GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.Tech. INFORMATION TECHNOLOGY

2018 A REGULATIONS : VERTICALS CURRICULA AND SYLLABI

Vertical I Data Science	**Vertical II Full Stack Development for IT**	**Vertical III Cloud Computing and Data Centre Technologies**	**Vertical IV Cyber Security and Data Privacy**	**Vertical V Creative Media**	**Vertical VI Artificial Intelligence and Machine Learning**
18IPE$31 - Exploratory Data Analysis (Common to CSE & IT)	18IPE$10 - Cloud Computing	18IPE$10 - Cloud Computing	18IPE$49 -Ethical Hacking (Common to CSE & IT)	18IPE$20 - Virtual and Augmented Reality	18IPE$61 - Knowledge Engineering
18IPE$32 - Recommender Systems (Common to CSE & IT)	18IPE$39 -App Development (Common to CSE & IT)	18IPE$18 - Virtualization Techniques	18IPE$50 -Digital and Mobile Forensics (Common to CSE & IT)	18IPE$55 - Multimedia and Animation	18IPE$14 -Soft Computing and its Applications
18IPE$33 - Neural Networks and Deep Learning	18IPE$40 - Cloud Services Management	18IPE$40 - Cloud Services Management	18IPE$51 - Social Network Security (Common to CSE & IT)	18IPE$56 - Video Creation and Editing	18IPE$33 - Neural Networks and Deep Learning
18IPE$34 - Text and Speech Analysis	18IPE$41 - UI and UX Design (Common to CSE & IT)	18IPE$45 - Data Warehousing	18IPE$52 -Modern Cryptography (Common to CSE & IT)	18IPE$41 - UI and UX Design (Common to CSE & IT)	18IPE$34 - Text and Speech Analysis
18IPE$35 -Business Analytics	18IPE$03 - Software Testing	18IPE$46 -Storage Technologies	18IPE$53 - Engineering Secure software systems	18IPE$57 - Digital marketing	18IPE$62 - Optimization Techniques and Applications
18IPE$36 - Image and video analytics	18IPE$42 - Web Application Security (Common to CSE & IT)	18IPE$28 - Software Defined Networking	18IPE$54 - Cryptocurrency and Blockchain Technologies (Common to CSE & IT)	18IPE$58 - Visual Effects	18IPE$63 - Game Theory (Common to CSE & IT)
18IPE$37 - Computer Vision and Applications	18IPE$43 - Dev-ops (Common to CSE & IT)	18IPE$47 - Stream Processing	18IPE$12 - Information Security (Common to CSE & IT)	18IPE$59 - Game Development	18IPE$64 - Cognitive Science (Common to CSE & IT)
18IPE$38 - Big Data Science and Analytics	18IPE$44 - Principles of Programming Languages (Common to CSE & IT)	18IPE$48 - Security and Privacy in Cloud (Common to CSE & IT)	18IPE$48 - Security and Privacy in Cloud (Common to CSE & IT)	18IPE$60 - Multimedia Data Compression and Storage	18IPE$65 - Ethics And AI (Common to CSE & IT)

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.Tech. INFORMATION TECHNOLOGY
CBCS 2018 REGULATIONS

Verticals – I

DATA SCIENCE

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18IPE$31	Exploratory Data Analysis (Common to CSE & IT)	PE	40	60	100	3	0	0	3
2	18IPE$32	Recommender Systems (Common to CSE & IT)	PE	40	60	100	3	0	0	3
3	18IPE$33	Neural Networks and Deep Learning	PE	40	60	100	3	0	0	3
4	18IPE$34	Text and Speech Analysis	PE	40	60	100	3	0	0	3
5	18IPE$35	Business Analytics	PE	40	60	100	3	0	0	3
6	18IPE$36	Image and video analytics	PE	40	60	100	3	0	0	3
7	18IPE$37	Computer Vision and Applications	PE	40	60	100	3	0	0	3
8	18IPE$38	Big Data Science and Analytics	PE	40	60	100	3	0	0	3

Verticals – II

FULL STACK DEVELOPMENT FOR IT

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18IPE$10	Cloud Computing	PE	40	60	100	3	0	0	3
2	18IPE$39	App Development (Common to CSE & IT)	PE	40	60	100	3	0	0	3
3	18IPE$40	Cloud Services Management	PE	40	60	100	3	0	0	3
4	18IPE$41	UI and UX Design (Common to CSE & IT)	PE	40	60	100	3	0	0	3
5	18IPE$03	Software Testing	PE	40	60	100	3	0	0	3
6	18IPE$42	Web Application Security (Common to CSE & IT)	PE	40	60	100	3	0	0	3
7	18IPE$43	Dev-ops (Common to CSE & IT)	PE	40	60	100	3	0	0	3
8	18IPE$44	Principles of Programming Languages (Common to CSE & IT)	PE	40	60	100	3	0	0	3

Verticals – III

CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18IPE$10	Cloud Computing	PE	40	60	100	3	0	0	3
2	18IPE$18	Virtualization Techniques	PE	40	60	100	3	0	0	3
3	18IPE$40	Cloud Services Management	PE	40	60	100	3	0	0	3
4	18IPE$45	Data Warehousing	PE	40	60	100	3	0	0	3
5	18IPE$46	Storage Technologies	PE	40	60	100	3	0	0	3
6	18IPE$28	Software Defined Networking	PE	40	60	100	3	0	0	3
7	18IPE$47	Stream Processing	PE	40	60	100	3	0	0	3
8	18IPE$48	Security and Privacy in Cloud (Common to CSE & IT)	PE	40	60	100	3	0	0	3

Verticals – IV

CYBER SECURITY AND DATA PRIVACY

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18IPE$49	Ethical Hacking (Common to CSE & IT)	PE	40	60	100	3	0	0	3
2	18IPE$50	Digital and Mobile Forensics (Common to CSE & IT)	PE	40	60	100	3	0	0	3
3	18IPE$51	Social Network Security (Common to CSE & IT)	PE	40	60	100	3	0	0	3
4	18IPE$52	Modern Cryptography (Common to CSE & IT)	PE	40	60	100	3	0	0	3
5	18IPE$53	Engineering Secure software systems	PE	40	60	100	3	0	0	3
6	18IPE$54	Cryptocurrency and Blockchain Technologies (Common to CSE & IT)	PE	40	60	100	3	0	0	3
7	18IPE$12	Information Security	PE	40	60	100	3	0	0	3
8	18IPE$48	Security and Privacy in Cloud	PE	40	60	100	3	0	0	3

Verticals – V

CREATIVE MEDIA

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18IPE$20	Virtual and Augmented Reality	PE	40	60	100	3	0	0	3
2	18IPE$55	Multimedia and Animation	PE	40	60	100	3	0	0	3
3	18IPE$56	Video Creation and Editing	PE	40	60	100	3	0	0	3
4	18IPE$41	UI and UX Design	PE	40	60	100	3	0	0	3
5	18IPE$57	Digital marketing	PE	40	60	100	3	0	0	3
6	18IPE$58	Visual Effects	PE	40	60	100	3	0	0	3
7	18IPE$59	Game Development	PE	40	60	100	3	0	0	3
8	18IPE$60	Multimedia Data Compression and Storage	PE	40	60	100	3	0	0	3

Verticals – VI

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18IPE$61	Knowledge Engineering	PE	40	60	100	3	0	0	3
2	18IPE$14	Soft Computing and its Applications	PE	40	60	100	3	0	0	3
3	18IPE$33	Neural Networks and Deep Learning	PE	40	60	100	3	0	0	3
4	18IPE$34	Text and Speech Analysis	PE	40	60	100	3	0	0	3
5	18IPE$62	Optimization Techniques and Applications	PE	40	60	100	3	0	0	3
6	18IPE$63	Game Theory (Common to CSE & IT)	PE	40	60	100	3	0	0	3
7	18IPE$64	Cognitive Science (Common to CSE & IT)	PE	40	60	100	3	0	0	3
8	18IPE$65	Ethics And AI (Common to CSE & IT)	PE	40	60	100	3	0	0	3

VERTICAL – I

DATA SCIENCE

18IPE$31	**EXPLORATORY DATA ANALYSIS** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To understand the representations and operations in descriptive statistics. 2. To learn the basics of inferential statistics and sampling distribution. 3. To learn the estimation of parameters using basic tests and hypotheses test. 4. To perform t-test for one sample and two independent sample. 5. To perform different test for analysis of variance

UNIT – I	**DESCRIPTIVE STATISTICS**	**(9 Periods)**
Frequency distribution for quantitative and qualitative data – Graph for quantitative and qualitative data – normal distributions and standard (z) scores – correlation – regression.		
UNIT – II	**INFERENTIAL STATISTICS**	**(9 Periods)**
Populations – samples – random sampling – probability and statistics Sampling distribution – creating a sampling distribution – mean of all sample means – standard error of the mean – Hypothesis testing – z-test – z-test procedure – statement of the problem – null hypothesis – alternate hypotheses – decision rule – calculations – decisions – interpretations.		
UNIT – III	**INFERENTIAL STATISTICS CONTINUED**	**(9 Periods)**
Need for hypothesis tests – Strong or weak decisions – one-tailed and two-tailed tests – case studies - Influence of sample size – power and sample size Estimation – point estimate – confidence interval – level of confidence – effect of sample size.		
UNIT – IV	**T-TEST**	**(9 Periods)**
t-test for one sample – sampling distribution of t – t-test procedure – degrees of freedom – estimating the standard error –t-test for two independent samples – statistical hypotheses – sampling distribution – test procedure – p-value – statistical significance – estimating effect size – meta analysis -t-test for two related samples.		
UNIT – V	**ANALYSIS OF VARIANCE**	**(9 Periods)**
F-test – ANOVA – estimating effect size – multiple comparisons – case studies Analysis of variance with repeated measures - Two-factor experiments – three f-tests – two-factor ANOVA – other types of ANOVA - Introduction to chi-square tests.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Robert S. Witte and John S. Witte,* ***"Statistics",*** *11th Edition, Wiley Publications, 2017.*

REFERENCES:

1	*Allen B. Downey,* ***"Think Stats: Exploratory Data Analysis in Python"****, Green Tea Press, 2014*
2	*Peter Bruce, Andrew Bruce, and Peter Gedek,* ***"Practical Statistics for Data Scientists",*** *2nd Edition, O'Reilly Publishers, 2020*
3	*Bradley Efron and Trevor Hastie,* ***"Computer Age Statistical Inference"****, Cambridge University Press, 2016*
4	*Charles R. Severance,* ***"Python for Everybody: Exploring Data in Python 3"****, Shroff Publishers, 2017*
5	*David Spiegelhalter,* ***"The Art of Statistics: Learning from Data"****, Pelican Books, 2019.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the description and distribution of data. **(Understand)**
CO2	Understand the concept of sampling and derive hypothesis for data. **(Understand)**
CO3	Perform basic tests and hypotheses test for estimation of parameters. **(Understand)**
CO4	Apply t-test for one sample and two independent samples. **(Understand)**
CO5	Analyze the variance by applying different types of tests. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	H	H	H	L					L		L	M	L
CO2	H	H	H	H	L					L		L	M	L
CO3	H	H	H	H	L					L		L	M	L
CO4	H	M	M	M	L					L		L	M	L
CO5	H	M	M	M	L					L		L	M	L
18IPE$31	H	M	M	M	L							L	M	L
L –Low, M- Medium, H- High														

18IPE$32	**RECOMMENDER SYSTEMS** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To summarize the various types of recommendation systems. 2. To learn the content and knowledge based recommendations. 3. To Understand the hybrid recommendations and explanations 4. To familiarize various evaluating strategies to evaluate recommender systems. 5. To learn advanced recommender systems and their applications.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Basic concepts and recent developments – Collaborative recommendation –User based and Item based nearest neighbor recommendation, Rating, Model based and Preprocessing based approaches, Recent practical approaches and systems.		
UNIT – II	**CONTENT AND KNOWLEDGE BASED RECOMMENDATION**	**(9 Periods)**
Content representation and content similarity – Similarity based retrieval, Text classification methods, Knowledge representation, Interacting with constraints based recommender systems - Interacting with Case based recommender systems – Example applications.		
UNIT – III	**HYBRID RECOMMENDATIONS AND EXPLANATIONS**	**(9 Periods)**
Opportunities for hybridization – Monolithic hybridization design –Parallelized hybridization design –Pipelined hybridization design –Explanations in recommender systems – Explanations in collaborative filtering recommenders.		
UNIT – IV	**EVALUATING RECOMMENDER SYSTEMS**	**(9 Periods)**
Properties of evaluations – Popular evaluation designs –Evaluations on historical datasets – Alternative evaluation designs - Case study: Personalized game recommendations on the mobile Internet		
UNIT – V	**RECOMMENDER SYSTEMS AND THE NEXT-GENERATION WEB**	**(9 Periods)**
Trust-aware recommender systems- Folksonomies- Ontological filtering- Extracting semantics from the web- Recommendations in ubiquitous environments- Context-aware recommendation- Application domains.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*DietmarJannach, Markus Zanker, Alexander Felfernig, and Gerhard Friedrich,* ***"Recommender Systems An Introduction"****, CambrigeUniversity Press, 2011*
2	*Charu C. Aggarwal,* ***"Recommender Systems",*** *Springer, 2016.*

REFERENCES :

1	*Manouselis N, Drachsler H, Verbert K, Duval E,* ***"Recommender Systems For Learning"****, Springer, 2013*
2	*Ricci F, Rokach L, Shapira D, Kantor B.P,* ***"Recommender Systems Handbook"*** *Springer, 2015*
3	*Kim Falk,* ***"Practical Recommender Systems"****, Manning Publications, 2019.*
4	*Michael Schrage,* ***"Recommendation Engines"****, MIT Press, 2020.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1	Summarize various types of recommendation techniques. **(Familiarize)**
CO2	Compare content based recommendations and Knowledge based recommendations. **(Familiarize)**
CO3	Identify appropriate hybrid recommendation models for specific underlying applications. **(Understand)**
CO4	Assess the recommendations based on well-defined metrics. **(Analyze)**
CO5	Describe emerging applications based on Web 2.0 and Semantic Web technologies. **(Familiarize)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	H												
CO2	L	H	L											
CO3	L	M	L	H									M	
CO4	L	H	L	H									M	
CO5	L	M	L	H									M	
18IPE$32	L	H	L	M									M	
L –Low, M- Medium, H- High														

18IPE$33	NEURAL NETWORKS AND DEEP LEARNING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	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 autoencoders and generative models for suitable applications.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An IntroductionEvolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.		
UNIT – II	**ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS**	**(9 Periods)**
Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative 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**	**(9 Periods)**
Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.		
UNIT – IV	**DEEP FEEDFORWARD NETWORKS**	**(9 Periods)**
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**	**(9 Periods)**
Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville***, "Deep Learning"***, MIT Press, 2016
2	Francois Chollet, ***"Deep Learning with Python",*** Second Edition, Manning Publications, 2021.

