT BOOKS:	
1	Raj Kumar Buyya , James Broberg, andrzejGoscinski, —Cloud Computing:‖, Wiley 2013
2	Dave shackleford, —Virtualization Security‖, SYBEX a wiley Brand 2013.
3	Mather, Kumaraswamy and Latif, —Cloud Security and Privacy‖, OREILLY 2011
REFERENCES:	
1	Mark C. Chu-Carroll —Code in the Cloud‖,CRC Press, 2011
2	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi
3	"Security and Privacy in Cloud Computing" Authors: Yang Xiang, Mohammed Atiquzzaman, and Song Guo
4	https://archive.org/details/cloudsecuritypri0000math

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Course name: SECURITY AND PRIVACY IN CLOUD		Course code: 22ITV14			
CO	**Course Outcomes**	**Unit**	**K-CO**		**PSOs**
CO1	Understand the cloud concepts and fundamentals.	**I**	K3	1,2,3,4 ,5,9,10 ,11,12	2
CO2	Explain the security challenges in the cloud.	**II**	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Define cloud policy and Identity and Access Management.	**III**	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Understand various risks and audit and monitoring mechanisms in the cloud.	**IV**	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	Define the various architectural and design considerations for security in the cloud.	**V**	K6	1,2,3,4 ,5,9,10 ,11,12	2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	-	-	-	1	1	1	3		1
CO2	1	3	2	3	1	-	-	-	2	2	3	2	3	1
CO3	3	2	2	3	2	-	-	-	3	1	1	2	2	3
CO4	2	1	2	3	3	-	-	-	3	2	3	3	1	1
CO5	1	3	3	1	1	-	-	-	2	3	3	2		3
CO	2	2.4	2.4	2.2	1.8	-	-	-	2.2	1.8	2.2	2.4	2.2	1.8

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22ITV15	CLOUD COMPUTING	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

UNIT I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	6

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges

UNIT II	VIRTUALIZATION BASICS	6

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

UNIT III	VIRTUALIZATION INFRASTRUCTURE AND DOCKER	6

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

UNIT IV	CLOUD DEPLOYMENT ENVIRONMENT	6

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT V	CLOUD SECURITY	6

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS

1. Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.
2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
3. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
4. Use the GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Install Hadoop single node cluster and run simple applications like wordcount.
8. Creating and Executing Your First Container Using Docker.
9. Run a Container from Docker Hub

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2	James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.
3	Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.
REFERENCES:	
1	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.
3	"Mastering Cloud Computing: Foundations and Applications Programming" by Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi
4.	https://www.infobooks.org/free-pdf-books/computers/cloud-computing/#google_vignette

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Course Name:CLOUD COMPUTING		**Course code: 22ITV15**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand the design challenges in the cloud.	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Apply the concept of virtualization and its types.	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Experiment with virtualization of hardware resources and Dockers.	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Develop and deploy services on the cloud and set up a cloud environment.	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Explain security challenges in the cloud environment.	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	-	-	-	2	3	1	3	2	1
CO2	3	1	2	2	1	-	-	-	1	2	1	3	2	2
CO3	2	3	2	3	1	-	-	-	3	1	1	3	1	1
CO4	1	2	3	3	3	-	-	-	3	3	1	2	1	3
CO5	2	3	3	1	3	-	-	-	2	2	1	2	2	2
CO	2.2	2.2	2.2	2	1.8	-	-	-	2.2	2.2	1	2.6	1.6	1.8

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22ITV16	APP DEVELOPMENT	L	T	P	C
		3	0	0	3
Course Objectives:	• To learn development of native applications with basic GUI Components • To develop cross-platform applications with event handling • To develop applications with location and data storage capabilities • To develop web applications with database access				
UNIT I	**FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT**				**6**
Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design					
UNIT II	**NATIVE APP DEVELOPMENT USING JAVA**				**6**
Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Development Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props					
UNIT III	**HYBRID APP DEVELOPMENT**				**6**
Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova					
UNIT IV	**CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE**				**6**
What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross-platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props					
UNIT V	**NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS**				**6**
Comparison of different Ap p frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability					
					TOTAL: 30 PERIODS

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TEXT BOOKS:	
1	Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2	Apache Cordova in Action, Raymond K. Camden, Manning. 2015
3	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, HousseinDjirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing
REFERENCES:	
1	Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2	Native Mobile Development by Shaun Lewis, Mike Dunn
3	Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, RuchaLingras
4	Apache Cordova 4 Programming, John M Wargo, 2015
5	https://www.freebookcentre.net/mobile-technology/Mobile-Application-Development-Books.html

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Course Name: APPDEVELOPMENT		**Course code: 22ITV16**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Develop Native applications with GUI Components.	**I**	K1	1,2,3,4,5,9, 10,11,12	1,2
CO2	Develop hybrid applications with basic event handling.	**II**	K2,K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Implement cross-platform applications with location and data storage capabilities.	**III**	K2,K4	1,2,3,4,5,9, 10,11,12	1,2
CO4	Implement cross platform applications with basic GUI and event handling.	**IV**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO5	Develop web applications with cloud database access.	**V**	K3,K5	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	2	3	-	-	-	1	1	2	1	2	3
CO2	2	1	3	2	2	-	-	-	3	2	2	3	3	2
CO3	2	2	2	1	2	-	-	-	1	1	1	1	1	1
CO4	1	3	1	1	3	-	-	-	1	1	3	2	1	3
CO5	1	1	3	1	3	-	-	-	1	1	2	1	3	2
CO	1.6	1.8	2	1.4	2.6	-	-	-	1.4	1.2	2	1.6	2	2.2

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22ITV17	UI AND UX DESIGN	L	T	P	C
		2	0	2	3

Course Objectives:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I	FOUNDATIONS OF DESIGN	6

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II	FOUNDATIONS OF UI DESIGN	6

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides

UNIT III	FOUNDATIONS OF UX DESIGN	6

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT IV	WIREFRAMING, PROTOTYPING AND TESTING	6

Sketching Principles - Sketching Red Routes - Responsive Design – Wire framing - Creating Wire flows - Building a Prototype - Building High-Fidelity Mock ups - Designing Efficiently with Tools- Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V	RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE	6

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

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

TEXT BOOKS:	
1	Joel Marsh, "UX for Beginners", O'Reilly , 2022.
2	Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly 2021
3	Steve Schoger, Adam Wathan "Refactoring UI", 2018
REFERENCES:	
1	Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition , O'Reilly 2020
2	https://www.nngroup.com/articles/
3	Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015
4	https://www.interaction-design.org/literature.

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Course Name: UI AND UX DESIGN		**Course code: 22ITV17**			
CO	**Course Outcomes**	**Unit**	K-CO	POs	PSOs
CO1	Build UI for user Applications	**I**	K1	1,2,3,4,5,9, 10,11,12	1,2
CO2	Evaluate UX design of any product or application	**II**	K2,K3	1,2,3,4,5,9, 10,11,12	1,2
CO3	Demonstrate UX Skills in product development	**III**	K2,K4	1,2,3,4,5,9, 10,11,12	1,2
CO4	Implement Sketching principles	**IV**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO5	Create Wireframe and Prototype	**V**	K3,K5	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO1**	**PSO2**
CO1	3	1	1	3	1	-	-	-	3	3	2	1	3	3
CO2	2	3	1	3	2	-	-	-	1	2	2	2	1	2
CO3	1	3	3	2	2	-	-	-	2	3	1	2	1	3
CO4	1	2	3	3	1	-	-	-	3	2	1	3	3	3
CO5	1	2	3	2	1	-	-	-	2	1	1	1	3	2
CO	1.6	2.2	2.2	2.6	1.4	-	-	-	2.2	2.2	1.4	1.8	2.2	2.6

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22ITV18	SOFTWARE TESTING AND AUTOMATION	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics of software testing
- To learn how to do the testing and planning effectively
- To build test cases and execute them
- To focus on wide aspects of testing and understanding multiple facets of testing
- To get an insight about test automation and the tools used for test automation

UNIT I	FOUNDATIONS OF SOFTWARE TESTING	6

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

UNIT II	TEST PLANNING	6

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

UNIT III	TEST DESIGN AND EXECUTION	6

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

UNIT IV	ADVANCED TESTING CONCEPTS	6

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

UNIT V	TEST AUTOMATION AND TOOLS	6

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

TOTAL: 30 PERIODS

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

PRACTICAL EXCERCISES	30 PERIODS

1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Test the e-commerce application and report the defects in it.
4. Develop the test plan and design the test cases for an inventory control system.
5. Execute the test cases against a client server or desktop application and identify the defects.
6. Test the performance of the e-commerce application.
7. Automate the testing of e-commerce applications using Selenium.
8. Integrate TestNG with the above test automation.

Mini Project:

- Build a data-driven framework using Selenium and TestNG
- Build Page object Model using Selenium and TestNG
- Build BDD framework with Selenium, TestNG and Cucumber

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Yogesh Singh, "Software Testing", Cambridge University Press, 2012
2	UnmeshGundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018
3	Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing
REFERENCES:	
1	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.
2	Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3	Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group
4	https://archive.org/details/softwaretestingp0000desi

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Course Name: SOFTWARE TESTING AND AUTOMATION		**Course code: 22ITV18**			
CO	COURSE OUTCOMES:	Unit	K-CO	POs	PSOs
CO1	Understand the basic concepts of software testing and the need for software testing	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Design Test planning and different activities involved in test planning	**II**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO3	Design effective test cases that can uncover critical defects in the application	**III**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO4	Carry out advanced types of testing	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Automate the software testing using Selenium and TestNG	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1	2	-	-	-	1	1	3	2	3	2
CO2	2	3	1	1	1	-	-	-	2	2	1	2	1	2
CO3	2	2	1	3	1	-	-	-	1	3	1	2	2	3
CO4	2	1	3	2	1	-	-	-	1	1	1	2	3	1
CO5	2	2	1	3	1	-	-	-	1	3	2	1	2	1
CO	2.2	2.2	1.6	2	1.2	-	-	-	1.2	2	1.6	1.8	2.2	1.8

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22ITV19	WEB APPLICATION SECURITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applications
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To get an insight about Hacking techniques and Tools

UNIT I	FUNDAMENTALS OF WEB APPLICATION SECURITY	6

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II	SECURE DEVELOPMENT AND DEPLOYMENT	6

Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III	SECURE API DEVELOPMENT	6

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV	VULNERABILITY ASSESSMENT AND PENETRATION TESTING	6

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V	HACKING TECHNIQUES AND TOOLS	6

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

TOTAL: 30 PERIODS

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

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TEXT BOOKS:	
1	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA
REFERENCES:	
1	Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4	Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5	https://www.dbooks.org/web-application-security-1492053112/