REFERENCES :

1	Aurélien Géron***, "Hands-On Machine Learning with Scikit-Learn and TensorFlow"***, Oreilly, 2018
2	Josh Patterson, Adam Gibson, ***"Deep Learning: A Practitioner's Approach"***, O'Reilly Media, 2017.
3	Charu C. Aggarwal, ***"Neural Networks and Deep Learning: A Textbook"***, Springer International Publishing, 1st Edition, 2018.
4	Jojo Moolayil ***,"Learn Keras for Deep Neural Networks"***, Apress,2018
5	Vinita Silaparasetty , ***"Deep Learning Projects Using TensorFlow 2"***, Apress, 2020

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

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	M	H	M	H	L			M	L			M	L
CO2	H	L	M	L						L	M	M	L	L
CO3	H	H	H	H	H	L			M	L			H	L
CO4	H	H	H	H	H				M		M	H	H	L
CO5	L	L	H	M	H				M				M	L
18IPE$33	H	M	H	H	M	L			M	L	L	L	H	L
L –Low, M- Medium, H- High														

18IPE$34	TEXT AND SPEECH ANALYSIS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	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	
UNIT – I	**NATURAL LANGUAGE BASICS**	**(9 Periods)**
Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model		
UNIT – II	**TEXT CLASSIFICATION**	**(9 Periods)**
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		
UNIT – III	**QUESTION ANSWERING AND DIALOGUE SYSTEMS**	**(9 Periods)**
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		
UNIT – IV	**TEXT-TO-SPEECH SYNTHESIS**	**(9 Periods)**
Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems		
UNIT – V	**AUTOMATIC SPEECH RECOGNITION**	**(9 Periods)**
Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems		
Contact Periods: **Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

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.*

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	*. Steven Bird, Ewan Klein, and Edward Loper,* ***"Natural language processing with Python"****, O'REILLY.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Explain existing and emerging deep learning architectures for text and speech processing. **(Familiarize)**
CO2	Apply deep learning techniques for NLP tasks, language modelling and machine translation. **(Analyze)**
CO3	Explain coreference and coherence for text processing. **(Familiarize)**
CO4	Build question-answering systems, chatbots and dialogue systems. **(Analyze)**
CO5	Apply deep learning models for building speech recognition and text-to-speech systems. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	H	M	H	L	H				L	M	L	M	H	L
CO2	H	L	M	L	H				M	M	L	H	H	L
CO3	M	M	L	H	L				H	H	L	M	H	L
CO4	M	L	L	L	M				M	L	M	M	H	L
CO5	L	H	M	M	L				H	M	L	L	H	L
18IPE$34	M	M	M	M	M				M	M	L	M	H	L
L –Low, M- Medium, H- High														

18IPE$35	BUSINESS ANALYTICS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1.To understand the basics of business analytics 2. To explore and familiarize various descriptive analytic techniques 3. To explore and familiarize various predictive analytic techniques 4. To explore and familiarize various prescriptive analytic techniques 5. To understand the application of analytics in in decision making	
UNIT – I	**INTRODUCTION TO BUSINESS ANALYTICS**	**(9 Periods)**
Evolution of Business Analytics - Descriptive, Predictive, and Prescriptive Analytics - Data for Business Analytics - Models in Business Analytics - Problem Solving with Analytics – database analytics - Data Sets and Databases - Data Queries: Tables, Sorting, and Filtering - Logical Functions - Lookup Functions for Database Queries.		
UNIT – II	**DESCRIPTIVE ANALYTICS**	**(9 Periods)**
Descriptive Statistics - Metrics and Data Classification - Frequency Distributions and Histograms- Computing Descriptive Statistics for Frequency Distributions - Random Variables and Probability Distributions - Discrete Probability Distributions - Continuous Probability Distributions - Data Modeling and Distribution Fitting - Sampling and Estimation - Statistical Inference		
UNIT – III	**PREDICTIVE ANALYTICS**	**(9 Periods)**
Modeling Relationships and Trends in Data - Residual Analysis and Regression Assumptions - Multiple Linear Regression - Forecasting Techniques - Spreadsheet Modeling and Analysis - Model-Building Strategies - Descriptive Spreadsheet Models - Predictive Spreadsheet Models - Prescriptive Spreadsheet Models - Monte Carlo Simulation - Monte Carlo Simulation in Excel - Dynamic Systems Simulation.		
UNIT – IV	**PRESCRIPTIVE ANALYTICS**	**(9 Periods)**
Optimization Models - Developing Linear Optimization Models - Solving Linear Optimization Models - Integer Linear Optimization Models - Nonlinear Optimization Models - Non-Smooth Optimization - What-If Analysis for Optimization Models - What-If Analysis for Integer Optimization Models.		
UNIT – V	**DECISION MAKING**	**(9 Periods)**
Formulating Decision Problems - Decision Strategies without Outcome Probabilities - Decision Strategies with Outcome Probabilities - Decision Trees - The Value of Information - Decisions with Sample Information - Utility and Decision Making.		
Contact Periods: **Lecture: 45Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*James R. Evans,* ***"Business Analytics - Methods, models and decisions"****, Pearson Education, 3rd Edition, 2020.*

REFERENCES:

1	*R N Prasad, Seema Acharya,* ***"Fundamentals of Business Analytics"****, Wiley publisher, 2nd Edition, 2016.*
2	*G.Shainesh Philip Kotler, Kevin lane Keller, Alexander Chernev, Jagdish N. Sheth,* ***"Marketing Management"****, Pearson Education,16th Edition,2021.*
3	*KavithaVenkatachari,* ***"Fundamentals of Business Analytics Using Excel And R: Practical Manual For Beginners"****, Shroff Publishers, 2016.*
4	*U. Dinesh Kumar,* ***"Business Analytics, 2ed: The Science of Data - Driven Decision Making",*** *wiley publishers, 2nd edition, 2021.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the basics of business analytics **(Understand)**
CO2	Apply different descriptive techniques for business analytics**. (Familiarize)**
CO3	Apply different predictive techniques for business analytics **(Familiarize)**
CO4	Adopt different prescriptive techniques for business analytics. **(Analyze)**
CO5	Analyze the data to infer decisions using different decision making techniques. **(Analyze)**

COURSE ARTICULATION MATRIX :

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L		L	L					L	H	L
CO2	M	M	L	M	L	L	L				L	L	M	L
CO3	M	M	L	M	L	L	L				L	L	M	L
CO4	M	M	L	M	L	L	L				L	L	M	L
CO5	H	H	M	H	M	L	L				L	L	M	L
18IPE$35	**M**	**M**	**L**	**M**	**M**	**L**	**L**				**L**	**L**	**M**	**L**
L –Low, M- Medium, H- High														

18IPE$36	IMAGE AND VIDEO ANALYTICS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To understand fundamental image processing techniques and their applications 2. To familiarize with image analysis techniques. 3. To learn about video processing techniques and understand the video standards. 4. To understand about motion estimation algorithms. 5. To appreciate various techniques used for segmentation and tracking for analysis video data	
UNIT – I	**FUNDAMENTALS OF IMAGE PROCESSING**	**(9 Periods)**
Introduction – Steps in Image Processing - Applications –Elements of Visual Perception –Image Formation models - Sampling and Quantization – Image Enhancement in spatial and Frequency Domain - Image Transforms: DFT, FFT, DCT		
UNIT – II	**IMAGE SEGMENTATION AND FEATURE EXTRACTION**	**(9 Periods)**
Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification – Object Recognition		
UNIT – III	**VIDEO FUNDAMENTALS**	**(9 Periods)**
Basic Concepts and Terminology – Analog Video Standards – Digital Video Basics – Analog to Digital Conversion – Sampling for analog and digital video – Rectangular and periodic 2-D sampling – Video Sampling Rate and Standards Conversion – Digital Video Formats – Video Features		
UNIT – IV	**MOTION ESTIMATION**	**(9 Periods)**
Fundamentals of Motion Estimation – Optical Flow Methods – 2D and 3D Motion Estimation – Block Based Methods - Point Correspondences Methods – Bayesien Methods –Frequency Domain Motion Estimation.		
UNIT – V	**VIDEO SEGMENTATION AND ANALYTICS**	**(9 Periods)**
Video Segmentation – Video Shot Boundary Detection – Motion Segmentation: Direct and Optical Flow method – Stereo and Motion Tracking – Kalman, Particle Filter based tracking - Multi-target/Multi-camera tracking		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Rafael Gonzalez, Richard E. Woods,* ***"Digital Image Processing"****, Fourth Edition, Pearson Education, 2018.*
2	*A. Murat Tekalp,* ***"Digital Video Processing"****, Second Edition, Prentice Hall, 2015.*

REFERENCES:

1	*Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,* ***"Digital Image Processing using MATLA"****, Pearson Education, Inc., 2011.*
2	*Milan Sonka, Vaclav Hlavac, Roger Boyle,* ***"Image Processing, Analysis and Machine Vision"****, Second Edition, Thompson Learning, 2007*
3	*Oges Marques,* ***"Practical Image and Video Processing Using MATLAB",*** *Wiley and Sons (IEEE Press), 2011*
4	*Alan C. Bovik,* ***"Handbook of Image and Video processing"****, Second Edition, Academic Press, 2005*
5	*Al Bovik (Alan C Bovik,* ***"The Essential Guide to Video Processing",*** *Academic Press, Second Edition, 2009*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms. **(Understanding)**
CO2	Analyze the various Image segmentation and feature extraction methods. **(Analyze)**
CO3	Analyze and implement the basic video processing algorithms in modern technologies. **(Familiarize)**
CO4	Analyze the approaches for identifying and tracking objects and person with motion based algorithms. **(Analyze)**
CO5	Segment video based on its features. **(Familiarize)**

COURSE ARTICULATION MATRIX :

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	3	L	L	L	L				L		L	M	L
CO2	M	H	L	L	L	L				L		L	M	L
CO3	H	H	M	M	L	L				L		L	H	L
CO4	M	H	M	M	M	L				L		L	H	L
CO5	H	H	M	M	M	L				L		L	H	L
18IPE$36	**M**	**H**	**M**	**M**	**L**	**L**				**L**		**L**	**H**	**L**
L –Low, M- Medium, H- High														

18IPE$37	COMPUTER VISION AND APPLICATIONS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To learn the basics of images, formation of images and transforms. 2. To learn recognition techniques, techniques for detection of different features and matching. 3. To learn about motion estimation approaches and computational photography. 4. To familiarize techniques related to 3D reconstruction and image-based rendering. 5. To learn applications of computer vision algorithms in different domains.

UNIT – I	**IMAGE FORMATION AND PROCESSING**	**(9 Periods)**
Geometric primitives – Photometric image formation – The digital camera: sampling and aliasing – Point operators: Pixel transforms, color transforms – separable filtering – two dimensional Fourier transforms – interpolation – decimation – mesh-based warping.		
UNIT – II	**RECOGNITION, FEATURE DETECTION AND MATCHING**	**(9 Periods)**
Instance recognition – feature based image classification methods – Face recognition – General object detection – instance segmentation – panoptic segmentation – Feature detectors and descriptors – large scale matching and retrieval – edge detection – successive approximation and hough transforms – graph based segmentation.		
UNIT – III	**MOTION ESTIMATION AND COMPUTATIONAL PHOTOGRAPHY**	**(9 Periods)**
Hierarchical motion estimation – Fourier based alignment – spline based motion – deep learning approaches – multi-frame motion estimation – Photometric calibration – Tone mapping – color image demosaicing – natural image matting - image matting.		
UNIT – IV	**3D RECONSTRUCTION, IMAGE - BASED RENDERING**	**(9 Periods)**
Shape from X – range data merging – surface representations – model based reconstruction: architecture, facial modelling and tracking – Estimating BRDFs – view dependent texture maps – Imposters, sprites and layers – environment mattes – Video based animation – video textures – 3D and free viewpoint video.		
UNIT – V	**APPLICATIONS**	**(9 Periods)**
Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, ObjectRecognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Richard Szeliski,* ***"Computer Vision: Algorithms and Applications"****, SpringerNature Switzerland AG,2nd Edition, 2022*

REFERENCES :

1	*Simon J. D. Prince,* ***"Computer Vision: Models, Learning, and Inference"****, Cambridge University Press, 2012*
2	*Mark S. Nixon, Alberto S. Aquado,* ***"Feature Extraction & Image Processing for ComputerVision",*** *4th Edition, Academic Press, 2020.*
3	*E. R. Davies,* ***"Computer & Machine Vision, Theory, Algorithms, Practicalities"****, 4th Edition, Academic Press, 2012*
4	*ReinhardKlette,* ***"Concise Computer Vision: An Introduction into Theory and lgorithms",*** *Springer Verlag London, 2014.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the basics of image formation and different types of transforms. **(Understand)**
CO2	Apply object recognition techniques, feature detection techniques and matching. **(Familiarize)**
CO3	Apply algorithms for motion estimation techniques and computational photography. **(Familiarize)**
CO4	Apply techniques for 3D reconstruction and image based rendering. **(Familiarize)**
CO5	Analyze the application of computer vision algorithms in different domains. **(Analyze)**

COURSE ARTICULATION MATRIX :

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L	L	L	L						L	L
CO2	M	M	M	M	L	L	L				L	L	M	L
CO3	M	M	M	M	L	L	L				L	L	M	L
CO4	M	M	M	M	L	L	L				L	L	M	L
CO5	M	M	M	M	L	L	L				L	L	M	L
18IPE$37	**M**	**M**	**M**	**M**	**L**	**L**	**L**				**L**	**L**	**M**	**L**
L –Low, M- Medium, H- High														

18IPE$38	BIG DATA SCIENCE AND ANALYTICS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To understand the basics and application areas of big data and analytics 2. To learn different data storage and management models in big data management. 3. To learn the HADOOP distributed file system and its input/output interfacing 4. To familiarize map reduce technique and its application in processing big data. 5. To learn different tools that support processing of big data.