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Course Name: WEB APPLICATION SECURITY		Course code: 22ITV19			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understanding the basic concepts of web application security and the need for it	**I**	K1	1,2,3,4,5,12	-
CO2	Be acquainted with the process for secure development and deployment of web applications	**II**	K2,K3	1,2,3,4,5	-
CO3	Acquire the skill to design and develop Secure Web Applications that use Secure APIs	**III**	K2,K4	1,2,3,4,5,12	-
CO4	Be able to get the importance of carrying out vulnerability assessment and penetration testing	**IV**	K5	1,2,3,4,5	-
CO5	Acquire the skill to think like a hacker and to use hackers tool sets	**V**	K3,K5	1,2,3,4,5,12	-

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	1	3	-	-	-	-	-	-	1	-	-
CO2	2	1	2	1	3	-	-	-	-	-	-	-	-	-
CO3	1	1	1	2	3	-	-	-	-	-	-	1	-	-
CO4	1	2	1	1	2	-	-	-	-	-	-	-	-	-
CO5	1	2	2	2	2	-	-	-	-	-	-	1	-	-
CO	1.2	1.6	1.6	1.4	2.6	-	-	-	-	-	-	0.6	-	-

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22ITV20	DEVOPS	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I	INTRODUCTION TO DEVOPS	6

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github

UNIT II	COMPILE AND BUILD USING MAVEN & GRADLE	6

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT III	CONTINUOUS INTEGRATION USING JENKINS	6

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV	CONFIGURATION MANAGEMENT USING ANSIBLE	6

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V	BUILDING DEVOPS PIPELINES USING AZURE	6

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

TOTAL: 30 PERIODS

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

TEXT BOOKS:	
1	Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2	Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014
3	David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
REFERENCES:	
1	Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020
2	by Mitesh Soni
3	Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
4	https://www.edureka.co/blog/ebook/devops-ebook

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Course Name: DEVOPS		**Course code: 22ITV20**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Understand different actions performed through Version control tools like Git.	**I**	K3	1,2,3,4,5	1,2
CO2	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.	**II**	K5	1,2,3,4,5	1,2
CO3	Ability to Perform Automated Continuous Deployment	**III**	K5	1,2,3,4,5	1,2
CO4	Ability to do configuration management using Ansible	**IV**	K6	1,2,3,4,5	1,2
CO5	Understand to leverage Cloud-based DevOps tools using Azure DevOps	**V**	K6	1,2,3,4,5	1,2

CO-PO-PSO Mapping

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

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22ITV21	PRINCIPLES OF PROGRAMMING LANGUAGES	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in programming languages
- To develop programs in non-procedural programming paradigms

UNIT I	SYNTAX AND SEMANTICS	9

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing

UNIT II	DATA, DATA TYPES, AND BASIC STATEMENTS	9

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT III	SUBPROGRAMS AND IMPLEMENTATIONS	9

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping

UNIT IV	OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING	9

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling

UNIT V	FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES	9

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

TOTAL: 30 PERIODS

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

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TEXT BOOKS:	
1	Robert W. Sebesta, "Concepts of Programming Languages", Twelfth Edition (Global Edition), Pearson, 2022.
2	Michael L. Scott, "Programming Language Pragmatics", Fourth Edition, Elsevier, 2018.
3	"Principles of Programming Languages" by Bruce J. MacLennan
REFERENCES:	
1	R. Kent Dybvig, "The Scheme programming language", Fourth Edition, Prentice Hall, 2011.
2	Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Pearson, 1997.
3	W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.
4	https://archive.org/details/principlesofprog0000dowe

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Course Name: PRINCIPLES OF PROGRAMMING LANGUAGES		**Course code: 22ITV21**			
CO	**Course Outcomes**	Unit	K-CO	POs	PSOs
CO1	Describe syntax and semantics of programming languages	**I**	K3	1,2,3,4,5,12	1,2
CO2	Explain data, data types, and basic statements of programming languages	**II**	K4	1,2,3,4,5,12	1,2
CO3	Design and implement subprogram constructs	**III**	K6	1,2,3,4,5,12	1,2
CO4	Apply object-oriented, concurrency, and event handling programming constructs and Develop programs in Scheme, ML, and Prolog	**IV**	K6	1,2,3,4,5,6	1,2
CO5	Understand and adopt new programming languages	**V**	K6	1,2,3,4,5,6, 7,8,9,10,11, 12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	2	1	-	-	-	-	-	-	3	2	3
CO2	3	3	3	2	2	-	-	-	-	-	-	3	2	3
CO3	3	3	3	2	2	-	-	-	-	-	-	3	2	3
CO4	3	3	3	3	2	2	-	-	-	-	-	-	3	2
CO5	3	3	3	3	3	3	2	2	1	3	1	3	3	3
CO	2.8	2.8	3	2.4	2	2.5	2	2	1	3	1	3	2.4	2.8

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22ITV22	ETHICAL HACKING	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	INTRODUCTION	6

EthicalHackingOverview-RoleofSecurityandPenetrationTesters.-Penetration-TestingMethodologies-Laws of the Land - Overview of TCP/IP- The Application Layer -The Transport Layer- TheInternetLayer-IPAddressing.-NetworkandComputerAttacks-Malware-ProtectingAgainstMalwareAttacks.-IntruderAttacks-AddressingPhysicalSecurity

UNIT II	FOOTPRINTING,RECONNAISSANCEANDSCANNINGNETWORKS	6

Foot printing Concepts – Foot printing through Search Engines, Web Services, Social NetworkingSites,Website,Email-CompetitiveIntelligence-FootprintingthroughSocialEngineering- Foot printing Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques – Scanning Beyond ID Sand Firewall

UNIT III	ENUMERATIONANDVULNERABILITYANALYSIS	6

EnumerationConcepts-NetBIOSEnumeration–SNMP,LDAP,NTP,SMTPandDNSEnumeration - Vulnerability Assessment Concepts- Desktop and Server OS Vulnerabilities-WindowsOSVulnerabilities-ToolsforIdentifyingVulnerabilitiesinWindows-LinuxOSVulnerabilities-Vulnerabilities of Embedded Oss

UNIT IV	SYSTEMHACKING	6

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web AttackersandSecurityTestersHackingWirelessNetworks-ComponentsofaWirelessNetwork–Wardriving-Wireless Hacking-Tools of the Trade

UNIT V	NETWORK PROTECTION SYSTEMS	6

AccessControlLists.-CiscoAdaptiveSecurityApplianceFirewall-ConfigurationandRiskAnalysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems- Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams –Honey pots.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Install Kali or Backtrack Linux/Metasploitable/Windows XP **2. Practice the basics of reconnaissance.** **3. Using FOCA/Search Diggity tools, extract metadata and expanding the target list.** **4. Aggregates information from public databases using online free tools like Paterva's Maltego.** **5. Information gathering using tools like Robtex** **6. Scan the target using tools like Nessus.** **7. View capture and network traffic using Wireshark** **8. Automate dig for vulnerabilities and match exploits using Armitage** **FOCA: http://www.informatica64.com/foca.aspx.** **Nessus:** **http://www.tenable.com/products/nessus.** **Wireshark:** **http://www.wireshark.org.** **Armitage: http://www.fastandeasyhacking.com/.** **Kali or Backtrack Linux, Metasploitable, Windows XP**	
	TOTAL: 60 PERIODS

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

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Course name: ETHICALHACKING		**Course code: 22ITV22**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	To express knowledge on basics of computer-based vulnerabilities	**I**	K3	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods	**II**	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	To demonstrate the enumeration and vulnerability analysis methods	**III**	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	To gain knowledge on hacking options available in Web and wireless applications.	**IV**	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	To acquire knowledge on the options for network protection.	**V**	K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**		**PSO2**
CO1	2	2	3	2	1	-	-	-	1	2	2	1	1	2
CO2	1	2	1	2	1	-	-	-	2	2	1	1	1	2
CO3	2	2	3	3	1	-	-	-	1	2	1	2		3
CO4	2	1	1	2	1	-	-	-	1	3	3	3	3	2
CO5	2	3	1	1	2	-	-	-	2	1	1	1	1	1
CO	1.8	2	1.8	2	1.2	-	-	-	1.4	2	1.6	1.6		2

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22ITV23	DIGITAL AND MOBILE FORENSICS	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation.
- To understand how to be prepared for digital forensic readiness.
- To understand and use forensics tools for iOS devices.
- To understand and use forensics tools for Android devices.

UNIT I	INTRODUCTION TO DIGITAL FORENSICS	6

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

UNIT II	DIGITAL CRIME AND INVESTIGATION	6

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

UNIT III	DIGITAL FORENSIC READINESS	6

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

UNIT IV	iOS FORENSICS	6

Mobile Hardware and Operating Systems - iOS Fundamentals – Jail breaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – Mobil Edit – iCloud

UNIT V	ANDROID FORENSICS	9

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

TOTAL: 30 PERIODS

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

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TEXT BOOKS:	
1	Andre Arnes, "Digital Forensics", Wiley, 2018.
2	Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.
3	Digital Forensic-The Fascinating World of Digital Forensics by Dr.NilakshiJain,Dr.DhanajayR.Kalbande
REFERENCES:	
1	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.
2	HandBook Of Digital Forensics And Investigation-Edited by Eoghan Casey
3	Mobile Forensic Investigations-A guide to evidence collection,Analysis, and presentation Second Edition by Lee Reiber
4	https://library.oapen.org/handle/20.500.12657/54441

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Course name: DIGITAL AND MOBILE FORENSICS		Course code: 22ITV23			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Have knowledge on digital forensics.	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Know about digital crime and investigations.	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Be forensic ready.	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Investigate, identify and extract digital evidence from iOS devices.	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Investigate, identify and extract digital evidence from Android devices.	**V**	K6	1,2,3,4,5,9, 10,11,12	1,2

CO-PO-PSO Mapping

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

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22ITV24	SOCIAL NETWORK SECURITY	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	FUNDAMENTALSOFSOCIAL NETWORKING	6

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

UNIT II	SECURITYISSUES INSOCIAL NETWORKS	6

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

UNIT III	EXTRACTIONAND MININGINSOCIALNETWORKINGDATA	6

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detectingcommunitiessocialnetworkinfrastructuresandcommunities,Bigdataand Privacy

UNIT IV	PREDICTINGHUMAN BEHAVIORANDPRIVACY ISSUES	6

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

UNIT V	ACCESSCONTROL,PRIVACYANDIDENTITYMANAGEMENT	6

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

TOTAL: 30 PERIODS

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

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TEXT BOOKS:	
1	Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2	BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3	Learning Neo4j 3.x –Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing
4	David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.
REFERENCES:	
1	asley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World‖, Cambridge University Press, 2010.
2	Jackson,MatthewO.,SocialandEconomicNetworks‖,PrincetonUniversityPress,2008.
3	GuandongXu ,Yanchun Zhang and Lin Li, Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
4	Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008
5	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling‖, IGI Global Snippet, 2009.
6	https://www.academia.edu/104582515/SOCIAL_NETWORK_SECURITY