UNIT – I	**INTRODUCTION TO BIG DATA**	**(9 Periods)**

Big data and its importance – digital marketing and non-line world –Big data and the marketing – Fraud and risk in big data – Big data and algorithmic trading – Big data in healthcare and medicine – advertising and big data – old and new approaches – open source technology for big data analytics – The cloud and big data – crowdsourcing analytics.

UNIT – II	**NoSQL DATA MANAGEMENT**	**(9 Periods)**

Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – sharding – master-slave replication – sharding and replication – consistency –version stamps.

UNIT – III	**HADOOP DISTRIBUTED FILE SYSTEM AND I/O**	**(9 Periods)**

Design of HDFS – HDFS concepts – Command line interface – HADOOP file system interface - Data flow – Data Ingest with Flume and sqoop-HADOOP archives – Hadoop I/O – Compression – Serialization – Avro and file based data structures.

UNIT – IV	**MAP REDUCE**	**(9 Periods)**

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

UNIT – V	**HADOOP ECO SYSTEM**	**(9 Periods)**

Pig: execution modes, comparison with databases, grunt, pig latin, user defined functions, data processing operators – Hbase: concepts, clients, example, comparison with RDBMS – Hive: : Shell, Services, Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying, Data and User Defined Functions

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

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	*Lena Wiese,****"Advanced data management: for SQL, NOSQL, cloud and distributed databases"****, walter-de-gruyter, 2015.*

REFERENCES :

1	*Tom White,**"Hadoop: The Definitive Guide"**, Shroff/O'Reilly, 4th edition, 2015.*
2	*ArvindSathi, **"BigDataAnalytics: Disruptive Technologies for Changing the Game"**, MC Press, 2012.*
3	*Eric Sammer, **"Hadoop Operations"**, O'Reilley, 2nd edition, 2015.*
4	Seema Acharya, SubhasiniChellappan, **"Big Data and Analytics"**, 2nd edition, Wiley 2019.
5	*Lars George, **"HBase: The Definitive Guide"**, O'Reilley, 2011.*
6	*Alan Gates, **"Programming Pig"**, O'Reilley, 2011*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the basic concepts and applications of big data and analytics. **(Understand)**
CO2	Adopt right data storage and technique for big data management. **(Analyze)**
CO3	Apply HADOOP distributed file system for big data management. **(Familiarize)**
CO4	Apply Map reduce technique for processing in big data from hadoop clusters. **(Familiarize)**
CO5	Adopt and apply different supportive tools in big data analytics. **(Analyze)**

COURSE ARTICULATION MATRIX :

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO 10**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L	L	L							L	L
CO2	M	M	M	L	M	L							M	L
CO3	M	M	M	L	H	L		L	L		L	M	M	L
CO4	M	M	M	L	H	L		L	L		L	M	M	L
CO5	M	M	M	L	H	L		L	L		L	M	M	L
18IPE$38	M	M	M	L	H	L		L	L		L	M	M	L
L –Low, M- Medium, H- High														

VERTICALS – II

FULL STACK DEVELOPMENT FOR IT

18IPE$10	CLOUD COMPUTING

PRE-REQUISITES	CATEGORY	L	T	P	C
Data Communication and Networking	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, * Overview of computing Paradigm. * Cloud computing architecture and its service models. * Representation of virtualization concepts. * Intensive computation in Cloud computing. * Applications and management of cloud computing

UNIT – I	**INTRODUCTION**	**(9 Periods)**
Principles of Parallel and Distributed Computing - Eras of Computing - Parallel vs. Distributed Computing - Hardware Architectures for Parallel Processing - Approaches to Parallel Programming - Levels of Parallelism - Distributed System - Technologies for Distributed Computing - Remote Procedure Call - Distributed Object Frameworks - Service Oriented Computing Cloud Computing Reference Model - Historical Developments - Building Cloud Computing Environments- Application Development - Infrastructure and System Development - Computing Platforms and Technologies.		
UNIT – II	**CLOUD COMPUTING ARCHITECTURE**	**(9 Periods)**
Introduction - Cloud Reference Model – Architecture - Infrastructure / Hardware as a Service - Platform as a Service - Software as a Service- Types of Clouds - Public Clouds - Private Clouds - Hybrid Clouds - Community Clouds- Open Challenges - Cloud Definition - Cloud Interoperability and Standards - Scalability and Fault Tolerance - Security- Trust- and Privacy - Organizational Aspects.		
UNIT – III	**VIRTUALIZATION**	**(9 Periods)**
Introduction - Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques - Execution Virtualization - Other Types of Virtualization - Virtualization and Cloud Computing - Pros and Cons of Virtualization - Xen- Paravirtualization- VMware- Full Virtualization - Microsoft Hyper-V.		
UNIT – IV	**DATA INTENSIVE COMPUTING AND CLOUD PLATFORMS**	**(9 Periods)**
Characterizing Data-Intensive Computations - Challenges Ahead - Technologies for Data-Intensive Computing - Storage Systems - Programming - Introducing the MapReduce Programming Model-cloud Platforms in Industry - Amazon Web Services - Compute Services - Storage Services - Communication Services -Google AppEngine - Microsoft Azure.		
UNIT – V	**APPLICATIONS AND MANAGEMENT OF CLOUD**	**(9 Periods)**
Scientific Applications- Business and Consumer Applications - Energy Efficiency in Clouds- Energy-Efficient and Green Cloud Computing Architecture- Market Based Management of Clouds- Market-Oriented Cloud Computing- Reference Model for MOCC- Federated Clouds / Inter Cloud-Characterization and Definition- Cloud Federation Stack- Aspects of Interest- Technologies for Cloud Federations- Third Party Cloud Services.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi,* ***"Mastering Cloud Computing"****, Tata McGraw Hill Education Private Limited, 2013.*
2	*M.N. Rao,* ***"Cloud computing",*** *PH1Learning Private Limited, 2015.*

REFERENCES:

1	*Nikos Antonopoulos, Lee Gillam,* ***"Cloud Computing: Principles, Systems and Applications",*** *Springer, 2012.*
2	*Rajkumar Buyya, James Broberg, Andrzej M. Goscinski,* ***"Cloud Computing: Principles and Paradigms",*** *Wiley - India, 2011.*
3	*Ronald L. Krutz, Russell Dean Vines,* ***"Cloud Security: A Comprehensive Guide to Secure Cloud Computing",*** *Wiley-India, 2010.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Identify the characteristics and properties of Cloud computing. [**Familiarize]**
CO2	Analyze the architecture of Cloud computing stack. [**Analyze**]
CO3	Differentiate between full and para virtualization. [**Understand**]
CO4	Design map reduce programming model. [**Analyze**]
CO5	List the applications of cloud. [**Understand**]

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	L	M	M	L	L	M					L	M	L
CO2	M	L	M	M	L	L	M					L	M	L
CO3	M	L	M	M	L	L	M					L	M	L
CO4	M	L	M	M	L	L	M					L	M	L
CO5	M	L	M	M	L	L	M					L	M	L
18IPE$10	M	L	M	M	L	L	M					L	M	L
L –Low, M- Medium, H- High														

18IPE$39	**APP DEVELOPMENT** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1.Apply the basic concepts of DART programming language to solve simple problems 2.Understand the development process of mobile application framework and develop simple mobile application using Flutterthat provide a smooth, seamless user experience, using techniques such as user interface (UI) design, user testing, and iterative design 3. Collect and analyze data from mobile applications, using tools such as Google Analytics and Firebase, and use the insights to improve the app's performance, usability, and user engagement. 4. To understand the major mobile platforms, such as Android and iOS, and their respective development environments, including programming languages, tools, and APIs 5. To deploy mobile applications to the target platform, following best practices for distribution, monetization, and app store optimization.	
UNIT – I	**PROGRAMMING DART**	**(9 periods)**
Creating a DART project - main function – variables – data types – conditionals – loops – functions – object-oriented programming – objects – classes – constructors - inheritance – abstract class - DART project structure and libraries		
UNIT – II	**INTRODUCTION TO FLUTTER**	**(9 periods)**
Flutter framework – Installing Android Studio – Installing and Configuring Flutter SDK – Run flutter app on android virtual device and mobile phone – Flutter widgets – Scaffold – Image – Container – Row and column – Card – Icon - Layouts – State management – Form validation - Data structures and Collections – Lists – Maps - Exception handling		
UNIT – III	**FLUTTER NAVIGATION AND ROUTING**	**(9 periods)**
Button Widget – Types – App Structure and navigation – Navigate with Named routes – Navigate to new screen and back - Send and return data among screens – Animate a widget – WebView widget – Introduction to Material design – Elements - Scrolling – Inputs and Selections – Dialogs – Alerts – Panels – MVC pattern - Provider – Consumer - Selector		
UNIT – IV	**FIREBASE, GPS AND GOOGLE MAPS**	**(9 periods)**
JSON – Adding firebase to app - Firebase authentication – signup and login to Flutter app – Configuring Firebase authentication – Firebase database – Real time database – cloud Firestore – Location aware apps – Adding Google maps to Flutter app – Google map marker		
UNIT – V	**APP TESTING AND PUBLISHING**	**(9 periods)**
Debugging tools – Dart analyzer – Flutter performance and optimizing - profiling – best practices – Deployment – code obfuscation – Build and release Android app – Build and release iOS app – Continuous delivery		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Sanjib Sinha, **"Beginning Flutter with Dart"**, Lean publishing, First Edition, 2021*
2	*Thomas Bailey, Alessandro Biessek, **"Flutter for Beginners"**, Packt Publishing, Second Edition, 2021*

REFERENCES:

1	*Sufyan bin Uzayr,* ***"Mastering Flutter – A Beginner's Guide"****, Taylor and Francis, First Edition, 2022*
2	*Simone Alessandria, Brian Kayfitz,* ***"Flutter Cookbook"****, Packt Publishing, First Edition, 2021*
3	*Rap Payne,* ***"Beginning App Development with Flutter: Create cross platform mobile apps"****, Apress, First Edition, 2019*
4	*Marco L Napoli,* ***"Beginning Flutter – A hands on guide to App Development"****, John Wiley & Sons, First Edition, 2020*
5	*https://docs.flutter.dev/*
6	*https://firebase.google.com/*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1	Setup a new Material App using Android Studio and use pre-made Flutter widgets for User Interface Design. **(Familiarize)**
CO2	Summarize the difference between Stateful and Stateless Widgets and Explore how Flutter widgets react to state changes. **(Understand)**
CO3	Apply common mobile design patterns to structure flutter apps and navigation. **(Understand)**
CO4	Design mobile applications with backend services, APIs and Create signup and login screens using Firebase Authentication and Cloud Firestore. **(Understand)**
CO5	Analyze the mobile app usage data and user feedback, and use the insights to improve app performance, usability, and user engagement. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	H	H	H	M				M	L	M	L	H	M
CO2	M	H	H	H	M				M	L	M	L	H	M
CO3	M	H	H	H	M				M	L	M	L	H	M
CO4	M	H	H	H	M				M	L	M	L	H	M
CO5	M	H	H	H	M				M	L	M	L	H	M
18IPE\$39	**M**	**H**	**H**	**H**	**M**				**M**	**L**	**M**	**L**	**H**	**M**
L –Low, M- Medium, H- High														

18IPE$40	CLOUD SERVICES MANAGEMENT

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Fundamentals of cloud services 2. working of Infrastructure as a Service 3. Platform as a Service and Software as a service 4. Business application solutions in cloud 5. Monitoring and managing of cloud services	
UNIT– I	**FOUNDATIONS OF SERVICES**	**(9Periods)**
Introduction to Cloud Computing - Cloud Computing a Nutshell –Roots of Cloud Computing –Layers and types of Clouds –Desired features of a Cloud –Cloud Infrastructure Management –Challenges and Risks –Migrating into a Cloud-Introduction –Broad Approaches –The Seven step model –Enriching the 'Integration as a Services' Paradigm for the Cloud Era: -Introduction –The Challenges of SaaS Paradigm –Approaching the SaaS Integration Enigma –New Integration Scenarios –The Integration Methodologies –SaaS Integration Services –The Enterprise Cloud Computing Paradigm: -Introduction –Background –Issues–Transition Challenges –The Cloud Supply Chain		
UNIT– II	**INFRASTRUCTURE AS A SERVICE**	**(9Periods)**
Virtual Machine Provisioning and Migration Services Introduction –Background –Manageability –Migration Services –Management of Virtual Machines for Cloud Infrastructures: -Anatomy of Cloud Infrastructures –Distributed Management of Virtual Infrastructures –Scheduling techniques for Advance Reservation of Capacity –Enhancing Cloud Computing Environments Using a Cluster as a Service: -Introduction –Related Work –RVWS Design –The Logical Design –Secure Distributed Data Storage in Cloud Computing: -Introduction –Cloud Storage from LANs to WANs –Technologies for Data Security –Challenges		
UNIT– III	**PLATFORM AND SOFTWARE AS A SERVICE**	**(9Periods)**
Introduction–Technologies and Tools –Cloud Platform - Resource Provisioning Service –Hybrid Cloud Implementation –CometCloud: An Autonomic Cloud Engine: -Introduction –CometCloud –Architecture –Autonomic Behavior of CometCloud –Overview of CometCloud-based Applications –Implementation and Evaluation		
UNIT– IV	**CLOUD BASED SOLUTION FOR BUSINESS APPLICATION**	**(9Periods)**
Introduction –Enterprise Demand of Cloud Computing –Dynamic ICT Service –Importance of Quality and Security in Clouds –Dynamic Data Centre Producing Business-ready; Dynamic ICT Services –The MapReduce Programming Model and Implementations: -Introduction –MapReduce Programming Model –MapReduce implementations for the Cloud.		
UNIT– V	**MONITORING AND MANAGEMENT**	**(9Periods)**
An Architecture for Federated Cloud Computing Introduction –A typical Usecase –The Basic Principles of Cloud Computing –A Federated Cloud Computing Model –Security Considerations –Service Providers Perspective of SLA Management in Cloud Computing: -Traditional Approaches to SLO Management –Types of SLA –Life Cycle of SLA –SLA Management in Cloud –Automated Policy-based Management –Performance Prediction for HPC on Clouds: -Introduction –Background –Grid and Cloud –Performance related issues of HPC in the Cloud		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Rajkumar Buyya, James Broberg, Andrzej Goscinsky,* ***"Cloud Computing Principles and Paradigms"****, Wiley India Pvt. Ltd, 2011*

REFERENCES:

1	*JudithHurwitz, MarciaKaufman, and Dr. Fern Halper,* ***"Cloud Services FORDUMmIES"*** *IBMLIMITEDEDITION, JohnWiley & Sons, Inc., Hoboken, New Jersey, 2012.*
2	*Nikos Antonopoulos, Lee Gillam,* ***"Cloud Computing: Principles, Systems and Applications"****, Springer, 2012.*
3	*Ronald L. Krutz, Russell Dean Vines,* ***"Cloud Security: A Comprehensive Guide to Secure Cloud Computing"****, Wiley-India, 2010.*

COURSEOUTCOMES: Oncompletion ofthe course, thestudents will beable to:	
CO1	List the operations and challenges of cloud services. **(Familiarize)**
CO2	Identify the operations and limitations of Infrastructure as a Service. **(Understand)**
CO3	Differentiate Platform as a Service and Software as a service. **(Understand)**
CO4	Apply Business application solutions in cloud. **(Analyze)**
CO5	How to Monitor and Manage the cloud services? **(Familiarize)**

COURSEARTICULATIONMATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	L	H	M	L					L	M	L	M	M
CO2	M	L	M	H	L					L	M	L	M	M
CO3	M	L	H	M	L					L	M	L	M	M
CO4	M	L	M	H	L					L	M	L	M	M
CO5	M	L	M	M	L					L	M	L	M	M
18IPE$40	**M**	**L**	**M**	**M**	**L**					**L**	**M**	**L**	**M**	**M**
L –Low, M- Medium, H- High														

18IPE$41	**UI AND UX DESIGN** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	**Upon completion of this course, the students will be familiar with,** • Principles of UX design, such as user research, user personas and user journey mapping • Importance of color theory, typography, layout, and visual hierarchy • Usage of design tools and software, such as Sketch, Figma, Adobe XD and Invision • Usage of wireframes and prototypes using design software to communicate design ideas • Methods for evaluating user interfaces

UNIT – I	**INTRODUCTION TO UI DESIGN**	**(9Periods)**

Basics of HCI - Design process- HCI in software process – Basics of interaction design - UI Design and Why it matters – UI disasters – Case studies – Design Process – Introduction – Usability Engineering – Task centered approaches – Use cases – Personas – Tasks – Scenarios –Design centered approaches – Psychology and human factors for UI Design – Fitts Law – Short-term – long-term – attention – perception – conceptual models – Design principles – visibility – feedback – mappings – constraints – High-level models – distributed cognition – activity theory – situated action

UNIT – II	**USER RESEARCH**	**(9Periods)**

UserCentered Approaches to Interaction Design -User Research methods – Interview and Focus groups – Observations – Contextual inquiry – Ethics and Consent – User Research Protocol – Log Analysis – Surveys and Questionnaires – Translating User Research to Support design – Qualitative analysis – Quantitative analysis – Examples - Implications for Design – From Research to Ideas – Ideation – Selection – Communicating to Stakeholders

UNIT – III	**PROTOTYPING**	**(9Periods)**

Interface Prototying techniques – Low fidelity – Paper prototype – Wireframing – Tool-based – Physical low fidelity prototyping – Introduction to Design principles and patterns – Layout – Color and consistency – Cultural factors – Interaction design patterns – Google Material design – Design critiques – eliciting and giving feedback

UNIT – IV	**UNIVERSAL DESIGN**	**(9Periods)**

Introduction – Sensory and Cognitive Impairments – Physical limitations – tools and standards – Design for older adults and children – Socio-economic differences – Design for different platforms and contexts – Mobile UI design – Wearable – Automotive User Interfaces – IoT and Physical Computing

UNIT – V	**EVALUATING USER INTERFACES AND TOOLS**	**(9Periods)**

Introduction to Evaluating User interfaces and Evaluation in UI Design process – Evaluation without users – Action Analysis – Cognitive Walkthroughs – Heuristic Evaluation – Nielsen's heuristics – Evaluation with Users – User Testing – Goals – Formative and Summative Evaluation – Ethics in evaluation – Tools – Adobe XD – Figma –Invision -Sketch

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Rex Hartson, Pardha S Pyla,* ***"The UX Book: Agile UX Design for a Quality User Experience"****, Morgan Kaufmann, Second Edition, 2018*
2	*Joel Marsh,* ***"UX for beginners"****, O'Reilly Media, 2015*

REFERENCES:

1	*Alan Cooper, Robert Riemann, David Cronin, Christopher Noessel,* ***"About Face: The Essentials of Interaction Design"****, Wiley, Fourth Edition, 2014*
2	*Ben Coleman, and Dan Goodwin,* ***"Designing UX: Prototyping: Because Modern Design is Never Static"****, SitePoint , 2017*
3	*Westley Knight,* ***"UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work"****, Apress, 2018*
4	*https://in.coursera.org/specializations/user-interface-design*
5	*Helen Sharp, Yvonne Rogers, Jenny Preece,* ***"Interaction design – beyond human computer interaction"****, Wiley, Fifth Edition, 2019*
6	*Elizabeth Goodman, Mike Kuniavsky, Andrea Moed,* ***"Observing the User Experience – A Practitioner's Guide to User Research"****, Morgan Kaufmann, Second Edition, 2012*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Articulate UI/UX design principles, tools, and best practices, and apply them to real-world scenarios. **(Understand)**
CO2	Conduct user research to gain insights into user needs and behaviors, and apply these insights to inform design decisions. **(Understand)**
CO3	Create wireframes and prototypes using design software to communicate design ideas. **(Understand)**
CO4	Design interfaces that adapt to different devices and screen sizes using responsive design principles. **(Understand)**
CO5	Collaboratively design and evaluate interfaces for web and mobile applications using tools like Adobe XD, Figma ,Invisionand Sketch. (Analyze)

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1			M	L	L							L	H	M
CO2			H	L	L					L		L	H	M
CO3		L	H	L	H					L		L	H	M
CO4			H	L	H							L	H	M
CO5		L	H	L	H					M		L	H	M
18IPE$41		L	H	L	H					L		L	H	M
L –Low, M- Medium, H- High														

18IPE$03	SOFTWARE TESTING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, * Significance of software testing * Test case design * Types and levels of Software testing * Test management * Monitoring and controlling

UNIT – I	TESTING BASICS	(9 Periods)

Purpose of Testing-Principles of Testing- Testing as an Engineering Activity- Role of Process in Software Quality- Testing as a Process- Basic Definitions-Software Testing Principles- The Tester's Role in a Software Development Organization- Origins of Defects- Defect Classes- The Defect Repository and Test Design- Defect Examples- Developer/Tester Support for Developing a Defect Repository.

UNIT – II	TEST CASE DESIGN	(9 Periods)

Introduction to Testing Design Strategies - The Smarter Tester- Test Case Design Strategies-Using Black Box Approach to Test Case Design Random Testing- Requirements based testing- Positive and Negative testing- Boundary Value Analysis- Decision Tables- Equivalence Class Partitioning state based testing- cause effect graphing-error guessing- compatibility testing- user documentation testing-Domain testing Using White–Box Approach to Test design- Test Adequacy Criteria- Static Testing vs. Structural Testing- Code functional testing- Coverage and Control Flow Graphs-Covering Code Logic- Paths- Their Role in White–box Based Test Design- Code complexity testing- Evaluating Test Adequacy Criteria.

UNIT – III	LEVELS OF TESTING	(9 Periods)

The Need for Levels of Testing- Unit Test- Unit Test Planning- Designing the Unit Test- The Test Harness- Running the Unit tests and Recording results- Integration tests- Designing Integration Tests-Integration Test Planning- Scenario testing- Defect base elimination System Testing- Types of system Testing- Acceptance testing- Performance testing- Regression Testing- Internationalization testing-Ad-hoc testing- Alpha Beta Tests- Testing OO systems- Usability and accessibility testing. .

UNIT – IV	TEST MANAGEMENT	(9 Periods)

People and organizational issues in testing- Organization structures for testing teams- Testing services- Test Planning- Test Plan Components- Test Plan Attachments- Locating Test Items- Test management- Test process-Reporting Test Results-The role of three groups in Test Planning and Policy Development-Introducing the test specialist-Skills needed by a test specialist- Building a Testing Group.

UNIT – V	CONTROLLING AND MONITORING	(9 Periods)

Software Test Automation- skills needed for automation-Scope of automation-Design and architecture for automation-Requirements for a test tool-Challenges in automation-Test metrics and measurements- Project- Progress and Productivity Metrics-Status Meetings- Reports and Control Issues- Criteria for Test Completion-SCM- Types of reviews-Developing a review program-Components of Review Plans-Reporting Review Results

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Ilene Burnstein,* ***"Practical Software Testing",*** *Springer International Edition, 2003*
2	*Srinivasan Desikan and Gopalaswamy Ramesh,* ***"Software Testing – Principles and Practices",*** *Pearson education, 2009.*

REFERENCES:

1	*Borris Benzer ,* ***"Software Testing Techniques",*** *International Thomson Computer Press, USA, 2006*
2	*RenuRajani, Pradeep Oak,* ***"Software Testing – Effective Methods, Tools and Techniques",*** *Tata McGraw Hill, 2003.*
3	*Sandeep Desai, AbhisekSrivastava,* ***"Software testing: A Practical approach",*** *Prentice Hall of India, 2012.*
4	*Ron Patton,* ***"Software Testing",*** *Second Edition, Sams Publishing, Pearson Education, 2004.*
5	*Aditya P. Mathur,* ***"Foundations of Software Testing – Fundamental algorithms and techniques",*** *Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2011.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Apply the testing process to identify the defects in the software. **[Understand]**
CO2	**CO2:** Design the test case for black box and white box testing. **[Analyze]**
CO3	**CO3:** Perform the testing at various levels. **[Understand]**
CO4	**CO4:** Manage the testing Process. **[Familiarize**]
CO5	**CO5:** Automate, Control and Monitor the testing Process. **[Analyze]**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	H	M		H								H	
CO2	M	M	H	L	H								M	
CO3	L	M	M	L	H								H	
CO4	L	M	M	L							L		H	L
CO5	M	H	H	M	M	L		L		M	H		H	M
18IPE$03	M	M	M	L	H	L		L		L	L		H	L
L –Low, M- Medium, H- High														

18IPE$42	**WEB APPLICATION SECURITY** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To Equip students with common security threats faced by web applications, such as SQL injection, cross-site scripting (XSS), cross-site request forgery (CSRF), and man-in-the-middle attacks 2. To Respond effectively to security threats and incidents 3. To Design secure web applications from the ground up, including secure authentication and authorization, secure communication protocols, firewalls, intrusion detection systems 4. To Apply industry standards and regulations, such as OWASP Top 10, and PCI DSS, that outline best practices for web application security 5. To Understand the principles of web security, browser security and database security and prevent security vulnerabilities
UNIT – I	**INTRODUCTION** **(9 Periods)**
Structure of a Modern Web Application – REST APIs – Javascript – SPA Frameworks – Web Servers – Sever side databases – Client-side data stores – Network Security vs Application Security – Thinking like a defender – OWASP Top Ten List – Security Fundamentals – Input Validation – Attack surface reduction – Classifying and Prioritizing threats	
UNIT – II	**WEB SECURITY PRINCIPLES** **(9 Periods)**
Authentication– Two factor and Three factor authentication – Web application authentication – Securing Password based authentication – Best Practices – Authorization –Access Control – Session management fundamentals – Securing web application session management	
UNIT – III	**BROWSER SECURITY** **(9 Periods)**
Same origin policy – Definition – Client-side vs Server-side - Exceptions – Cross site Scripting – XSS Discovery and Exploitation – Stored XSS – Reflected XSS – DOM-based XSS – Mutation-based XSS - Cross site Request Forgery – Query parameter tampering – Alternate GET payloads – CSRF against POST endpoints	
UNIT – IV	**DATABASE AND FILE SECURITY** **(9 Periods)**
SQL Injection –Code injection – Command injection – Setting database permissions – Stored procedure security – Insecure direct object references –File Security principles – Keeping source code secure – Security through Obscurity – Forceful browsing – Directory traversal	
UNIT – V	**SECURE DEVELOPMENT AND DEPLOYMENT** **(9 Periods)**
Securing modern web applications – Secure application architecture – Reviewing Code – Vulnerability discovery and management – Defending against XSS, CSRF, XXE, Injection and DoS attacks – Industry standards – Maturity models – Securing third party dependencies	
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**	

TEXT BOOK:

1	*Andrew Hoffman,* ***"Web Application Security – Exploitation and Countermeasures for Modern Web Applications"****, O'Reilly, 2020*
2	*Bryan Sullivan, Vincent Liu,* ***"Web Application Security – A Beginner's Guide"****, McGraw Hill, 2012*

REFERENCES:

1	*Mike Shema,* ***"Hacking Web Apps – Detecting and Preventing Web Application Security Problems"****, Elsevier, 2012*
2	*Ron Lepofsky,* ***"The Manager's Guide to Web Application Security – A Concise guide to Web Application Security"****, Apress, 2014*
3	*Dafydd Stuttard, Marcus Pinto,* ***"The Web Application Hacker's Handbook – Finding and Exploiting Security flaws"****, John Wiley & Sons, Second Edition, 2011*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Be Familiar with secure coding best practices, such as OWASP Top 10. **(Familiarize)**
CO2	Write secure code, including input validation, error handling, and password protection. **(Understand)**
CO3	Comprehendthe most common web security threats, such as cross-site scripting (XSS), cross-site request forgery (CSRF), SQL injection, and others. **(Understand)**
CO4	Implement and manage web security policies and procedures, including incident response planning and management, security auditing, and security monitoring. **(Understand)**
CO5	Identify and prioritize potential security threats to web applications and develop effective strategies for mitigating those threats. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	M	H	L	M			H		L		L	H	L
CO2	H	M	H	L	M			H		L		L	H	L
CO3	H	M	H	L	M			H		L		L	H	L
CO4	H	M	H	L	M			H		L		L	H	L
CO5	H	M	H	L	M			H		L		L	H	L
18IPE\$42	H	M	H	L	M			H		L		L	**H**	**L**
L –Low, M- Medium, H- High														