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Course name: SOCIAL NETWORK SECURITY		Course code: 22ITV24			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Develop semantic web related simple applications	**I**	K3	1,2,3,4,5,9, 10,11,12	1,2
CO2	Address Privacy and Security issues in Social Networking	**II**	K4	1,2,3,4,5,9, 10,11,12	1,2
CO3	Explain the data extraction and mining of social networks	**III**	K5	1,2,3,4,5,9, 10,11,12	1,2
CO4	Discuss the prediction of human behavior in social communities	**IV**	K6	1,2,3,4,5,9, 10,11,12	1,2
CO5	Describe the applications of social networks	**V**	K6	1,2,3,4,5,9, 10,11,12	2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	3	2	-	-	-	3	2	1	2	3	3
CO2	2	2	2	3	3	-	-	-	1	2	2	3	3	3
CO3	2	1	1	3	2	-	-	-	1	2	1	1	1	3
CO4	3	3	3	3	2	-	-	-	1	1	1	1	2	1
CO5	1	3	2	2	2	-	-	-	1	1	3	1	-	3
CO	2.2	2	2	2.8	2.2	-	-	-	1.4	1.6	1.6	1.6		2.6

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22ITV25	MODERN CRYPTOGRAPHY	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn about Modern Cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudo and om permutation.
- To construct Basic cryptanalytic techniques.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT I	INTRODUCTION	6

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message In distinguish ability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door Permutations.

UNIT II	FORMAL NOTIONS OF ATTACKS	6

Attacks under Message In distinguish ability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphe rtext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NM-CCA2, Inter-relations among the attack model

UNIT III	RANDOM ORACLES	6

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudo-random Functions (PRF)

UNIT IV	BUILDING A PSEUDORANDOM PERMUTATION	6

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT V	MESSAGE AUTHENTICATION CODES	6

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Implement Feige-Fiat-Shamir identification protocol. 2. Implement GQ identification protocol. 3. Implement Schnorr identification protocol. 4. Implement Rabin one-time signature scheme. 5. Implement Merkle one-time signature scheme. 6. Implement Authentication trees and one-time signatures. 7. Implement GMR one-time signature scheme.	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)
3	"Understanding Cryptography: A Textbook for Students and Practitioners" Authors: Christof Paar and Jan Pelzl
REFERENCES:	
1	ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2	OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3	William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd Edition, 2006.
4	https://yehudalindell.com/wp-content/uploads/2023/06/IntroductionModernCryptography.pdf

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Course name: MODERN CRYPTOGRAPHY		**Course code: 22ITV25**			
CO	**Course Outcomes**	**Unit**	**K-CO**		**PSOs**
CO1	Interpret the basic principles of cryptography and general cryptanalysis.	**I**	K3	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	Determine the concepts of symmetric encryption and authentication.	**II**	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Identify the use of public key encryption, digital signatures, and key establishment.	**III**	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.	**IV**	K6	1,2,3,4 ,5,9,10 ,11,12	2
CO5	Express the use of Message Authentication Codes.	**V**	K6	1,2,3,4 ,5,9,10 ,11,12	2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	1	-	-	-	2	1	1	2	2	1
CO2	1	3	2	1	2	-	-	-	3	2	2	2	2	1
CO3	1	1	2	3	2	-	-	-	1	1	1	3	1	1
CO4	3	1	2	1	3	-	-	-	3	2	1	2	-	2
CO5	2	3	3	3	3	-	-	-	3	1	1	1	-	1
CO	2	2.2	2.4	2.2	2.2	-	-	-	2.4	1.4	1.2	2	2	1.2

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22ITV26	ENGINEERING SECURE SOFTWARE SYSTEMS	L	T	P	C
		2	0	2	3

Course Objectives:

- Know the importance and need for software security.
- Know about various attacks.
- Learn about secure software design.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

UNIT I	NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS	6

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory-Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

UNIT II	SECURE SOFTWARE DESIGN	6

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UINT III	SECURITY RISK MANAGEMENT	6

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV	SECURITY TESTING	6

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing– Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection- Tools for Penetration Testing

UNIT V	SECURE PROJECT MANAGEMENT	6

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

TOTAL: 30 PERIODS

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

TEXT BOOKS:	
1	Julia H. Allen, "Software Security Engineering", Pearson Education, 2008
2	Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011
3	Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006
REFERENCES:	
1	Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2	Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3	Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4	Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5	Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012
6	https://archive.org/details/engineeringsafes0000axel

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Course name: ENGINEERING SECURE SOFTWARE SYSTEMS		**Course code: 22ITV26**			
CO	**Course Outcomes**	**Unit**	**K-CO**		**PSOs**
CO1	Identify various vulnerabilities related to memory attacks.	**I**	K3		1,2
CO2	Apply security principles in software development	**II**	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Evaluate the extent of risks.	**III**	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Involve selection of testing techniques related to software security in the testing phase of software development.	**IV**	K6		1,2
CO5	Use tools for securing software.	**V**	K6		1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**		**PSO2**
CO1	2	3	2	3	2	-	-	-	2	1	2	2	2	2
CO2	2	2	2	3	3	-	-	-	2	1	2	2	1	2
CO3	1	2	2	2	1	-	-	-	1	1	2	1	2	2
CO4	2	3	2	2	2	-	-	-	2	1	2	2	2	2
CO5	2	1	2	2	3	-	-	-	2	1	1	2	2	1
CO	**1.8**	**2.2**	**2**	**2.4**	**2.2**	-	-	-	**1.8**	**1**	**1.8**	**1.8**		**1.8**

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22ITV27	CRYPTO CURRENCY AND BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

UNIT I	INTRODUCTION TO BLOCKCHAIN	6

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

UNIT II	BITCOIN AND CRYPTOCURRENCY	6

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

UNIT III	BITCOIN CONSENSUS	6

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

UNIT IV	HYPERLEDGER FABRIC & ETHEREUM	6

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

UNIT V	BLOCKCHAIN APPLICATIONS	6

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

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS

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

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2	Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.
3	Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.
REFERENCES:	
1	Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
2	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3	Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015
4	https://innovate.ieee.org/wp-content/uploads/2022/05/River-Blockchain.pdf

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Course name: CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES		**Course code: 22ITV27**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**PO**	**PSOs**
CO1	Understand emerging abstract models for Blockchain Technology	**I**	K3	1,2,3,4 ,5,9,12	1,2
CO2	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.	**II**	K4	1,2,3,4 ,5,9,12	2
CO3	It provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.	**III**	K5	1,2,3,4 ,5,9,12	2
CO4	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.	**IV**	K6	1,2,3,4 ,5,9,12	1,2
CO5	Design and implement basic blockchain-based applications, including smart contracts and decentralized applications (DApps), using platforms like Ethereum or Hyperledger.	**V**	K6	1,2,3,4 ,5,9,12	2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	-	-	-	1	-	-	2	3	3
CO2	3	3	3	3	1	-	-	-	2	-	-	2	-	3
CO3	3	3	3	3	2	-	-	-	3	-	-	2	-	3
CO4	3	2	3	2	3	-	-	-	3	-	-	2	3	2
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	3	2.75	2.75	2.5	1.75	-	-	-	2.25	-	-	2	-	2.75

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22ITV28	NETWORK SECURITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn the fundamentals of cryptography.
- To learn the key management techniques and authentication approaches.
- To explore the network and transport layer security techniques.
- To understand the application layer security standards.
- To learn the real time security practices.

UNIT I	INTRODUCTION	6

Basics of cryptography, conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT II	KEY MANAGEMENT AND AUTHENTICATION	6

Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.

UNIT III	ACCESS CONTROL AND SECURITY	6

Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control - IP Security - Internet Key Exchange (IKE). Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application.

UNIT IV	APPLICATION LAYERSECURITY	6

Electronic Mail Security: Pretty Good Privacy, S/MIME, DomainKeys Identified Mail. Wireless Network Security: Mobile Device Security

UNIT V	SECURITY PRACTICES	6

Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations. Blockchains, Cloud Security and IoT security

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Implement symmetric key algorithms 2. Implement asymmetric key algorithms and key exchange algorithms 3. Implement digital signature schemes 4. Installation of Wire shark, tcpdump and observe data transferred in client-server communication using UDP/TCP and identify the UDP/TCP datagram. 5. Check message integrity and confidentiality using SSL 6. Experiment Eavesdropping, Dictionary attacks, MITM attacks 7. Experiment with Sniff Traffic using ARP Poisoning 8. Demonstrate intrusion detection system using any tool. 9. Explore network monitoring tools 10. Study to configure Firewall, VPN	
	TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN 13:9780133354690.
2	Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013, ISBN-10: 1284031675, ISBN-13: 978-1284031676.
3	The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dreamtech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.
REFERENCES:	
1	Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.
2	Linux iptables Pocket Reference, Gregor N. Purdy, O'Reilly, 2004, ISBN-13: 978-0596005696.
3	Linux Firewalls, by Michael Rash, No Starch Press, October 2007, ISBN: 978-1-59327- 141-1.
4	https://download.e-bookshelf.de/download/0003/7043/55/L-G-0003704355-0016418221.pdf

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Course Name: NETWORK SECURITY		Course code: 22ITV28			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Classify the encryption techniques	I	K3	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	Illustrate the key management technique and authentication.	II	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Evaluate the security techniques applied to network and transport layer	III	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Discuss the application layer security standards.	IV	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	Apply security practices for real time applications.	V	K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	2	1	2	1	2	3
CO2	1	1	3	2	2	-	-	-	2	2	1	1	3	1
CO3	1	2	1	1	2	-	-	-	3	3	1	3	2	1
CO4	2	2	3	2	3	-	-	-	3	3	2	1	2	1
CO5	2	1	3	2	2	-	-	-	2	1	1	3	2	1
CO	1.8	1.8	2.4	1.8	2.2	-	-	-	2.4	2	1.4	1.8	2.2	1.4

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22ITV29	AUGMENTED REALITY/VIRTUAL REALITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I	INTRODUCTION	6

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT II	VR MODELING	6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III	VR PROGRAMMING	6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV	APPLICATIONS	6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V	AUGMENTED REALITY	6

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and

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Annotation- Navigation-Wearable devices
TOTAL: 30 PERIODS