18IPE$43	**DEV-OPS** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Understanding of DevOps principles, including continuous integration (CI), continuous delivery (CD), and agile development methodologies 2. Familiar with a range of DevOps tools and technologies, such as Git, Jenkins, Docker, Kubernetes, and Ansible 3. Manage and Orchestrate containers using Docker and Kubernetes 4. Write scripts to automate tasks and create pipelines for CI/CD 5. Understand Monitoring and Logging tools, such as Prometheus and Grafana, and the ability to use them to monitor and analyze system performance

UNIT – I	**INTRODUCTION**	**(9 Periods)**
What is DevOps – Roles and responsibilities of DevOps engineer – DevOps and SDLC – Virtualization – Shell scripting – SSH – Git for DevOps–Branches – Merge requests – Commits – Resolving Conflicts – Deletions – Build tools and Package managers – Artifact Repository manager		
UNIT – II	**CONTAINERS**	**(9 Periods)**
What is container – Docker components and architecture – Docker vs. Virtual machine – Main docker commands – Docker compose – running multiple services – Dockerfile – Building a docker image - Deploy containerized app – Docker volumes		
UNIT – III	**ORCHESTRATION**	**(9 Periods)**
What is Container orchestration - Introduction to Kubernetes – Components – Architecture – Commands – YAML configuration – Namespaces – Service types – Persisting data – Deploying Kubernetes Cluster – Stateful app deployment using Helm		
UNIT – IV	**CI/CDPIPELINE**	**(9 Periods)**
What is Build Automation –Continuous Integration and Continuous Delivery Principles -Introduction to Jenkins – Install Jenkins on Cloud Server – Plugins – Build tools – Docker in Jenkins – Configuring Jenkins pipeline –Multi-branch pipeline Job– Webhooks		
UNIT – V	**MONITORING**	**(9 Periods)**
Docker container monitoring – statistics – metrics – events – Performance monitoring – Container monitoring – Container administration – Auditing and Analyzing Vulnerabilities in Kubernetes – Enhancing observability and monitoring in Kubernetes with Prometheus and Grafana		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Mikael Krief,* ***"Learning DevOps - The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps"****, Packt Publishing, 2019*
2	*Jose Manuel Ortega Candel,* ***"Implementing DevSecOps with Docker and Kubernetes"****, BPB Publications, First Edition, 2022*

REFERENCES:

1	*Joakim Verona,* ***"Practical DevOps"****, Packt Publishing, 2016*
2	*Len Brass, Ingo Weber, Liming Zhu,* ***"DevOps – A Software Architect's Perspective"****, Pearson Education, 2015*
3	*Gene Kim, Jez Humble, Patrick Debois, John Willis,* ***"The DevOps Handbook – How to create world-class agility, reliability and security in technology organizations"****, IT Revolution, Second edition, 2016*
4	*Jennifer Davis, Katherine Daniels,* ***"Effective DevOps"****, O'Reilley Media, 2015*
5	*https://github.com/milanm/DevOps-Roadmap*
6	*https://github.com/annfelix/DEVOPS-WORLD*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Explore the DevOps principles and practices, such as continuous integration, continuous delivery, infrastructure as code, and collaboration between development and operations teams **(Familiarize)**
CO2	Implement containerization and container orchestration using tools such as Docker and Kubernetes. **(Understand)**
CO3	Create and manage infrastructure on public and private cloud platforms such as AWS, Azure, and GCP using tools such as Terraform and CloudFormation. **(Analyze)**
CO4	Write scripts to automate tasks and create pipelines for continuous integration and continuous delivery. **(Understand)**
CO5	Extrapolatethe purpose of monitoring and logging tools such as Prometheus and Grafana and be able to use them to monitor and analyze system performance. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	H	H	M	M	M	H	L		M	M	H	H	M
CO2	M	H	H	H	H	H	H	L	M	M	M	H	H	M
CO3	M	H	H	H	H	H	H	L	M	M	M	H	H	M
CO4	M	H	H	H	H	H	H	L	M	M	M	M	H	M
CO5	M	H	H	H	H	H	H	L	M	M	M	H	H	M
18IPE$43	M	H	H	H	H	H	H	L	M	M	M	H	H	M
L –Low, M- Medium, H- High														

18IPE$44	**PRINCIPLES OF PROGRAMMING LANGUAGES** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Describe syntax and semantics of programming languages 2.Understand call-return architecture and ways of implementing them 3.Analyze and Evaluate the different programming paradigms 4. Practice Functional and Concurrent programming with Haskell 5.Explain the design concepts and issues behind programming languages like C, Java, Scala, Lisp, Prolog, or any new language	
UNIT – I	**FOUNDATIONS**	**(9 Periods)**
Evolution of Major Programming Languages –Overview of Compilation – Describing Syntax and Semantics – Lexical and Syntax analysis - Names, Scopes and Bindings – Data Types – Expressions and Assignment Statements –Type Systems		
UNIT – II	**CORE ISSUES IN LANGUAGE DESIGN**	**(9 Periods)**
Control Flow – Structured and Unstructured Flow – Sequencing – Selection – Iteration – Recursion – Subroutines and Control Abstraction – Stack layout – Calling Sequences – Parameter Passing – Blocks – Dynamic Scoping - Exception Handling – Coroutines – Events		
UNIT – III	**OBJECT ORIENTED PARADIGM**	**(9 Periods)**
Abstract Data Types and Encapsulation Concepts – Design Issues – Namespaces - Inheritance - Inner Classes – Type Extensions – Dynamic Method Binding – Mix-in Inheritance – True Multiple Inheritance - Examples – Object Models – Smalltalk, C++, Java, Scala		
UNIT – IV	**FUNCTIONAL AND LOGIC PROGRAMMING**	**(9 Periods)**
Functional Programming – Programs as Functions – Delayed Evaluation – Lambda Calculus – Examples from Lisp - Introduction to Haskell Programming – Comparison of Functional and Imperative languages – Logic Programming - Predicate Calculus – Proving theorems – Resolution and Unification - Elements of Prolog – Applications		
UNIT – V	**CONCURRENT PROGRAMMING**	**(9 Periods)**
Parallel Processing and Programming Languages – Threads – Semaphores – Monitors – Message Passing – Parallelism in Non-Imperative Languages – Java threads – Haskell concurrency primitives and abstractions		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Robert W. Sebesta,* ***"Concepts of Programming Languages"****, Pearson Education, Twelfth Edition, 2019*
2	*Michael L. Scott,* ***"Programming Language Pragmatics"****, Morgan Kauffman, Fourth Edition, 2016*

REFERENCES:

1	*Kenneth C. Louden, Kenneth A. Lambert,* ***"Programming Languages – Principles and Practice"****, Course Technology, Cengage Learning, Third Edition, 2011*
2	*Daniel P. Friedman, Mitchell Wand,* ***"Essentials of Programming Languages"****, MIT Press, Third Edition, 2008*
3	*Carlo Ghezzi, Mehdi Jazayeri,* ***"Programming Language Concepts"****, John Wiley & Sons, Third Edition, 2008*
4	*Peter Sestoft,* ***"Programming Language Concepts"****, Springer-Verlag, Second Edition, 2017*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the key concepts and theories behind programming languages, including syntax, semantics, grammar, and parsing. **(Familiarize)**
CO2	Compare the different programming language paradigms and be able to choose the appropriate paradigm for different types of software.**(Understand)**
CO3	Explain the core issues in procedural and object-oriented programming language design. **(Familiarize)**
CO4	Apply functional programming concepts and logic programming concepts and be able to write functional code using languages such as Lisp or Prolog or Haskell or Scheme. **(Understand)**
CO5	Describe the principles of concurrent and parallel programming, including threads, locks, and semaphores, and be able to write concurrent and parallel code using languages Java or Haskell. **(Understand)**

COURSE ARTICULATION MATRIX:

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	L	M	L	M								H	
CO2	M	M	M	L	M								H	
CO3	M	L	M	L	M								H	
CO4	M	L	L	L	H								H	
CO5	M	M	L	L	H								H	
18IPE$44	M	L	M	L	M								H	
L –Low, M- Medium, H- High														

VERTICAL – III

CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES

18IPE$10	CLOUD COMPUTING

PRE-REQUISITES	CATEGORY	L	T	P	C
Data Communication and Networking	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, * Overview of computing Paradigm. * Cloud computing architecture and its service models. * Representation of virtualization concepts. * Intensive computation in Cloud computing. * Applications and management of cloud computing

UNIT – I	**INTRODUCTION**	**(9 Periods)**
Principles of Parallel and Distributed Computing - Eras of Computing - Parallel vs. Distributed Computing - Hardware Architectures for Parallel Processing - Approaches to Parallel Programming - Levels of Parallelism - Distributed System - Technologies for Distributed Computing - Remote Procedure Call - Distributed Object Frameworks - Service Oriented Computing Cloud Computing Reference Model - Historical Developments - Building Cloud Computing Environments- Application Development - Infrastructure and System Development - Computing Platforms and Technologies.		
UNIT – II	**CLOUD COMPUTING ARCHITECTURE**	**(9 Periods)**
Introduction - Cloud Reference Model – Architecture - Infrastructure / Hardware as a Service - Platform as a Service - Software as a Service- Types of Clouds - Public Clouds - Private Clouds - Hybrid Clouds - Community Clouds- Open Challenges - Cloud Definition - Cloud Interoperability and Standards - Scalability and Fault Tolerance - Security- Trust- and Privacy - Organizational Aspects.		
UNIT – III	**VIRTUALIZATION**	**(9 Periods)**
Introduction - Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques - Execution Virtualization - Other Types of Virtualization - Virtualization and Cloud Computing - Pros and Cons of Virtualization - Xen- Paravirtualization- VMware- Full Virtualization - Microsoft Hyper-V.		
UNIT – IV	**DATA INTENSIVE COMPUTING AND CLOUD PLATFORMS**	**(9 Periods)**
Characterizing Data-Intensive Computations - Challenges Ahead - Technologies for Data-Intensive Computing - Storage Systems - Programming - Introducing the MapReduce Programming Model-cloud Platforms in Industry - Amazon Web Services - Compute Services - Storage Services - Communication Services -Google AppEngine - Microsoft Azure.		
UNIT – V	**APPLICATIONS AND MANAGEMENT OF CLOUD**	**(9 Periods)**
Scientific Applications- Business and Consumer Applications - Energy Efficiency in Clouds- Energy-Efficient and Green Cloud Computing Architecture- Market Based Management of Clouds- Market-Oriented Cloud Computing- Reference Model for MOCC- Federated Clouds / Inter Cloud-Characterization and Definition- Cloud Federation Stack- Aspects of Interest- Technologies for Cloud Federations- Third Party Cloud Services.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi,* ***"Mastering Cloud Computing"****, Tata McGraw Hill Education Private Limited, 2013.*
2	*M.N. Rao,* ***"Cloud computing",*** *PH1Learning Private Limited, 2015.*

REFERENCES:

1	*Nikos Antonopoulos, Lee Gillam,* ***"Cloud Computing: Principles, Systems and Applications",*** *Springer, 2012.*
2	*Rajkumar Buyya, James Broberg, Andrzej M. Goscinski,* ***"Cloud Computing: Principles and Paradigms",*** *Wiley - India, 2011.*
3	*Ronald L. Krutz, Russell Dean Vines,* ***"Cloud Security: A Comprehensive Guide to Secure Cloud Computing",*** *Wiley-India, 2010.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Identify the characteristics and properties of Cloud computing. [**Familiarize]**
CO2	Analyze the architecture of Cloud computing stack. [**Analyze**]
CO3	Differentiate between full and para virtualization. [**Understand**]
CO4	Design map reduce programming model. [**Analyze**]
CO5	List the applications of cloud. [**Understand**]

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	L	M	M	L	L	M					L	M	L
CO2	M	L	M	M	L	L	M					L	M	L
CO3	M	L	M	M	L	L	M					L	M	L
CO4	M	L	M	M	L	L	M					L	M	L
CO5	M	L	M	M	L	L	M					L	M	L
18IPE$10	M	L	M	M	L	L	M					L	M	L
L –Low, M- Medium, H- High														

18IPE$18	VIRTUALIZATION TECHNIQUES

PRE-REQUISITES	CATEGORY	L	T	P	C
Operating Systems Data Communication and Networking	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, * Virtualization concepts * Virtualized infrastructure design * Operating system virtualization * Storage virtualization * Network virtualization	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Architect for virtualization- virtualization – five step process – Discovery – Virtualization – Hardware maximization – Architectures – manage virtualization.		
UNIT – II	**VIRTUALIZATION INFRASTRUCTURE**	**(9 Periods)**
Build the resource pool – planning and preparation – network layer – storage – host servers - testing levels- lab requirement – reuse of lab deliverables – management practices.		
UNIT – III	**OS VIRTUALIZATION**	**(9 Periods)**
Hardware level virtualization – OS level Virtualization – Interception Technique on windows – Feather weight Virtual Machine- FVM states- operations – Design of virtualization layer – Implementation – System call log analysis – Limitations of FVM.		
UNIT – IV	**STORAGE VIRTUALIZATION**	**(9 Periods)**
Storage virtualization – Enhanced Storage and Data Services – Implementation – High Availability – Performance – Capacity – SNIA storage management – Policy based service level management – Future of storage virtualization.		
UNIT – V	**NETWORK VIRTUALIZATION**	**(9 Periods)**
Key Concepts- Architecture –Virtualized network Components -Logical Networks-Logical Network Design-Naming Conventions -Port profiles-uplink port profiles –network adapter port profiles – Logical switches- planning logical switch design -deployment –Operations.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Matthew portnoy,* ***"Virtualization Essentials",*** *SYBEX (Wiley Brand) 2nd Edition, 2016.*
2	*Yang Yu,* ***"OS-level Virtualization and Its Applications",*** *ProQuest LLC, 2009.*
3	*Frank Bunn, Nik Simpson, Robert Peglar, Gene Nagle,* ***"Technical Tutorial – Storage Virtualization",*** *Storage Networking Association (SNIA), 2004.*

REFERENCES:

1	*Danielle Ruest, Nelson Ruest,* ***"Virtualization: A Beginner's Guide",*** *McGraw-Hill, 2009.*
2	*Nigel Cain, Alvin Morales, Michel Luescher, Damian Flynn Mitch Tulloch,* ***"Microsoft System Center -Building a virtualized Network Solutio",*** *Microsoft press, 2004.*
3	*Matthew Portney,* ***"Virtualization Essentials",*** *John Wiley & Sons, 2012.*
4	*Tim cerfing, Jeff buller, Chuck Enstall, Richard Ruiz,* ***"Mastering Microsoft Virtualization",*** *Wiley Publication, 2010.*
5	*William Von Hagen ,* ***"Professional Xen Virtualization",*** *Wiley publication, 2008.*
6	*Cody Bunch,* ***"Automating vSphere with VMware vCenter Orchestrator: Technology Hands-on",*** *Pearson Education, 2012.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Identify the need of virtualization.
CO2	Use virtualization infrastructure.
CO3	Create OS level virtualization.
CO4	Identify storage level virtualization.
CO5	Analyze network level virtualization.