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

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TEXT BOOKS:	
1	Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018
2	Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016
3	"Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing"Editors: Erin Pangilinan, Steve Lukas, and Vasanth Mohan
REFERENCES:	
1	John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
2	William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003
3	"Augmented Reality and Virtual Reality: Empowering Human, Place and Business" Editors: M. Claudia tom Dieck and Timothy Jung
4	https://download.e-bookshelf.de/download/0000/3403/20/L-G-0000340320-0013215360.pdf

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Course Name: AUGMENTED REALITY/VIRTUAL REALITY		Course code: 22ITV29			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the basic concepts of AR and VR	I	K3	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	Understand the tools and technologies related to AR/VR	II	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Know the working principle of AR/VR related Sensor devices	III	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Design of various models using modelling techniques	IV	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	Develop AR/VR applications in different domains	V	K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	2	2	1	2	2	1
CO2	3	2	2	1	3	-	-	-	3	2	2	3	3	1
CO3	3	3	2	2	3	-	-	-	3	2	1	2	3	2
CO4	3	3	3	2	3	-	-	-	3	2	2	3	3	2
CO5	3	3	3	3	3	-	-	-	3	3	3	3	3	3
CO	3.00	2.60	2.40	2.00	3.00	-	-	-	2.80	2.20	1.80	2.60	2.80	1.80

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22ITV30	MULTI MEDIA AND ANIMATION	L	T	P	C
		2	0	2	3

Course Objectives:

- To grasp the fundamental knowledge of Multimedia elements and systems
- To get familiar with Multimedia file formats and standards
- To learn the process of Authoring multimedia presentations
- To learn the techniques of animation in 2D and 3D and for the mobile UI
- To explore different popular applications of multimedia

UNIT I	INTRODUCTION TO MULTIMEDIA	6

Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, Challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning.

UNIT II	MULTIMEDIA FILE FORMATS AND STANDARDS	6

File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models. Multimedia data and file formats for the web.

UNIT III	MULTIMEDIA AUTHORING	6

Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools,audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulations.

UNIT IV	ANIMATION	6

Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.

UNIT V	MULTIMEDIA APPLICATIONS	6

Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS

Working with Image Editing tools:

Install tools like GIMP/ InkScape / Krita / Pencil and perform editing operations:

- Use different selection and transform tools to modify or improve an image
- Create logos and banners for home pages of websites.

Working with Audio Editing tools:

- Install tools like, Audacity / Ardour for audio editing, sound mixing and special effects like fade- in or fade-out etc.,
- Perform audio compression by choosing a proper codec.

Working with Video Editing and conversion tools:

- Install tools like OpenShot / Cinelerra / HandBrake for editing video content.
- Edit and mix video content, remove noise, create special effects, add captions.
- Compress and convert video file format to other popular formats.

Working with web/mobile authoring tools:

Adapt / KompoZer/ BlueGriffon / BlueFish / Aptana Studio/ NetBeans / WordPress /Expression Web:

- Design simple Home page with banners, logos, tables quick links etc
- Provide a search interface and simple navigation from the home page to the inside pages of the website.
- Design Responsive web pages for use on both web and mobile interfaces.

Working with Animation tools:

Install tools like, Krita, Wick Editor, Blender:

- Perform a simple 2D animation with sprites
- Perform simple 3D animation with keyframes, kinematics

Working with Mobile UI animation tools: Origami studio / Lottie / Framer etc.,

Working with E-Learning authoring tools:

Install tools like EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache, VideoLAN:

- Demonstrate screen recording and further editing for e-learning content.
- Create a simple E-Learning module for a topic of your choice.

Creating VR and AR applications:

- Any affordable VR viewer like Google Cardboard and any development platform like Openspace 3D / ARCore etc.

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III)
2	Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021.
3	Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
REFERENCES:	
1	John M Blain, The Complete Guide to Blender Graphics: Computer Modeling& Animation, CRC press, 3rd Edition, 2016.
2	Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018.
3	PrabhatK.Andleigh, Kiran Thakrar,"Multimedia SystemDesign",Pearson Education, 1st Edition, 2015.
4	https://www.sci.brooklyn.cuny.edu/~goetz/cisc3630/books/fundamentals_of_multimedia_v4.pdf

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Course Name: MULTIMEDIA AND ANIMATION		Course code: 22ITV30			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Get the bigger picture of the context of Multimedia and its applications	I	K3	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	Use the different types of media elements of different formats on content pages	II	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Author 2D and 3D creative and interactive presentations for different target multimedia applications.	III	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Use different standard animation techniques for 2D, 21/2 D, 3D applications	IV	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	Understand the complexity of multimedia applications in the context of cloud, security, big data streaming, social networking, CBIR etc.,	V	K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	-	-	-	3	2	1	2	3	2
CO2	3	3	3	3	3	-	-	-	3	3	2	2	3	2
CO3	3	3	3	3	3	-	-	-	3	3	2	3	3	2
CO4	3	3	3	3	3	2	-	-	3	3	3	3	3	3
CO5	3	3	3	3	3	2	-	-	3	3	3	3	3	3
CO	3.00	2.80	3.00	2.80	3.00	2.00	-	-	3.00	2.80	2.20	2.60	3.00	2.40

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22ITV31	VIDEO CREATION AND EDITING	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording. To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

UNIT I	FUNDAMENTALS	6

Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.

UNIT II	STORYTELLING	6

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management.

UNIT III	USING AUDIO AND VIDEO	6

Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs.

UNIT IV	WORKING WITH FINAL CUT PRO	6

Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio - Using Media Tools - Viewing and Setting Preferences.

UNIT V	WORKING WITH AVID XPRESS DV 4	6

Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Write a Movie Synopsis (Individual/Team Writing) 2. Present team stories in class. 3. Script/Storyboard Writing(Individual Assignment) 4. Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements 5. Production: Single camera production personnel & equipment, Documentary Production 6. Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching 7. Write Documentary & Animation Treatment 8. Post-production: Editing, Sound design, Finishing	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Avid Xpress DV 4 User Guide, 2007.
2	Final Cut Pro 6 User Manual, 2004.
3	"Digital Filmmaking: The Changing Art and Craft of Making Motion Pictures" Author: Thomas Ohanian and Michael E. Phillips
REFERENCES:	
1	Keith Underdahl, "Digital Video for Dummies", Third Edition, Dummy Series, 2001.
2	Robert M. Goodman and PartickMcGarth, "Editing Digital Video: The Complete Creative and Technical Guide", Digital Video and Audio, McGraw – Hill 2003.
3	The Filmmaker's Handbook: A Comprehensive Guide for the Digital Age Authors: Steven Ascher and Edward Pincus
4	https://oasis.col.org/server/api/core/bitstreams/c3a70f12-9710-4365-bb19-01428e977e86/content

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Course Name:VIDEO CREATION AND EDITING		Course code: 22ITV31			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Compare the strengths and limitations of Nonlinear editing.	I	K3	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	Identify the infrastructure and significance of storytelling.	II	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Apply suitable methods for recording to CDs and VCDs	III	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Address the core issues of advanced editing and training techniques	IV	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	Design and develop projects using AVID XPRESS DV 4	V	K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	-	-	-	1	2	3	2	3	1
CO2	2	3	3	3	1	-	-	-	1	2	2	1	1	1
CO3	2	2	3	3	1	-	-	-	3	1	1	1	2	1
CO4	2	2	2	2	1	-	-	-	3	1	1	1	2	2
CO5	2	1	3	3	1	-	-	-	3	2	1	2	2	2
CO	2.2	1.8	2.6	2.4	1	-	-	-	2.2	1.6	1.6	1.4	2	1.4

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22ITV32	DIGITAL MARKETING	L	T	P	C
		2	0	2	3

Course Objectives:	• The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment. • It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured. • Discuss innovations such as AI in marketing, voice search optimization, and the use of AR/VR in creating immersive marketing experiences. • Emphasize the importance of privacy, data security, and ethical considerations in executing digital marketing campaigns. • Enable students to implement learned concepts in practical settings, such as case studies, live projects, or simulated marketing campaigns.

UNIT I	**INTRODUCTION TO ONLINE MARKET**	**6**
Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.		
UNIT II	**SEARCH ENGINE OPTIMISATION**	**6**
Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement		
UNIT III	**E- MAIL MARKETING**	**6**
E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting		
UNIT IV	**SOCIAL MEDIA MARKETING**	**6**
Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.		
UNIT V	**DIGITAL TRANSFORMATION**	**6**
Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.		
		TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments. 2. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool. 3. Demonstrate how to use the Google WebMasters Indexing API 4. Discuss an interesting case study regarding how an insurance company manages leads. 5. Discuss negative and positive impacts and ethical implications of using social media for political advertising. 6. Discuss how Predictive analytics is impacting marketing automation	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education.
2	First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
3	Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
REFERENCES:	
1	Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
2	Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited..
3	Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.
4	Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education
5	https://www.reliablesoft.net/free-marketing-ebooks/

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Course Name: DIGITAL MARKETING														**Course code: 22ITV32**
CO	**Course Outcomes**										**Unit**	**K-CO**	**POs**	**PSOs**
CO1	To examine and explore the role and importance of digital marketing in today's rapidly changing business environment										I	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.										II	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	To know the key elements of a digital marketing strategy.										III	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	To study how the effectiveness of a digital marketing campaign can be measured										IV	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.										V	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO-PO-PSO Mapping														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1	3	-	-	-	1	2	3	3	3	3
CO2	2	2	2	1	3	-	-	-	1	2	3	3	3	3
CO3	1	1	1	2	2	-	-	-	1	2	1	1	3	2
CO4	3	2	2	3	1	-	-	-	1	3	2	3	2	3
CO5	2	3	1	3	3	-	-	-	2	3	1	2	1	2
CO	2.2	2.2	1.6	2	2.4	-	-	-	1.2	2.4	2	2.4	2.4	2.6

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22ITV33	VISUAL EFFECTS	L	T	P	C
		2	0	2	3

Course Objectives:

- To get a basic idea on animation principles and techniques
- To get exposure to CGI, color and light elements of VFX
- To have a better understanding of basic special effects techniques
- To have a knowledge of state of the art vfx techniques
- To become familiar with popular compositing techniques

UNIT I	ANIMATION BASICS	6

VFX production pipeline, Principles of animation, Techniques: Keyframe, kinematics, Full animation, limited animation, Rotoscoping, stop motion, object animation, pixilation, rigging, shape keys, motion paths.

UNIT II	CGI, COLOR, LIGHT	6

CGI – virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights, photometric light, BRDF shading model

UNIT III	SPECIAL EFFECTS	6

Special Effects – props, scaled models, animatronics, pyrotechniques, Schüfftan process, Particle effects – wind, rain, fog, fire

UNIT IV	VISUAL EFFECTS TECHNIQUES	6

Motion Capture, Matt Painting, Rigging, Front Projection.Rotoscoping, Match Moving – Tracking, camera reconstruction, planar tracking, Calibration, Point Cloud Projection, Ground plane determination, 3D Match Moving

UNIT V	COMPOSITING	6

Compositing – chroma key, blue screen/green screen, background projection, alpha compositing, deep image compositing, multiple exposure, matting, VFX tools - Blender, Natron, GIMP.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
Using Natron: • Understanding Natron Environment: • Working with color and using color grading • using Channels • Merging images • Using Rotopaint • performing Tracking and stabilizing • Transforming elements • Stereoscopic compositing **Using Blender:** • Motion Tracking – camera and object tracking • Camera fx, color grading, vignettes • Compositing images and video files • Multilayer rendering	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Chris Roda, Real Time Visual Effects for the Technical Artist, CRC Press, 1st Edition, 2022.
2	Steve Wright, Digital Compositing for film and video, Routledge, 4th Edition, 2017.
3	John Gress, Digital Visual Effects and Compositing, New Riders Press, 1st Edition, 2014.
REFERENCES:	
1	Jon Gress, "Digital Visual Effects and Compositing", New Riders Press, 1st Edition, 2014.
2	Robin Brinkman, The Art and Science of Digital Compositing: Techniques for Visual Effects, Animation and Motion Graphics", Morgan Kauffman, 2008.
3	Luiz Velho, Bruno Madeira, "Introduction to Visual Effects A Computational Approach", Routledge, 2023.
4	Jasmine Katatikarn, Michael Tanzillo, "Lighting for Animation: The art of visual storytelling
5	https://archive.org/details/isbn_9780240812427

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Course Name: VISUAL EFFECTS		Course code: 22ITV33			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	To implement animation in 2D / 3D following the principles and techniques	I	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	To use CGI, color and light elements in VFX applications	II	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	To create special effects using any of the state of the art tools	III	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	To apply popular visual effects techniques using advanced tools	IV	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	To use compositing tools for creating VFX for a variety of applications	V	K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1	-	-	-	1	2	1	1	3	3
CO2	1	3	3	2	1	-	-	-	3	2	2	2	1	1
CO3	2	3	3	2	1	-	-	-	1	2	1	2	2	2
CO4	3	3	2	2	3	-	-	-	3	3	2	2	2	3
CO5	1	2	1	1	2	-	-	-	1	3	2	3	2	3
CO	2	2.8	2.4	2	1.6	-	-	-	1.8	2.4	1.6	2	2	2.4

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22ITV34	GAME DEVELOPMENT	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	3D GRAPHICS FOR GAME DESIGN	6

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

UNIT II	GAME DESIGN PRINCIPLES	6

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

UNIT III	GAME ENGINE DESIGN	6

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.

UNIT IV	OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS	6

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.

UNIT V	GAME DEVELOPMENT USING PYGAME	6

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.

TOTAL: 30 PERIODS

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

TEXT BOOKS:	
1	Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison Wesley,2013.
2	Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress,2007.
3	"Game Programming Patterns"Author: Robert Nystrom
REFERENCES:	
1	Paul Craven, "Python Arcade games", Apress Publishers,2016.
2	David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, CRC Press,2006.
3	Jung Hyun Han, "3D Graphics for Game Programming", Chapman and Hall/CRC, 2011.
4	https://archive.org/details/introductiontoga0000unse

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Course Name: GAME DEVELOPMENT		Course code: 22ITV34			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the concepts of 2D and 3d Graphics	I	K3	1,2,3,4,5	1,2
CO2	Design game design documents.	II	K6	1,2,3,4,5	1,2
CO3	Implementation of gaming engines.	III	K6	1,2,3,4,5	1,2
CO4	Survey gaming environments and frameworks.	IV	K6	1,2,3,4,5	1,2
CO5	Implement a simple game in Pygame.	V	K6	1,2,3,4,5	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	-	-	-	-	-	-	-	2	2
CO2	1	2	2	1	2	-	-	-	-	-	-	-	2	2
CO3	1	1	1	2	1	-	-	-	-	-	-	-	2	2
CO4	3	3	1	3	3	-	-	-	-	-	-	-	2	2
CO5	3	3	2	1	3	-	-	-	-	-	-	-	2	2
CO	2.2	2.2	1.6	1.6	2.2	-	-	-	-	-	-	-	2	2

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22ITV35	MULTI MEDIA DATA COMPRESSION AND STORAGE	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics of compression techniques
- To understand the categories of compression for text, image and video
- To explore the modalities of text, image and video compression algorithms
- To know about basics of consistency of data availability in storage devices
- To understand the concepts of data streaming services

UNIT I	BASICS OF DATA COMPRESSION	6

Introduction —Lossless and Lossy Compression– Basics of Huffmann coding- Arithmetic coding- Dictionary techniques- Context based compression – Applications

UNIT II	IMAGE COMPRESSION	6

Lossless Image compression – JPEG-CALIC-JPEG LS-Prediction using conditional averages – Progressive Image Transmission – Lossless Image compression formats – Applications - Facsimile encoding

UNIT III	VIDEO COMPRESSION	6

Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1- MPEG-2- H.263

UNIT IV	DATA PLACEMENT ON DISKS	6

Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storage system – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system

UNIT V	DISK SCHEDULING METHODS	6

Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Construct Huffman codes for given symbol probabilities. 2. Encode run lengths with fixed-length code. 3. Lempel-Ziv algorithm for adaptive variable-length encoding 4. Compress the given word using arithmetic coding based on the frequency of the letters. 5. Write a shell script, which converts all images in the current directory in JPEG. 6. Write a program to split images from a video without using any primitives. 7. Create a photo album of a trip by applying appropriate image dimensions and format. 8. Write the code for identifying the popularity of content retrieval from media server. 9. Write the code for ensuring data availability in disks using strip based method. 10. Program for scheduling requests for data streams.	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition.
2	Philip K.C.Tse, Multimedia Information Storage and Retrieval: Techniques and Technologies, 2008
3	Irina Bocharova, Compression for Multimedia, Cambridge University Press; 1st edition, 2009
REFERENCES:	
1	David Salomon, A concise introduction to data compression, 2008.
2	Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series, 2017.
3	Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor& Francis,2019
4	https://drive.uqu.edu.sa/_/mskhayat/files/MySubjects/20178FS%20Multimedia%20Systems/20178%20FMSLectures/DataCompression.pdf

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Course Name: MULTIMEDIA DATA COMPRESSION AND STORAGE		Course code: 22ITV35			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the basics of text, Image and Video compression	I	K3	1,2,3,4,5	1,2
CO2	Understand the various compression algorithms for multimedia content	II	K4	1,2,3,4,5	1,2
CO3	Explore the applications of various compression techniques	III	K5	1,2,3,4,5	1,2
CO4	Explore knowledge on multimedia storage on disks	IV	K6	1,2,3,4,5	1,2
CO5	Understand scheduling methods for request streams	V	K6	1,2,3,4,5	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	-	2	2
CO2	3	2	2	1	2	-	-	-	-	-	-	-	2	2
CO3	3	2	2	1	2	-	-	-	-	-	-	-	2	2
CO4	3	2	2	1	1	-	-	-	-	-	-	-	2	2
CO5	3	2	2	1	1	-	-	-	-	-	-	-	2	2
CO	3	2	2	1	1.4	-	-	-	-	-	-	-	2	2

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22ITV36	NATURAL LANGUAGE PROCESSING	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn the fundamentals of natural language processing.
- To learn the word level analysis methods.
- To explore the syntactic analysis concepts.
- To understand the semantics and pragmatics.
- To learn to analyze discourses and Lexical Resources.

UNIT I	INTRODUCTION	6

Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

UNIT II	WORD LEVEL ANALYSIS	6

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III	SYNTACTIC ANALYSIS	6

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, DynamicProgramming parsing – Shallow 85 parsing – Probabilistic CFG, Probabilistic CYK,Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

UNIT IV	SEMANTICS AND PRAGMATICS	6

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods

UNIT V	DISCOURSE ANALYSIS AND LEXICAL RESOURCES	6

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Word Analysis 2. Word Generation 3. Morphology 4. N-Grams 5. N-Grams Smoothing 6. POS Tagging: Hidden Markov Model 7. POS Tagging: Viterbi Decoding 8. Building POS Tagger 9. Chunking 10. Building Chunker	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2	Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, O'Reilly Media, 2009.
3	Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019
REFERENCES:	
1	Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015
2	Richard M Reese, —Natural Language Processing with Javal, O'Reilly Media, 2015.
3	Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

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Course name: NATURAL LANGUAGE PROCESSING		Course code: 22ITV36			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Tag a given text with basic Language features	**I**	K3	1,2,3,4,5, 6,8,12	1,2
CO2	Implement a rule based system to tackle morphology/syntax of a language	**II**	K4	1,2,3,4,5, 6,8,12	1,2
CO3	Design a tag set to be used for statistical processing for real-time applications.	**III**	K5	1,2,3,4,5, 6,8,12	1,2
CO4	Compare and contrast the use of different statistical approaches for different types of NLP applications.	**IV**	K6	1,2,3,4,5, 6,8,12	1,2
CO5	Use tools to process natural language and design innovative NLP applications	**V**	K6	1,2,3,4,5, 6,8,12	1,2

CO-PO-PSO Mapping

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

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22ITV37	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

UNIT I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	6

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II	AUTOMATION PROCESS ACTIVITIES	6

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events

UNIT III	APP INTEGRATION, RECORDING AND SCRAPING	6

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT IV	EXCEPTION HANDLING AND CODE MANAGEMENT	6

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT V	DEPLOYMENT AND MAINTENANCE	6

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA

TOTAL: 30 PERIODS

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

TEXT BOOKS:	
1	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2	Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.
3	Robotic process Automation using UiPathStudioX -A citizen Developer's Guide to hyperautomation by Adeel Javed,AnumSundrani,NadiaMalik,Sidney Madison Prescott
REFERENCES:	
1	Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3	A Gerardus Blokdyk, "Robotic Process Automation RpaA Complete Guide ", 2020
4	https://download.e-bookshelf.de/download/0015/2696/35/L-G-0015269635-0054632077.pdf

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Course Name: ROBOTIC PROCESS AUTOMATION		Course code: 22ITV37			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Enunciate the key distinctions between RPA and existing automation techniques and platforms.	I	K4	1,2,3,4 ,5,9,10 ,11,12	1,2
CO2	Use UiPath to design control flows and work flows for the target process	II	K5	1,2,3,4 ,5,9,10 ,11,12	1,2
CO3	Implement recording, web scraping and process mining by automation	III	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO4	Use UIPath Studio to detect, and handle exceptions in automation processes	IV	K6	1,2,3,4 ,5,9,10 ,11,12	1,2
CO5	Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.	V	K6	1,2,3,4 ,5,9,10 ,11,12	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	3	-	-	-	1	3	3	2	2	2
CO2	1	1	2	3	3	-	-	-	1	2	3	1	3	2
CO3	2	3	2	3	3	-	-	-	2	3	1	1	3	3
CO4	1	2	1	2	2	-	-	-	1	2	1	3	3	3
CO5	3	3	3	3	3	-	-	-	3	1	1	1	3	2
CO	2	2.2	2	2.4	2.8	-	-	-	1.6	2.2	1.8	1.6	2.8	2.4

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22ITV38	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Objectives:

- Learn the basic AI approaches
- Develop problem solving agents
- To Learn CSP
- Perform logical reasoning
- Perform probabilistic reasoning

UNIT I	INTELLIGENT AGENTS	9

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies.