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	H	M	H	M	L	M	M					M	L
CO2	M	H	M	M	M	L	M	M					M	L
CO3	M	H	M	M	M	L	M	M					M	L
CO4	M	H	M	H	M	L	M	M					M	L
CO5	M	H	M	H	M	L	M	M					M	L
18IPE$18	M	H	M	H	M	L	M	M					M	L
L –Low, M- Medium, H- High														

18IPE$40	CLOUD SERVICES MANAGEMENT

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	6. Fundamentals of cloud services 7. working of Infrastructure as a Service 8. Platform as a Service and Software as a service 9. Business application solutions in cloud 10. Monitoring and managing of cloud services	
UNIT– I	**FOUNDATIONS OF SERVICES**	**(9Periods)**
Introduction to Cloud Computing - Cloud Computing a Nutshell –Roots of Cloud Computing –Layers and types of Clouds –Desired features of a Cloud –Cloud Infrastructure Management –Challenges and Risks –Migrating into a Cloud-Introduction –Broad Approaches –The Seven step model –Enriching the 'Integration as a Services' Paradigm for the Cloud Era: -Introduction –The Challenges of SaaS Paradigm –Approaching the SaaS Integration Enigma –New Integration Scenarios –The Integration Methodologies –SaaS Integration Services –The Enterprise Cloud Computing Paradigm: -Introduction –Background –Issues–Transition Challenges –The Cloud Supply Chain		
UNIT– II	**INFRASTRUCTURE AS A SERVICE**	**(9Periods)**
Virtual Machine Provisioning and Migration Services Introduction –Background –Manageability –Migration Services –Management of Virtual Machines for Cloud Infrastructures: -Anatomy of Cloud Infrastructures –Distributed Management of Virtual Infrastructures –Scheduling techniques for Advance Reservation of Capacity –Enhancing Cloud Computing Environments Using a Cluster as a Service: -Introduction –Related Work –RVWS Design –The Logical Design –Secure Distributed Data Storage in Cloud Computing: -Introduction –Cloud Storage from LANs to WANs –Technologies for Data Security –Challenges		
UNIT– III	**PLATFORM AND SOFTWARE AS A SERVICE**	**(9Periods)**
Introduction–Technologies and Tools –Cloud Platform - Resource Provisioning Service –Hybrid Cloud Implementation –CometCloud: An Autonomic Cloud Engine: -Introduction –CometCloud –Architecture –Autonomic Behavior of CometCloud –Overview of CometCloud-based Applications –Implementation and Evaluation		
UNIT– IV	**CLOUD BASED SOLUTION FOR BUSINESS APPLICATION**	**(9Periods)**
Introduction –Enterprise Demand of Cloud Computing –Dynamic ICT Service –Importance of Quality and Security in Clouds –Dynamic Data Centre Producing Business-ready; Dynamic ICT Services –The MapReduce Programming Model and Implementations: -Introduction –MapReduce Programming Model –MapReduce implementations for the Cloud.		
UNIT– V	**MONITORING AND MANAGEMENT**	**(9Periods)**
An Architecture for Federated Cloud Computing Introduction –A typical Usecase –The Basic Principles of Cloud Computing –A Federated Cloud Computing Model –Security Considerations –Service Providers Perspective of SLA Management in Cloud Computing: -Traditional Approaches to SLO Management –Types of SLA –Life Cycle of SLA –SLA Management in Cloud –Automated Policy-based Management –Performance Prediction for HPC on Clouds: -Introduction –Background –Grid and Cloud –Performance related issues of HPC in the Cloud		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Rajkumar Buyya, James Broberg, Andrzej Goscinsky,* ***"Cloud Computing Principles and Paradigms"****, Wiley India Pvt. Ltd, 2011*

REFERENCES:

1	*JudithHurwitz, MarciaKaufman, and Dr. Fern Halper,* ***"Cloud Services FORDUMmIES"*** *IBMLIMITEDEDITION, JohnWiley & Sons, Inc., Hoboken, New Jersey, 2012.*
2	*Nikos Antonopoulos, Lee Gillam,* ***"Cloud Computing: Principles, Systems and Applications"****, Springer, 2012.*
3	*Ronald L. Krutz, Russell Dean Vines,* ***"Cloud Security: A Comprehensive Guide to Secure Cloud Computing"****, Wiley-India, 2010.*

COURSEOUTCOMES: Oncompletion ofthe course, thestudents will beable to:	
CO1	List the operations and challenges of cloud services. **(Familiarize)**
CO2	Identify the operations and limitations of Infrastructure as a Service. **(Understand)**
CO3	Differentiate Platform as a Service and Software as a service. **(Understand)**
CO4	Apply Business application solutions in cloud. **(Analyze)**
CO5	How to Monitor and Manage the cloud services? **(Familiarize)**

COURSEARTICULATIONMATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	L	H	M	L					L	M	L	M	M
CO2	M	L	M	H	L					L	M	L	M	M
CO3	M	L	H	M	L					L	M	L	M	M
CO4	M	L	M	H	L					L	M	L	M	M
CO5	M	L	M	M	L					L	M	L	M	M
18IPE$40	**M**	**L**	**M**	**M**	**L**					**L**	**M**	**L**	**M**	**M**
L –Low, M- Medium, H- High														

18IPE$45	DATA WAREHOUSING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To understand the basic concepts, planning and requirements for data warehousing. 2. To understand the architecture and infrastructure of warehouses. 3. To learn various techniques for data modelling, extraction, transformation and Loading. 4. To learn concepts about information access and delivery. 5. To learn various techniques on physical storage implementation and maintenance.

UNIT – I	**CONCEPTS, PLANNING AND REQUIREMENTS**	**(9 Periods)**
The need for Data warehousing – Data warehousing defined – Milestones and challenges – Defining features – data warehouses vs data marts – Architectural types – components – significant trends – planning data warehouse – development phases – Dimensional analysis – requirement gathering methods – data design – architectural plan – storage specification.		
UNIT – II	**ARCHITECTURE AND INFRASTRUCTURE**	**(9 Periods)**
Architectural components – infrastructure as the foundation for data warehousing – Significant role of metadata: importance, types by functional area, business meta data, technical metadata, providing metadata.		
UNIT – III	**DATA DESIGN AND PREPARATION**	**(9 Periods)**
Dimensional modelling: basics, the star schema, star schema keys and advantages – snowflake schema – aggregate fact tables –Data Extraction – Data Transformation – Data Loading - Importance of data quality – data quality challenges and tools.		
UNIT – IV	**INFORMATION ACCESS AND DELIVERY**	**(9 Periods)**
Information delivery and tools – OLAP: need for OLAP, Major features and functions, Models – Web enabled data warehouse and delivery – Data mining techniques and applications.		
UNIT – V	**IMPLEMENTATION AND MAINTENANCE**	**(9 Periods)**
Physical design steps and considerations – Physical storage – indexing – Techniques for enhancing the performance – testing – Major development activities – security – Backup and recovery – Monitoring the data warehouse – user training and support – managing the data warehouse.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*PaulrajPonnaiah,* ***"Data warehousing Fundamentals for IT professionals"****, wiley, 2nd edition, 2010.*

REFERENCES:

1	*Parteekbhatia,**"Data Mining and Data Warehousing: Principles and Practical Techniques"**, Cambridge University Press, 2019*
2	Thomas C. Hammergren, Alan R.Simon, **"Data Warehousing: For dummies"**, For dummies, 2nd edition, 2019.
3	*Jiaweihan, Michelinekamber, Jianpei, **"Data mining concepts and techniques"**, 3rd Edition, Morgan Kaufmann publishers, 2012.*
4	*Herbert Jones, **"Data Science: The Ultimate Guide to Data Analytics, Data Mining, Data Warehousing, Data Visualization, Regression Analysis, Database Querying, Big Data for Business and Machine Learning for Beginners",** Bravex, 2020.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Understand the basic concepts, planning and requirements for data warehousing. **(Understand)**
CO2	Understand the architecture and infrastructure of warehouses. **(Understand)**
CO3	Apply various techniques for data modelling, extraction, transformation and Loading **(Familiarize)**
CO4	Demonstrate information access and delivery in data warehouses. **(Analyze)**
CO5	Apply various techniques for physical storage implementation and maintenance. **(Analyze)**

COURSE ARTICULATION MATRIX :

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L								L	L	L
CO2	M	L	M	M	L	L			L			L	M	L
CO3	M	L	M	M	L	L			L			L	M	L
CO4	M	L	M	M	L	L			L			L	M	L
CO5	M	L	M	M	L	L			L			L	M	L
18IPE$45	M	L	M	M	L	L			L			L	M	L
L –Low, M- Medium, H- High														

18IPE$46	STORAGE TECHNOLOGIES

PRE-REQUISITES	CATEGORY	L	T	P	C
Cloud Computing	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, 1. Detailed knowledge insight into the implementation and management of various storage technologies. 2. Focus towards applying these technologies in an information lifecycle paradigm. 3. Evolution of storage and implementation models. 4. Storage devices principles, Storage classes (SAN, NAS. CAS) and Backup 5. Business Continuity, and Disaster Recovery principles	
UNIT– I	**INTRODUCTION TO STORAGE TECHNOLOGY**	**(9Periods)**
Information Storage -Data, Types of Data, Information, Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle -Information Lifecycle Management, ILM Implementation, ILM Benefits.		
UNIT– II	**DATA PROTECTION AND INTELLIGET STORAGE SYSTEM**	**(9Periods)**
Components of a Storage System Environment, RAID -Implementation of RAID, RAID Array Components, RAID levels, RAID Impact on Disk Performance, Components of an Intelligent Storage System, Intelligent StorageArray-High-end Storage Systems, Midrange Storage System.		
UNIT– III	**STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION**	**(9Periods)**
Direct-Attached Storage and Introduction to SCSI-Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, Storage Area Networks-Fibre Channel: Overview, SAN and its evolution, Components of SAN, Network-Attached Storage-General Purpose Servers vs. NAS Devices, Benefits of NAS, Components of NAS.		
UNIT– IV	**CAS AND BUSINESS CONTINUITY**	**(9Periods)**
CAS -Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS. Introduction to Business Continuity- Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis.		
UNIT– V	**BACKUP RECOVERY AND REPLICATION**	**(9Periods)**
Backup and Recovery: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Process, Backup and Restore Operations, Backup Topologies, Backup Technologies. Replication: Local Replication-Uses of Local Replicas, Data Consistency, Local Replication Technologies, Remote Replication-Modes of Remote Replication, Remote Replication Technologies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXTBOOKS:

1	*Somasundaram Gnanasundaram Alok Shrivastava,* ***"Information Storage and Management"****, 2nd Edition, Wiley Publication, 2012.*

REFERENCE BOOKS:

1	*Marc Farley,* ***"Building Storage Networks"****, Tata McGraw Hill, Osborne, 2001.*
2	*Robert Spalding,* ***"Storage Networks: The Complete Reference",*** *Tata McGraw Hill, Osborne, 2001.*
3	Silvangai, RogerAndersson,DiegoCrupnicoffandVipinJain, **"Buildingafuture-proofcloudinfrastructure:AunifiedArchforNetwork,SecurityandStorageServices"**, PearsonAddison– Wesley 2020

COURSEOUTCOMES: Oncompletion ofthe course,the studentswill beable to:	
CO1	Implement and manage various storage technologies. **(Understand)**
CO2	Applying these technologies in an information lifecycle paradigm. **(Analyze)**
CO3	Identify theevolution of storage and implementation models. **(Familiarize)**
CO4	Evaluate the Storage devices principles, Storage classes (SAN, NAS. CAS) and Backup. **(Understand)**
CO5	Analyze the Business Continuity, and Disaster Recovery principles Applying these technologies in an information lifecycle paradigm. **(Analyze)**

COURSEARTICULATIONMATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	L	M	H	L					M	M	L	M	M
CO2	M	L	M	H	L					M	M	L	M	M
CO3	M	L	M	H	L					M	M	L	M	M
CO4	M	L	M	H	L					L	M	M	M	M
CO5	M	L	M	M	L					L	M	M	M	M
18IPE$46	M	L	M	M	L					M	M	L	M	M
L –Low, M- Medium, H- High														