UNIT II	PROBLEM SOLVING	9

Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments

UNIT III	GAME PLAYING AND CSP	9

Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP.

UNIT IV	LOGICAL REASONING	9

Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution

UNIT V	PROBABILISTIC REASONING	9

Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks

TOTAL: 45 PERIODS

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TEXT BOOKS:	
1	Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2	Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007
REFERENCES:	
1	Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
2	Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013
3	http://nptel.ac.in/

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Course name: ARTIFICIAL INTELLIGENCE		Course code: 22ITV38			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain intelligent agent frameworks	**I**	K3	1,2,3,4,5, 6,8,12	1,2
CO2	Apply problem solving techniques	**II**	K4	1,2,3,4,5, 6,8,12	1,2
CO3	Apply game playing and CSP techniques	**III**	K5	1,2,3,4,5, 6,8,12	1,2
CO4	Perform logical reasoning	**IV**	K6	1,2,3,4,5, 6,8,12	1,2
CO5	Perform probabilistic reasoning under uncertainty	**V**	K6	1,2,3,4,5, 6,8,12	1,2

CO-PO-PSO Mapping

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

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22ITV39	CYBER SECURITY	L	T	P	C
		2	0	2	3

Course Objectives:

- To learn cybercrime and cyber law.
- To understand the cyber-attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber-attack.
- To learn how to prevent a cyber-attack.

UNIT I	INTRODUCTION	6

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

UNIT II	ATTACKS AND COUNTERMEASURES	6

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

UNIT III	RECONNAISSANCE	6

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

UNIT IV	INTRUSION DETECTION	6

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

UNIT V	INTRUSION PREVENTION	6

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

TOTAL: 30 PERIODS

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

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

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Course Name: CYBER SECURITY		**Course code: 22ITV39**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the basics of cyber security, cyber crime and cyber law (K2)	I	K3	1,2,3,4 ,6,11	1,2
CO2	Classify various types of attacks and learn the tools to launch the attacks (K2)	II	K4	1,2,3,4 ,6	1,2
CO3	Apply various tools to perform information gathering (K3)	III	K5	1,2,3,4 ,6,11	1,2
CO4	Apply intrusion techniques to detect intrusion (K3)	IV	K6	1,2,3,4 ,6	1,2
CO5	Apply intrusion prevention techniques to prevent intrusion (K3)	V	K6	1,2,3,4 ,6,8,11	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	1	-	1	-	-	-	-	1	-	2	2
CO2	1	3	1	3	2	1	-	-	-	-	-	-	2	2
CO3	2	1	1	1	-	1	-	-	-	-	1	-	2	2
CO4	3	3	2	2	2	1	-	-	-	-	-	-	2	2
CO5	3	2	1	1	1	1	-	1	-	-	1	-	2	2
CO	2	2	1.2	1.6	1	1	0	0.2	0	0	0.6	0	2	2

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22ITV40	QUANTUM COMPUTING	L	T	P	C
		2	0	2	3

Course Objectives:

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and its relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the basics of quantum information and the theory behind it.

UNIT I	QUANTUM COMPUTING BASIC CONCEPTS	6

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits – Super positions

UNIT II	QUANTUM GATES AND CIRCUITS	6

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction

UNIT III	QUANTUM ALGORITHMS	6

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

UNIT IV	QUANTUM INFORMATION THEORY	6

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels

UNIT V	QUANTUM CRYPTOGRAPHY	6

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91

TOTAL: 30 PERIODS

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

TEXT BOOKS:	
1	Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).
2	Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3	Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".
REFERENCES:	
1	Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2	N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.
3	Introduction to Quantum Computing by Ray LaPierre
4	https://www.fi.muni.cz/usr/gruska/qbook1.pdf

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Course Name: QUANTUM COMPUTING		Course code: 22ITV40			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the basics of quantum computing.	I	K3	1,2,3,4 9	1,2
CO2	Understand the background of Quantum Mechanics.	II	K3	1,2,3,4 9	1,2
CO3	Analyze the computation models.	III	K5	1,2,3,4 5,9	1,2
CO4	Model the circuits using quantum computation. Environments and frameworks.	IV	K6	1,2,3,4 5,9	1,2
CO5	Understand the quantum operations such as noise and error–correction.	V	K6	1,2,3,4 9	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	2	-	-	-	2	3
CO2	3	2	2	2	-	-	-	-	2	-	-	-	2	3
CO3	3	3	3	3	2	-	-	-	3	-	-	-	3	2
CO4	3	3	3	3	3	-	-	-	3	-	-	-	1	3
CO5	3	3	2	3	-	-	-	-	2	-	-	-	1	3
CO	3	2.6	2.4	2.6	1	-	-	-	2.4	-	-	-	1.8	2.8

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22ITV41	AI in IoT	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand IoT fundamentals and their integration with AI
- Apply machine learning techniques to IoT data, focusing on classification, feature scaling, and model optimization.
- Utilize genetic algorithms and reinforcement learning to solve IoT problems and optimize models.
- Implement generative models and explore their applications in IoT scenarios.
- Analyze and apply AI techniques for industrial IoT and smart city applications

UNIT I	PRINCIPLES AND FOUNDATIONS OF IOT AND AI	9

IoT reference model, loT platforms, loT verticals, Big data and lot, Infusion of Al- data science in IoT, Cross-industry standard process for data mining Al platforms and loT platforms and Tools, Tensor Flow, Keras, Datasets, The combined cycle power plant dataset Wine quality dataset, Air quality data.

UNIT II	ML FOR IoT	9

Cross-entropy loss function, Classifying wine using logistic regressor Classification using support vector machines, Maximum margin hyper plane, Kernel trick, Classifying wine using SVM, Naive Bayes, Gaussian Naive Bayes for wine quality, Decision trees, Decision trees in scikit, Decision trees in action, Ensemble learning Voting classifier, Bagging and pasting, Improving your model - tips and tricks Feature scaling to resolve uneven data scale, Over fitting, Regularization, Cross validation, No Free Lunch theorem, Hyper parameter tuning and grid search.

UNIT III	GENETIC ALGORITHMS AND REINFORCEMENT LEARNING FOR IoT	9

Deterministic and analytic methods - Gradient descent method Newton-Raphson method - Natural optimization methods Simulated annealing- Coding genetic algorithms using Distributed Evolutionary Algorithms in Python- Genetic algorithm for CNN architecture-Genetic algorithm for LSTM optimization- Deep reinforcement learning-Q learning-Q Networks.

UNIT IV	GENERATIVE MODELS FOR IOT and HOME IoT	9

GANS - Implementing a vanilla GAN in Tensor Flow Deep Convolutional GANS- Applications of GANS-Distributed AI- Apache MLlib-Regression in MLlib- Personal loT- Classification in MLlib Continuous glucose monitoring- Hypoglycemia prediction using CGM data- Heart monitor- Digital assistants- Human activity recognition- HAR using wearable sensors- Smart home automation.

UNIT V	AI FOR INDUSTRIAL IoT AND SMART CITIES	9

Predictive maintenance using Al- Predictive maintenance using Long Short-Term Memory Predictive maintenance advantages and disadvantages-Electrical load forecasting in industry STLF using LSTM- Components of a smart city-Smart traffic management-Smart parking- Smart waste

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management-Smart policing-Smart lighting-Smart governance-Cities with open data Adapting lot for smart cities and the necessary steps.
TOTAL: 45 PERIODS

TEXT BOOKS:	
1	Hands-On Artificial Intelligence for IoT, Packt Publishing Ltd, Birmingham, UK. Amita Kapoor, 2019.
2	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
3	Hiran. Internet of Things (IoT): Principles, paradigms, and applications of IoT. Bpb Publications, 2020
REFERENCES:	
1	Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspectivel, CRC Press, 2012.
2	Kurniawan, Agus. IoT Projects with NVIDIA Jetson Nano. Apress Berkeley, CA (2021)
3	Perry Lea, —Internet of Things for Architectsl, PACKT, 2018 5. Andy King, —Programming the Internet of Things: An Introduction to Building Integrated, Device to Cloud IoT solutionsl, O'REILLY', 2021.

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Course name: AI in IoT		**Course code: 22ITV41**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the basics of NLP and Text models.	**I**	K3	1,2,3,5,9, 11,12	1,2
CO2	Apply Syntax, Semantic and Parsing Techniques in NLP.	**II**	K4	1,2,3,5,9, 11,12	1,2
CO3	Understand and implement the methods involved in text classification and Semantic Analysis	**III**	K5	1,2,3,5,9, 11,12	1
CO4	Design Sequence model and perform machine translation	**IV**	K6	1,2,3,5,9, 11,12	2
CO5	Understand the ethics and ensure fairness in NLP applications	**V**	K6	1,2,3,5,9, 11,12	1

CO-PO-PSO Mapping

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

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22ITV42	3D PRINTING AND DESIGN	L	T	P	C
		2	0	2	3
Course Objectives:	• To discuss on basics of 3D printing • To explain the principles of 3D printing technique • To explain and illustrate inkjet technology • To explain and illustrate laser technology • To discuss the applications of 3D printing				
UNIT I	**INTRODUCTION**				**6**
Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats					
UNIT II	**PRINCIPLE**				**6**
Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations					
UNIT III	**INKJET TECHNOLOGY**				**6**
Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continous jet, Mulitjet; Powder based fabrication – Colourjet.					
UNIT IV	**LASER TECHNOLOGY**				**6**
Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures					
UNIT V	**INDUSTRIAL APPLICATIONS**				**6**
Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Future trends					
					TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS

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

TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2	Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons, 2013.
3	3D Printing and Design byDr,SabreSoloman
REFERENCES:	
1	Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010
2	Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007
3	Joan Horvath, Mastering 3D Printing, APress, 2014
4	https://it.dru.ac.th/o-bookcs/pdfs/09.pdf

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Course Name:3D PRINTING AND DESIGN		Course code: 22ITV42			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Outline and examine the basic concepts of 3D printing technology	I	K3	1,2,3,4 ,5,6,9, 11,12	1,2
CO2	Outline 3D printing workflow`	II	K4	1,2,3,4 ,5,6,9, 11,12	1,2
CO3	Explain and categories the concepts and working principles of 3D printing using inkjet technique	III	K5	1,2,3,4 ,5,6,9, 11,12	1,2
CO4	Explain and categories the working principles of 3D printing using laser technique	IV	K5	1,2,3,4 ,5,6,9, 11,12	1,2
CO5	Explain various method for designing and modeling for industrial applications	V	K6	1,2,3,4 ,5,6,9, 11,12	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	2	3	1	-	-	2	-	2	2	3	2
CO2	3	2	3	3	3	2	-	-	3	-	3	2	3	2
CO3	2	2	2	2	2	2	-	-	2	-	2	2	3	2
CO4	2	2	2	2	3	2	-	-	2	-	2	2	3	3
CO5	1	3	3	3	3	3	-	-	3	-	3	3	3	3
CO	1.8	2	2.4	2.4	2.8	2	-	-	2.4	-	2.4	2.2	3	2.4

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22ITV43	KNOWLEDGE ENGINEERING	L	T	P	C
		2	0	2	3

Course Objectives:

- To understand the basics of Knowledge Engineering.
- To discuss methodologies and modeling for Agent Design and Development.
- To design and develop ontologies.
- To apply reasoning with ontologies and rules.
- To understand learning and rule learning.