18IPE$28	SOFTWARE DEFINED NETWORKING

PRE-REQUISITES	CATEGORY	L	T	P	C
Data Communication and Networking	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, * Fundamentals of Software Defined Networks. * Seperation of the data Plane and Control Plane. * Principles of Software Defined Network Programming. * Various Applications of Software Defined Networks	
UNIT– I	**INTRODUCTION**	**(9Periods)**
Evolution of Software Defined Networking (SDN) – Modern Data Centre – Traditional Switch Architecture – Need for SDN – Evolution of SDN –Working of SDN – Centralized and Distributed Control Plane and Data Plane.		
UNIT– II	**OPEN FLOW AND SDN CONTROLLERS**	**(9Periods)**
OpenFlow specification - Drawbacks of Open SDN – SDN via APIs – SDN via Hypervisor-Based Overlays - SDN via Opening up the device – Network Function Virtualization – Alternatives Overlap and ranking – SDN protocol models – SDN controller Models – Application Models – Approaches to SDN security.		
UNIT– III	**DATA CENTRES AND OTHER ENVIRONMENTS**	**(9Periods)**
Data centre: Demands – Tunneling technology – Path technology – Ethernet Fabrics – SDN use Cases – Consistency Policy Configuration – Wide Area Networks – Service Providers - Campus Networks - Hospitality Networks and Mobile Networks		
UNIT– IV	**SDN PROGRAMMING AND APPLICATIONS**	**(9Periods)**
Network Function Virtualization – SDN players – Types of Applications - SDN Controllers - Controller Considerations - Device Considerations – Creating Network Virtualization Tunnels – Offloading flows in Data centre – Access Control for campus – Traffic Engineering for service Providers.		
UNIT– V	**SDN OPEN SOURCE**	**(9Periods)**
OpenFlow – Switch Implementation – Controller Implementation – Orchestration and Network Virtualization – Simulation, Testing and Tools – Open Source Cloud Software: OpenStack, CloudStack – Juniper SDN framework – IETF SDN framework – Open Daylight controller.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXTBOOKS:

1	*Paul Goransson and Chuck Black,* ***"Software Defined Networks: A Comprehensive Approach",*** *First Edition, Morgan Kaufmann, 2014.*
2	*Thomas D. Nadeau, Ken Gray,* ***"SDN: Software Defined Networks",*** *O'Reilly Media, 2013.*

REFERENCE BOOKS:

1	*Siamak Azodolmolky,* ***"Software Defined Networking with Open Flow",*** *Packet Publishing, 2013.*
2	*Vivek Tiwari,* ***"SDN and Open Flow for Beginners‖, Amazon Digital Services",*** *Inc., 2013.*
3	*Fei Hu, Editor,* ***"Network Innovation through Open Flow and SDN: Principles and Design",*** *CRC Press, 2014.*

COURSEOUTCOMES: Oncompletion ofthe course,the studentswill beable to:	
CO1	Analyze the evolution of Software Defined networks **[Analyze]**
CO2	Express the various components of SDN and its uses. **[Understand]**
CO3	Explain the use of SDN in the current Networking Scenario. **[Familiarize]**
CO4	Design and develop various applications of SDN. **[Understand]**
CO5	Demonstrate the SDN open source framework and software. **[Understand]**

COURSEARTICULATIONMATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	M	H	M	H			L			M		M	L
CO2	H	H	H	H	H	L		L			M	L	H	L
CO3	M	M	M	M	H						M	L	M	L
CO4	M	L	L	L	L						M	L	L	L
CO5	H	H	H	H	H						M	M	H	L
18IPE$28	M	M	H	M	H	L		L			M	L	M	L
L –Low, M- Medium, H- High														

18IPE$47	STREAM PROCESSING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion ofthiscourse,thestudentswillbefamiliarwith, 1. Fundamentals of Streamprocessing. 2. Systems of stream processing. 3. Properties of Stream Processing 4. Architecture of Stream Processing 5. Application and Analytics of Stream Processing	
UNIT– I	**FUNDAMENTALS OF STREAM PROCESSING**	**(9 Periods)**
Continuous data processing, Stream processing foundations- data management technology, parallel and distributed systems, signal processing, statistics and data mining, optimization theory, stream processing, Introduction to stream processing – Stream processing applications, information flow processing technologies.		
UNIT– II	**STREAM PROCESSING SYSTEMS AND APPLICATION**	**(9 Periods)**
Data, processing, system architecture, implementation, application basics – characteristics, languages, introduction to SPL, common stream processing operators, data flow programming- flow composition, flow manipulation.		
UNIT– III	**PROPERTIES OF STREAM PROCESSING**	**(9 Periods)**
Modularity and Extensibility- types, functions, primitive operators, composition and custom operators, distributed programming- logical Vs physical flow graphs, placement, transport, visualization – topology, metrics, status, data, debugging – semantic, user-defined operator, deployment, performances.		
UNIT– IV	**ARCHITECTURE OF STREAM PROCESSING SYSTEM**	**(9 Periods)**
Architecture building blocks, Architecture overview – job management, resource management, scheduling, monitoring, data transport, fault tolerance, security and access control, Infosphere stream architecture – components, services- job management, resource management, data transport, logging, tracing and error reporting, application development support, debugging.		
UNIT– V	**APPLICATION DESIGN AND ANALYTICS**	**(9 Periods)**
Design principles and patterns, functional design pattern and principles- edge adaptation, flow manipulation, dynamic adaptation, non-functional principles and design patterns – application design and composition, parallelization, performance optimization, fault tolerance.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Henrique C.M.Andrade,BugraGedikandDeepakS.Turaga,* ***"FundamentalsofStreamProcessing:ApplicationDesign,SystemsandAnalytics"****, CambridgeUniversitypress., 2014.*

REFERENCES:

1	*MartinKleppmann, **"MakingSenseofStreamProcessing"**, O'ReillyMedia,Inc., 2016.*
2	*TylerAkidan,SlavaChernyakandReuvenLax, **"StreamingSystems",** O'ReillyMedia,Inc,Second Edition, 2019.*

CO1	Understand the fundamentals of stream processing**. (Understand)**
CO2	Identify the basis of stream processing application. **(Familiarize)**
CO3	Distinguish the properties of stream processing. **(Familiarize)**
CO4	Design the architecture of stream processing. **(Analyze)**
CO5	Analyze the application of stream processing. **(Analyze)**

COURSEARTICULATIONMATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	M	M	L	M					M	L	L	M	M
CO2	L	M	M	L	M					M	L	L	M	M
CO3	L	M	M	L	M					M	L	L	M	M
CO4	L	M	M	L	M					M	L	L	M	M
CO5	L	M	M	L	M					M	L	L	M	M
18IPE$47	L	M	M	L	M					M	L	L	M	M
L –Low, M- Medium, H- High														

18IPE$48	**SECURITY AND PRIVACY IN CLOUD** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To understand the evolution of Cloud Computing and IT infrastructure security capabilities at the network, host, and application levels 2. To familiarize with data security and storage of data in the cloud, identity and access management (IAM) 3. To learn about security management frameworks and the standards 4. To understand the fundamentals of privacy aspects to consider within the context of cloud computing 5. To know about the importance of audit and compliance functions within the cloud	
UNIT – I	**INTRODUCTION AND SECURITY LEVELS**	**(9 Periods)**
The Evolution of Cloud Computing, Key Drivers to Adopting the Cloud,The Impact of Cloud Computing on Users, Governance in the Cloud Barriers to Cloud Computing Adoption in the Enterprise. Infrastructure Security - The Network Level, The Host Level, The Application Level.		
UNIT – II	**DATA SECURITY AND STORAGE**	**(9 Periods)**
Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security identity and access management- Trust Boundaries and IAM, IAM Challenges, IAM Definitions, IAM Architecture and Practice, IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management, Cloud Service Provider IAM Practice		
UNIT – III	**SECURITY MANAGEMENT IN THE CLOUD**	**(9 Periods)**
Security Management Standards, Security Management in the Cloud - Availability Management, SaaS Availability Management, PaaS Availability Management, IaaS Availability Management, Access Control - Security Vulnerability, Patch, and Configuration Management.		
UNIT – IV	**PRIVACY**	**(9 Periods)**
Privacy, Data Life Cycle, Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications		
UNIT – V	**AUDIT AND COMPLIANCE**	**(9 Periods)**
Internal Policy Compliance - Governance, Risk, and Compliance (GRC), Illustrative Control Objectives for Cloud Computing, Incremental CSP-Specific Control Objectives, Additional Key Management Control Objectives, Control Considerations for CSP Users, Regulatory/External Compliance, Other Requirements, Cloud Security Alliance, Auditing the Cloud for Compliance.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK :

1	*Tim Mather, Subra Kumaraswamy, and Shahed LatifCopyright**, "Cloud Security and Privacy",** O'Reilly Media, 2009.*

REFERENCES:

1	John R. Vacca, **"*Cloud Computing Security Foundations and Challenges",*** CRC Press, 2nd Edition, 2020.
2	*Siani Pearson, George Yee* ***"Privacy and Security for Cloud Computing"*** *Computer Communications and Networks, Springer, 2013.*
3	Ronald L. Krutz, Russell Dean Vines, **"Cloud Security: A Comprehensive Guide to Secure Cloud Computing"**, Wiley Publishing, 2010
4	Ben Halper, **"Auditing Cloud Computing: A Security and Privacy Guide"** John Wiley & Sons, Inc. Publications, 2011.

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Describe the evolution of cloud computing and IT infrastructure security capabilities that cloud services generally offer. **(Familiarize)**
CO2	Examine the current state of data security and the storage of data in the cloud and explain the identity and access management (IAM) practice and support capabilities for authentication, authorization, and auditing of users who access cloud services. **(Understand)**
CO3	Depicts security management frameworks and the standards that are relevant for the cloud. **(Familiarize)**
CO4	Explain the privacy aspects to be consider within the context of cloud computing and analyzes the similarities and differences with traditional computing models. **(Familiarize)**
CO5	Enumerate the importance of audit and compliance functions within the cloud along with the various standards and frameworks. **(Analyze)**

COURSE ARTICULATION MATRIX :

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	M	M	L	M	L					M	L	L	M
CO2	L	M	M	L	M	L					M	L	L	M
CO3	L	M	M	L	M	L					M	L	L	M
CO4	L	M	M	L	M	L					M	L	L	M
CO5	L	M	M	L	M	L					M	L	L	M
18IPE$48	L	M	M	L	M	L					M	L	L	M
L –Low, M- Medium, H- High														

VERTICAL – IV

CYBER SECURITY AND DATA PRIVACY

18IPE$49	**ETHICAL HACKING** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on Computer networks and Web technology	PE	3	0	0	3

Course Objectives	1. To explore the concepts of security testing and the knowledge required to protect against the hacker and attackers. 2. To understand reconnaissance and the publicly available tools used to gather information on potential targets. 3. To discover the scanning techniques used to identify network systems open ports. 4. To identify network system vulnerabilities and confirm their exploitability. 5. To explore techniques for identifying web application vulnerabilities and attacks.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Introduction to Hacking –Important Terminologies – Hacktivism – Computer Crimes and Implications. Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement–Penetration Testing Methodologies: OSSTMM–NIST –OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports		
UNIT – II	**INFORMATION GATHERING AND SCANNING**	**(9 Periods)**
Information Gathering Techniques: Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute: ICMP, TCP and UDP Traceroute – Enumerating and Fingerprinting the Webservers – Google Hacking – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.		
UNIT – III	**NETWORK ATTACKS**	**(9 Periods)**
Network Sniffing – Types of Sniffing – Promiscuous versus Nonpromiscuous Mode – MITM Attacks – ARP Attacks –MAC flooding - Denial of Service Attacks – Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic –DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation –Attacking Network Remote Services – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication.		
UNIT – IV	**EXPLOITATION**	**(9 Periods)**
Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E–Mails with Malicious Attachments – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Cracking the Hashes: Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials.		
UNIT – V	**WIRELESS AND WEB HACKING**	**(9 Periods)**
Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Log-In Protection Mechanisms – Captcha Validation Flaw –Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability– Session Attacks – SQL Injection Attacks.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*RafayBaloch, **"Ethical Hacking and Penetration Testing Guide"**, CRC Press, 2014.*

REFERENCES:

1	*Kevin Beaver, **"Ethical Hacking for Dummies"**, Sixth Edition, Wiley, 2018.*
2	*Kimberly Graves, **"Certified Ethical Hacker STUDY GUIDE**, Wiley publication, 2010.*
3	*Michael Gregg, **Certified Ethical Hacker**, Pearson publication, 2014.*
4	*Matt Walker, "**All-in-one Certified Ethical Hacker Exam Guide**, McGraw Hill Edition, 2012.*
5	*Jon Erickson, **"Hacking: The Art of Exploitation"**, Second Edition, Rogunix, 2007.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Use the various security tools to assess and to predict the vulnerabilities across any computing system using penetration testing. **(Familiarize)**
CO2	Identify prediction mechanism to prevent any kind of attacks using information gathering mechanisms**. (Understand)**
CO3	Protect the system using scanning techniques from malicious software and worms. **(Understand)**
CO4	Evaluate the wireless network flaws and able to apply security patches with different exploitations. **(Analyze)**
CO5	Analyze the risk and support the organization for effective security measures. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M		M	L	M			L		M			M	**L**
CO2	M	H	L	L	M			L					M	L
CO3	H		H	L	M	M		H		M			H	M
CO4	H	H	H	M	H	M		M					M	M
CO5	H	H	L	L	L			L					L	M
18IPE$49	H	H	H	L	M	L		L		M			M	M
L –Low, M- Medium, H- High														