UNIT I	REASONING UNDER UNCERTAINTY	6

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

UNIT II	METHODOLOGY AND MODELING	6

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

UNIT III	ONTOLOGIES – DESIGN AND DEVELOPMENT	6

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

UNIT IV	REASONIING WITH ONTOLOGIES AND RULES	6

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

UNIT V	LEARNING AND RULE LEARNING	9

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

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Perform operations with Evidence Based Reasoning. 2. Perform Evidence based Analysis. 3. Perform operations on Probability Based Reasoning. 4. Perform Believability Analysis. 5. Implement Rule Learning and refinement. 6. Perform analysis based on learned patterns. 7. Construction of Ontology for a given domain.	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Gheorghe Tecuci, DorinMarcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016.
2	Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.
3	King , Knowledge Management and Organizational Learning , Springer, 2009.
REFERENCES:	
1	Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2	Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3	John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4	King , Knowledge Management and Organizational Learning , Springer, 2009.
5	https://www.academia.edu/16162395/An_Introduction_to_Knowledge_Engineering_2007_

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Course name: KNOWLEDGE ENGINEERING		**Course code: 22ITV43**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the basics of Knowledge Engineering.	**I**	K3	1,2,3,4,5, 6,9,10,11, 12	1,2
CO2	Apply methodologies and modelling for Agent Design and Development	**II**	K4	1,2,3,4,5, 9,10,11,1 2	1,2
CO3	Design and develop ontologies.	**III**	K6	1,2,3,4,5, 9,10,11,1 2	1,2
CO4	Apply reasoning with ontologies and rules.	**IV**	K6	1,2,3,4,5, 9,10,11,1 2	1,2
CO5	Understand learning and rule learning..	**V**	K6	1,2,3,4,5, 9,10,11,1 2	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	1	1	1	1	-	-	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	-	-	-	2	2	2	2	2	1
CO5	2	2	2	1	1	-	-	-	2	1	1	1	2	1
CO	2.4	1.8	2.4	1.4	1.4	0.2	0	0	2	1.6	1.6	1.6	2.2	1.6

ANNAPOORANA ENGINEERING COLLEGE AUTONOMOUS SALEM

22ITV44	SOFT COMPUTING	L	T	P	C
		2	0	2	3

Course Objectives:

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

UNIT I	INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC	6

Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems

UNIT II	NEURAL NETWORKS	6

Supervised Learning Neural Networks – Perceptrons - Backpropagation -Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks

UNIT III	GENETIC ALGORITHMS	6

Chromosome Encoding Schemes -Population initialization and selection methods - Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function

UNIT IV	NEURO FUZZY MODELING	6

ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum - Analysis of Adaptive Learning Capability

UNIT V	APPLICATIONS	6

Modeling a two input sine function - Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction.

TOTAL: 30 PERIODS

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

TEXT BOOKS:	
1	SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall,1997
2	Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python
3	With Case Studies and Applications from the Industry, Apress, 202
REFERENCES:	
1	roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2	S. Rajasekaran and G.A.V.Pai, —Neural Networks, Fuzzy Logic and Genetic Algorithmsl, PHI, 2003.
3	Samir Roy, Udit Chakraborthy, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
4	S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.
5	https://www.academia.edu/31364885/Introduction_to_Soft_Computing

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Course name: SOFT COMPUTING		Course code: 22ITV44			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the fundamentals of fuzzy logic operators and inference mechanisms	**I**	K3	1,2,3,4,5, 9,10,11,1 2	1,2
CO2	Understand neural network architecture for AI applications such as classification and clustering	**II**	K4	1,2,3,4,5, 9,10,11,1 2	1,2
CO3	Learn the functionality of Genetic Algorithms in Optimization problems	**III**	K5	1,2,3,4,5, 9,10,11,1 2	1,2
CO4	Use hybrid techniques involving Neural networks and Fuzzy logic	**IV**	K6	1,2,3,4,5, 9,10,11,1 2	1,2
CO5	Apply soft computing techniques in real world applications	**V**	K6	1,2,3,4,5, 9,10,11,1 2	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3	-	-	-	3	1	3	2	3	1
CO2	2	3	3	2	3	-	-	-	3	2	3	2	2	1
CO3	1	3	2	2	1	-	-	-	3	1	1	2	1	3
CO4	1	2	1	3	2	-	-	-	3	3	1	1	2	1
CO5	2	3	1	2	1	-	-	-	3	3	3	2	1	2
CO	1.8	2.6	2	2.4	2	-	-	-	3	2	2.2	1.8	1.8	1.6

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22ITV45	ETHICS AND AI	L	T	P	C
		2	0	2	3

Course Objectives:

- Study the morality and ethics in AI
- Learn ae Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and Ethics- challenges and opportunities

UNIT I	INTRODUCTION	6

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

UNIT II	ETHICAL INITIATIVES IN AI	6

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.

UNIT III	AI STANDARDS AND REGULATION	6

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

UNIT IV	ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS	6

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

UNIT V	AI AND ETHICS- CHALLENGES AND OPPORTUNITIES	6

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Recent case study of ethical initiatives in healthcare, autonomous vehicles and defense 2. Exploratory data analysis on a 2 variable linear regression model 3. Experiment the regression model without a bias and with bias 4. Classification of a dataset from UCI repository using a perceptron with and without bias 5. Case study on ontology where ethics is at stake 6. Identification on optimization in AI affecting ethics.	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,‖The ethics of artificial intelligence: Issues and initiatives‖, EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2	Patrick Lin, Keith Abney, George A Bekey,‖ Robot Ethics: The Ethical and Social Implications of Robotics‖, The MIT Press- January 2014.
REFERENCES:	
1	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2	Mark Coeckelbergh,‖ AI Ethics‖, The MIT Press Essential Knowledge series, April 2020
3	https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/

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Course name: ETHICS AND AI		Course code: 22ITV45			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Learn about morality and ethics in AI	**I**	K3	1,2,3,4,5, 9,10,11,1 2	1,2
CO2	Acquire the knowledge of real time application ethics, issues and its challenges.	**II**	K4	1,2,3,4,5, 9,10,11,1 2	1,2
CO3	Understand the ethical harms and ethical initiatives in AI	**III**	K5	1,2,3,4,5, 9,10,11,1 2	1,2
CO4	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems	**IV**	K6	1,2,3,4,5, 9,10,11,1 2	1,2
CO5	Understand the concepts of Roboethics and Morality with professional responsibilities.	**V**	K6	1,2,3,4,5, 9,10,11,1 2	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	1	-	-	-	1	2	1	1	3	1
CO2	2	1	1	2	1	-	-	-	1	2	1	1	3	3
CO3	2	3	1	1	3	-	-	-	2	1	1	2	3	2
CO4	3	1	3	3	2	-	-	-	2	2	3	1	2	1
CO5	3	1	1	3	3	-	-	-	2	3	3	3	1	3
CO	2.6	1.6	1.8	2.4	2	-	-	-	1.6	2	1.8	1.6	2.4	2

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22ITV46	GENERATIVE AI	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the basics of Generative AI.
- Know the basics of Text Generation.
- Understand the process of generating videos.
- Know about GAN and its variants.
- Understand and Apply Gen AI tools

UNIT I	INTELLIGENT AGENTS	9

Historical Overview of Generative modeling - Difference between Gen AI and Discriminative Modeling – Importance of generative models in AI and Machine Learning – Types of Generative models – GANs, VAEs, autoregressive models and Vector quantized Diffusion models - Understanding if probabilistic modeling and generative process - Challenges of Generative Modeling – Future of Gen AI – Ethical Aspects of AI – Responsible AI – Use Cases.

UNIT II	GENERATIVE MODELS FOR TEXT	9

Language Models Basics – Building blocks of Language models - Transformer Architecture – Encoder and Decoder – Attention mechanisms - Generation of Text – Models like BERT and GPT models – Generation of Text - Autoencoding – Regression Models – Exploring ChatGPT – Prompt Engineering – Designing Prompts– Revising Prompts using Reinforcement Learning from Human Feedback (RLHF) - Retrieval Augmented Generation – Multimodal LLM – Issues of LLM like hallucination

UNIT III	GENERATION OF IMAGES	9

Introduction to Generative Adversarial Networks – Adversarial Training Process – Nash Equilibrium – Variational Autoencoders – Encoder-Decoder Architectures - Stable Diffusion Models – Introduction to Transformer-based Image Generation – CLIP – Visual Transformers ViT- Dall-E2 and Dall-E3, GPT-4V – Issues of Image Generation models like Mode Collapse and Stability.

UNIT IV	GENERATION OF PAINTING, MUSIC, AND PLAY	9

Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution

UNIT V	OPEN SOURCE MODELS AND PROGRAMMING FRAMEWORKS	9

Training and Fine tuning of Generative models – GPT4All - Transfer learning and Pretrained models - Training vision models – Google Copilot - Programming LLM – LangChain – Open Source Models – Llama - Programming for TimeSformer – Deployment – Hugging Face.

TOTAL: 45 PERIODS

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TEXT BOOKS:	
1	Denis Rothman, —Transformers for Natural Language Processing and Computer Vision‖, Third Edition , Packt Books, 2024
REFERENCES:	
1	David Foster, ‖Generative Deep Learning‖, O'Reily Books, 2024
2	Altaf Rehmani, —Generative AI for Everyone‖, BlueRose One, 2024.

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Course name: GENERATIVE AI		Course code: 22ITV46			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the concepts of Generative Modeling.	**I**	K3	1,2,3,4,5, 6,8,9,12	1,2
CO2	Apply Gen AI to Generating Texts.	**II**	K4	1,2,3,4,5, 6,8,9,12	1,2
CO3	Understand and Apply Gen AI for generating video.	**III**	K5	1,2,3,4,5, 6,8,9,12	1,2
CO4	Understand and Apply Gen AI for generating video.	**IV**	K6	1,2,3,4,5, 6,8,9,12	1,2
CO5	Apply Open Source Tools for solving problems using Gen AI.	**V**	K6	1,2,3,4,5, 6,8,9,12	1,2

CO-PO-PSO Mapping

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

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22ITV47	OPTIMIZATION TECHNIQUES	L	T	P	C
		2	0	2	3

Course Objectives:

- Formulate and solve linear programming problems (LPP)
- Evaluate Integer Programming Problems, Transportation and Assignment Problems.
- Obtain a solution to network problems using CPM and PERT techniques.
- Able to optimize the function subject to the constraints.
- Identify and solve problems under Markovian queuing models.

UNIT I	LINEAR MODELS	6

Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods to solve LPP- Simplex Method- Two-Phase method

UNIT II	INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS	6

Integer programming: Branch and bound method- Transportation and Assignment problems - Traveling salesman problem.

UNIT III	PROJECT SCHEDULING	6

Project network -Diagram representation – Floats - Critical path method (CPM) – PERT- Cost considerations in PERT and CPM

UNIT IV	CLASSICAL OPTIMIZATION THEORY	6

Unconstrained problems – necessary and sufficient conditions - Newton-Rapson method, Constrained problems – equality constraints – inequality constraints - Kuhn-Tucker conditions.

UNIT V	QUEUING MODELS	6

Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels.

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Solving simplex maximization problems using R programming. 2. Solving simplex minimization problems using R programming. 3. Solving mixed constraints problems – Big M & Two phase method using TORA. 4. Solving transportation problems using R. 5. Solving assignment problems using R. 6. Solving optimization problems using LINGO. 7. Studying Primal-Dual relationships in LP using TORA. 8. Solving LP problems using dual simplex method using TORA. 9. Sensitivity & post optimality analysis using LINGO. 10. Solving shortest route problems using optimization software 11. Solving Project Management problems using optimization software 12. Testing random numbers and random variates for their uniformity. 13. Testing random numbers and random variates for their independence 14. Solve single server queuing model using simulation software package. 15. Solve multi server queuing model using simulation software package.	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.
2	ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4th Edition, 2011.
REFERENCES:	
1	J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5th Edition, 2012.
2	Hiller F.S, Liberman G.J, Introduction to Operations Research, 10th Edition McGraw Hill, 2017.
3	Jit. S. Chandran, Mahendran P. Kawatra, KiHoKim, Essentials of Linear Programming, Vikas Publishing House Pvt.Ltd. New Delhi, 1994.
4	Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2nd Edition, 2007.

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Course name: OPTIMIZATION TECHNIQUES		**Course code: 22ITV47**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Formulate and solve linear programming problems (LPP)	**I**	K3	1,2,3,4,5, 9,10,11,1 2	1,2
CO2	Evaluate Integer Programming Problems, Transportation and Assignment Problems.	**II**	K4	1,2,3,4,5, 9,10,11,1 2	1,2
CO3	Obtain a solution to network problems using CPM and PERT techniques.	**III**	K5	1,2,3,4,5, 9,10,11,1 2	1,2
CO4	Able to optimize the function subject to the constraints.	**IV**	K6	1,2,3,4,5, 9,10,11,1 2	1,2
CO5	Identify and solve problems under Markovian queuing models	**V**	K6	1,2,3,4,5, 9,10,11,1 2	1,2

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1	1	-	-	-	2	1	1	2	3	3
CO2	3	1	2	2	3	-	-	-	3	2	3	1	2	1
CO3	2	3	3	2	2	-	-	-	3	3	1	3	1	3
CO4	2	2	1	1	3	-	-	-	2	1	3	1	2	1
CO5	2	1	1	3	2	-	-	-	3	3	1	3	3	2
CO	2.4	2	1.8	1.8	2.2	-	-	-	2.6	2	1.8	2	2.2	2

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22ITV48	GAME THEORY	L	T	P	C
		2	0	2	3

Course Objectives:

- To introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets.
- To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in 41odelIing applications.
- To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.
- To introduce contemporary topics in the intersection of game theory, computer science, and economics.
- To apply game theory in searching, auctioning and trading.

UNIT I	INTRODUCTION	6

Introduction — Making rational choices: basics of Games — strategy — preferences — payoffs — Mathematical basics — Game theory — Rational Choice — Basic solution concepts-non-cooperative versus cooperative games — Basic computational issues — finding equilibria and learning in games- Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets).

UNIT II	GAMES WITH PERFECT INFORMATION	6

Games with Perfect Information — Strategic games — prisoner's dilemma, matching pennies - Nash equilibria —mixed strategy equilibrium — zero-sum games

UNIT III	GAMES WITH IMPERFECT INFORMATION	6

Games with Imperfect Information — Bayesian Games — Motivational Examples — General Definitions— Information aspects — Illustrations — Extensive Games with Imperfect — Information — Strategies — Nash Equilibrium —Repeated Games — The Prisoner's Dilemma — Bargaining

UNIT IV	NON-COOPERATIVE GAME THEORY	6

Non-cooperative Game Theory — Self-interested agents — Games in normal form — Analyzing games: from optimality to equilibrium — Computing Solution Concepts of Normal — Form Games— Computing Nash equilibria of two-player, zero-sum games —Computing Nash equilibria of two- player, general- sum games — Identifying dominated strategies

UNIT V	MECHANISM DESIGN	6

Aggregating Preferences — Social Choice — Formal Model — Voting — Existence of social functions — Ranking systems — Protocols for Strategic Agents: Mechanism Design — Mechanism design with unrestricted preferences

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Prisoner's dilemma 2. Pure Strategy Nash Equilibrium 3. Extensive Form – Graphs and Trees, Game Trees 4. Strategic Form – Elimination of dominant strategy 5. Minimax theorem, minimax strategies 6. Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium, 7. Imperfect-information games - Mixed Strategy Nash Equilibrium - Finding mixed-strategy Nash equilibria for zero sum games, mixed versus behavioral strategies. 8. Repeated Games 9. Bayesian Nash equilibrium	
	TOTAL: 60 PERIODS

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TEXT BOOKS:	
1	M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.
2	M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
3	N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2007.
REFERENCES:	
1	A.Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.
2	YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008.
3	Zhu Han, DusitNiyato, WalidSaad, TamerBasar and Are Hjorungnes, —Game Theory in Wireless and Communication Networks‖, Cambridge University Press, 2012.
4	Y.Narahari, —Game Theory and Mechanism Design‖, IISC Press, World Scientific.

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Course name: GAME THEORY				Course code: 22ITV48	
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.	**I**	K3	1,2,3,4,5	1,2
CO2	Discuss the use of Nash Equilibrium for other problems.	**II**	K4	1,2,3,4,5	1,2
CO3	Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.	**III**	K5	1,2,3,4,5	1,2
CO4	Identify some applications that need aspects of Bayesian Games.	**IV**	K6	1,2,3,4,5	1,2
CO5	Implement a typical Virtual Business scenario using Game theory.	**V**	K6	1,2,3,4,5	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	-	-	-	-	-	-	-	1	1
CO2	3	3	3	2	3	-	-	-	-	-	-	-	1	1
CO3	1	1	3	3	3	-	-	-	-	-	-	-	1	1
CO4	2	1	1	1	1	-	-	-	-	-	-	-	1	1
CO5	2	2	3	2	1	-	-	-	-	-	-	-	1	1
CO	2.2	2	2.4	2.2	2.2	-	-	-	-	-	-	-	1	1

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22ITV49	COGNITIVE SCIENCE	L	T	P	C
		2	0	2	3

Course Objectives:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition.

UNIT I	PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE	6

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

UNIT II	COMPUTATIONAL INTELLIGENCE	6

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

UNIT III	PROBABILISTIC PROGRAMMING LANGUAGE	6

Web PPL Language – Syntax – Using Java script Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Co routines: Functions that receive continuations –Enumeration

UNIT IV	INFERENCE MODELS OF COGNITION	6

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

UNIT V	LEARNING MODELS OF COGNITION	6

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

TOTAL: 30 PERIODS

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PRACTICAL EXCERCISES	30 PERIODS
1. Demonstration of Mathematical functions using Web PPL. 2. Implementation of reasoning algorithms. 3. Developing an Application system using generative model. 4. Developing an Application using conditional inference learning model. 5. Application development using hierarchical model. 6. Application development using Mixture model.	
	TOTAL: 60 PERIODS

TEXT BOOKS:	
1	Vijay V Raghavan,VenkatN.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
2	Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015
3	Robert A. Wilson, Frank C. Keil, —The MIT Encyclopedia of the Cognitive Sciences‖,The MIT Press, 1999.
REFERENCES:	
1	Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020
2	Noah D. Goodman, Andreas Stuhlmuller, —The Design and Implementation of Probabilistic Programming Languages‖, Electronic version of book, https://dippl.org/.
3	Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, —Probabilistic Models of Cognition‖, Second Edition, 2016, https://probmods.org/.

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Course name: COGNITIVE SCIENCE		Course code: 22ITV49			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Understand the underlying theory behind cognition.	**I**	K3	1,2,3,4,5, 9,10,11,1 2	1,2
CO2	Connect to the cognition elements computationally.	**II**	K5	1,2,3,4,5, 9,10,11,1 2	1,2
CO3	Implement mathematical functions through WebPPL.	**III**	K6	1,2,3,4,5, 9,10,11,1 2	1,2
CO4	Develop applications using cognitive inference model.	**IV**	K6	1,2,3,4,5, 9,10,11,1 2	1,2
CO5	Develop applications using cognitive learning model.	**V**	K6	1,2,3,4,5, 9,10,11,1 2	1,2

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	2	-	-	-	1	1	2	2	1	2
CO2	2	2	1	1	2	-	-	-	3	2	3	1	2	3
CO3	1	3	1	3	3	-	-	-	1	3	1	3	3	1
CO4	2	1	1	2	3	-	-	-	1	2	3	1	3	3
CO5	1	2	3	2	2	-	-	-	1	2	2	2	2	2
CO	1.8	1.8	1.8	2	2.4	-	-	-	1.4	2	2.2	1.8	2.2	2.2

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