18IPE$50	**DIGITAL AND MOBILE FORENSICS** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on Digital Data, concepts of Operating systems and functionalities of Network layers.	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with: ★ Aspects and principles of digital data as evidence. ★ Cybercrime laws and duties of experts. ★ Techniques to conduct/report a digital forensics investigation. ★ Recovery of digital evidence using a variety of software utilities. ★ Role of internet in cyber crime investigation.	
UNIT – I	**DIGITAL EVIDENCE**	**(9 Periods)**
Digital Evidence- Increasing Awareness of Digital Evidence- Principles of Digital Forensics- Challenging Aspects of Digital Evidence- Following the Cybertrail- Language of Computer Crime Investigation - Role of Computers in Crime.		
UNIT – II	**CYBER CRIME AND LAWS**	**(9 Periods)**
Duty of Experts- Admissibility - Levels of Certainty in Digital Forensics- Direct versus Circumstantial Evidence- Scientific Evidence- Presenting Digital Evidence- Federal Cybercrime Law- Constitutional Law- Specific Cybercrime Offenses- Computer-Integrity Crimes- Computer-Assisted Crimes- Content-Related Cybercrimes.		
UNIT – III	**DIGITAL INVESTIGATIONS**	**(9 Periods)**
Digital Investigation Process Models- Scaffolding- Applying the Scientific Method- Guidelines for Handling Digital Crime Scenes- Fundamental Principles- Authorization- Digital Crime Scene: Preparing to Handle, Surveying, Preserving- Equivocal Forensic Analysis- Crime Scene Characteristics - Threshold Assessments- Modus Operandi- Motive and Technology.		
UNIT – IV	**COMPUTER AND MOBILE FORENSICS**	**(9 Periods)**
Representation of Data- Storage Media and Data Hiding- File Systems and Location of Data- Dealing with Password Protection and Encryption- Applying Forensic Science to Computers- Digital Evidence: Windows Systems, UNIX Systems, Macintosh Systems- Understanding Mobile Device Security - Analyzing SIM Cards - Analyzing Android, BlackBerry and iOS devices.		
UNIT – V	**NETWORK FORENSICS**	**(9 Periods)**
Role of the Internet in Criminal Investigations- Connecting Networks Using Internet Protocols- Legitimate versus Criminal Uses- Using the Internet as an Investigative Tool- Online Anonymity and Self-Protection- Forgery and Tracking: E-mail, Usenet- Linking the Data-Link and Network Layers: Encapsulation- Documentation, Collection, and Preservation- Analysis Tools and Techniques- TCP/IP-Related Digital Evidence.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Eoghan Casey,* ***"Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet"****, Elsevier, Third Edition, 2011.*
2	*Reiber Lee,* ***"Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation"****, McGraw Hill LLC, Second Edition, 2018.*

REFERENCES:

1	*Soufiane Tahiri,* ***"Mastering Mobile Forensics"****, Packt Publishing, 2016.*
2	*Oleg Afonin,* ***"Mobile Forensics – Advanced Investigative Strategies"****, Packt Publishing, 2016.*
3	*Filipo Sharevski,* ***"Mobile Network Forensics Emerging Research and Opportunities"****, IGI Global, 2018.*
4	*Ali Dehghantanha, Kim-Kwang Raymond Choo,* ***"Investigations of Cloud and Mobile Applications"****, Elsevier Science, 2016.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Define the terminologies involved in digital evidence and different aspects of computer crime investigations. **(Familiarize)**
CO2	Recite legal issues that arise in computer-related investigations and cyber laws. **(Familiarize)**
CO3	Demonstrate the usage of digital evidence in reconstructing a crime or incident, identify suspects and understand criminal motivations. **(Understand)**
CO4	Analyze the role of computers and digital devices in crime investigations. **(Understand)**
CO5	Examine the underlying complexity of computer networks in digital investigation mechanism. **(Analyze)**

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	M	L		L		L							M	L
CO2	M	L	L	L		L						L	M	L
CO3	M	L	M	M	L	L	L	L				L	M	M
CO4	M	M	M	M	L	L	L	L				L	M	M
CO5	M	L	M	M	L	L	L	L				L	M	M
18IPE$50	M	L	M	M	L	L	L	L				L	M	M
L –Low, M- Medium, H- High														

18IPE$51	**SOCIAL NETWORK SECURITY** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on Cryptography, Information Security and Network Security	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with: * The need for security and privacy in online social networks. * Understand issues and challenges associated with securing social networks. * Crowdsourcing and its effects * Trust management and context aware resource discovery in online social networks. * Understand the behavioral characteristics of end users.

UNIT – I	**INTRODUCTION**	**(9 Periods)**
Structure and Evolution of Online Social Networks – Diffusion of Information - Security and Privacy in Social Networks –Privacy and anonymization in Social Networks - Interdisciplinary Impact Analysis of Privacy in Social Networks.		
UNIT – II	**SECURITY ISSUES AND TECHNICAL CHALLENGES**	**(9 Periods)**
Risks of Social Networking – False information and information leakage – Retention – Backup – Loss of data – Risk Management – Policies and privacy – Handling fake account, passwords, privacy and information sharing – content security.		
UNIT – III	**CROWDSOURCING AND ITS MEASURES**	**(9 Periods)**
Recognizing Your Digital Friends - Encryption and Decryption for Peer-to-Peer Social Networks - Crowdsourcing and Ethics - The Effect of Social Status on Decision-Making - Applications of k-Anonymity and ℓ-Diversity in Publishing Online Social Networks**.**		
UNIT – IV	**CONTROLLED INFORMATION SHARING**	**(9 Periods)**
Managing security issues in social networks –Trust Management – Types of trust – Controlled Information Sharing – Secure resource discovery –Context Awareness - Access Control and Inference for Social Networks.		
UNIT – V	**PROFILING ONLINE USERS**	**(9 Periods)**
Profiling Online Users: Emerging Approaches and Challenges - Securing Mobile Social Networks- Protecting Regular and Social Network Users in a Wireless Network by Detecting Rogue Access Point: Limitations and Countermeasures- Cross-Site Scripting Attack – Defense against Online Social Networks		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	Yaniv Altshuler, Yuval Elovici, Armin B.Cremers, Nadav Aharony, Alex Pentland, **"*Security and Privacy in Social Networks*"**, Springer , 2012
2	Michael Cross, **"*Social Media Security: Leveraging Social Networking While Mitigating Risk*"**, Syngress, 2013.

REFERENCES :

1	Barbara Carminati , Elena Ferrari , Marco Viviani, **"*Security*and Trust in Online Social Networks"** , Springer, 2014.
2	Al-Sakib Khan Pathan, **" *Securing Social Networks in Cyberspace"*** ,CRC Press, 2022
3	Bhavani Thuraisingham, Satyen Abrol, Raymond Heatherly, Murat Kantarcioglu, Vaibhav Khadilkar, Latifur Khan, **"*Analyzing and Securing Social Networks*"**, Auerbach Publications, 2020.
4	**Brij B. Gupta, Somya Ranjan Sahoo, "*Online Social Networks Security Principles, Algorithm, Applications, and Perspectives*", CRC Press, 2021.**

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Recite the need for security and privacy in Social Networks.**(Familiarize)**
CO2	Argue Risk Management, Policies and Decision making in Social Networks. **(Familiarize)**
CO3	Describe Crowdsourcing and its countermeasures for Online Social Networks.**(Familiarize)**
CO4	Examine trust, privacy and access control mechanisms for Social Networks. **(Understand)**
CO5	Determine and analyze attacks on Social Networks. **(Understand)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1		L											L	M
CO2		M	L										L	M
CO3	L	M	L	H	H	M		M					L	M
CO4	L	M	L	M	H			M					M	M
CO5	L	M	L	H	H	M		M					M	M
18IPE$51	L	M	L	M	H	M		M					M	M
L –Low, M- Medium, H- High														

18IPE$52	**MODERN CRYPTOGRAPHY** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on number theory and basic cryptography	**PE**	**3**	**0**	**0**	**3**

Course Objectives	Upon completion of this course, the students will be familiar with, ★ Principles and concepts of modern cryptography. ★ Modern public key cryptographic algorithms. ★ Number Theory and private key cryptography. ★ Identity based encryption mechanism. ★ Post quantum cryptographic algorithms.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Cryptography and Modern Cryptography- Basic Principles of Modern Cryptography - Perfectly-Secret Encryption - Computational Complexity - Zero-knowledge Properties - Zero-knowledge Argument - Protocols with Two-sided-error - Round Efficiency - Non-interactive Zero-knowledge.		
UNIT – II	**SYMMETRIC CRYPTOGRAPHY**	**(9 Periods)**
Computational Approach to Cryptography - Defining Computationally-Secure Encryption – Secure Communication and Message Integrity-Collision-Resistant Hash Functions - NMAC and HMAC - One-Way Functions -Limitations of Private-Key Cryptography.		
UNIT – III	**ASYMMETRIC CRYPTOGRAPHY**	**(9 Periods)**
Primes and Divisibility - Modular Arithmetic - Cyclic Groups - Algorithms for Factoring -, Computing Discrete Logarithms - Goldwasser-Micali Encryption Scheme - Rabin Encryption Scheme - Paillier Encryption Scheme - Digital Signature Schemes - Lamport's One-Time Signature Scheme - Signatures from Collision-Resistant Hashing.		
UNIT – IV	**IDENTITY BASED ENCRYPTION**	**(9 Periods)**
Bilinear map – Security Model- Hardness Assumptions - Boneh-Franklin Identity based Encryption (IBE) – Gentry's IBE- Dual System Encryption – Waters' IBE - Boneh-Boyen IBE – Security Model for Hierarchical IBE - Waters' Realization – Generic Group Model.		
UNIT – V	**POST QUANTUM CRYPTOGRAPHY**	**(9 Periods)**
Lattice Problems – NTRU Cryptosystem - Lattice-Based Cryptography – Ring Variants of Learning with Errors (LWE) & Learning with Rounding (LWR) - (LWE+LWR)-Based Public-Key Encryption – Ring Variant of Lizard- Code based Cryptography: McEliece & Niederreiter Cryptosystem, Security Analysis.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Jonathan Katz and Yehuda Lindell,* ***"Introduction to Modern Cryptography",*** *CRC press, 2008.*
2	*Intae Kim, Wai Kong Lee, Seong Oun Hwang,* ***"Modern Cryptography with Proof Techniques and Implementations",*** *CRC press, 2021*

REFERENCES:

1	*William Stallings,* ***"Cryptography and Network security Principles and Practices",*** *Pearson/PHI, 2016.*
2	*Wade Trappe, Lawrence C Washington,* ***"Introduction to Cryptography with coding theory",*** *Pearson, 2020.*
3	*W. Mao,* ***"Modern Cryptography – Theory and Practice",*** *Pearson Education, 2003.*
4	*Song Y. Yan ,* ***"Computational Number Theory and Modern Cryptography",*** *Wiley, 2013.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Realize the modern cryptographic principles and concepts. **(Familiarize)**
CO2	Apply a symmetric cryptography mechanism for encryption using hash functions**. (Understand)**
CO3	Apply asymmetric cryptography mechanism for public key encryption.**(Understand)**
CO4	Demonstrate identity based encryption using hardness assumption and security models. **(Understand)**
CO5	Use post-quantum standardization algorithms. **.(Understand)**

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O 2**
CO1	M	M										L	M	
CO2	M	M	M	L		L						L	M	L
CO3	M	M	M	L		L						L	M	L
CO4	M	M	M	H		L					L	L	M	L
CO5	M	M	L	H	M	L					M	L	M	L
18IPE$52	M	M	M	M	L	L					L	L	M	L
L –Low, M- Medium, H- High														

18IPE$53	ENGINEERING SECURE SOFTWARE SYSTEMS

PREREQUISITES	CATEGORY	L	T	P	C
Knowledge on Software Development life cycle and software testing	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, ★ Identify and mitigate potential security risks in software systems. ★ Touchpoints for software security in different stages of software development, including requirements gathering, design, implementation, and testing. ★ Identification and assess risks associated with different software architectures. ★ Knowledge of risk-based security testing, identify security risks, prioritize them and develop testing strategies to mitigate them. ★ Use testing tools and techniques to identify vulnerabilities and ensure the security of software systems.	
UNIT – I	**SOFTWARE SECURITY FUNDAMENTALS**	**(9 Periods)**
Security Problems in Software - Pillars of Software Security - Rise of Security Engineering - Risk Management into Practice - Five Stages of Activity - Risk Management Framework (RMF): Multilevel Loop, Applying the RMF, Software Security - Importance of Measurement.		
UNIT – II	**TOUCHPOINTS FOR SOFTWARE SECURITY**	**(9 Periods)**
Flyover- Black and White - Moving Left - Touchpoints as Best Practices - Who Should Do Software Security? - Multidisciplinary Effort - Touchpoints to Success - Catching Implementation Bugs Early - Approaches to Static Analysis - Commercial Tool Vendors - Touchpoint Process - Use a Tool to Find Security Bugs.		
UNIT – III	**ARCHITECTURAL RISK ANALYSIS**	**(9 Periods)**
Security Risk Analysis Approaches - Traditional Risk Analysis Terminology - Knowledge Requirement - Forest-Level View - Example of a Risk Calculation - Traditional Vs. Modern Risk Analysis - Architectural Risk Analysis using Touchpoint - Penetration Testing - Incorporating Findings Back into Development - Using Penetration Tests to Assess the Application Landscape - Proper Penetration Testing.		
UNIT – IV	**RISK-BASED SECURITY TESTING**	**(9 Periods)**
Risk Management and Security Testing - How to Approach Security Testing - Thinking about (Malicious) Input - Getting Over Input - Leapfrogging the Penetration Test - Security Is Not a Set of Features - Creating Useful Abuse Cases - Abuse Case Development using Touchpoint - Abuse Cases Are Useful – Kumbaya.		
UNIT – V	**KNOWLEDGE FOR SOFTWARE SECURITY**	**(9 Periods)**
Business Climate - Building Blocks of Change - Building an Improvement Program - Establishing a Metrics Program - Continuous Improvement – COTS - Adopting a Secure Development Lifecycle - Experience, Expertise, and Security - Security Knowledge: A Unified View - Security Knowledge and the Touchpoints - Department of Homeland Security Build Security In Portal - Taxonomy of Coding Errors - Phyla - Lists, Piles, and Collections.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*McGraw, Gary, **"Software Security: Building Security In"**, Addison-Wesley, 2006.*

REFERENCES:

1	*John Viega, Gary McGraw ,* ***"Building Secure Software: How to Avoid Security Problems the Right Way"****, Addison-Wesley, 2011.*
2	*Raimundas Matulevicius,* ***"Fundamentals of Secure System Modelling"****, Springer International Publishing, 2017.*
3	*Charles Antony Richard Hoare* , **"*Software System Reliability and Security*"**, *IOS Press* , 2007.
4	*Heather Adkins, Betsy Beyer, Paul Blankinship, Piotr Lewandowski, Ana Oprea, Adam Stubblefield,* ***"Building Secure and Reliable Systems Best Practices for Designing, Implementing, and Maintaining Systems"****, O'Reilly Media, 2020.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Understand the fundamental principles of software security, including common threats and vulnerabilities. **(Familiarize)**
CO2	Identify security Touchpoints in the software development lifecycle and develop strategies to integrate security into each stage of the development process. **(Understand)**
CO3	Understand the concepts and methods of architectural risk analysis, and apply penetration testing techniques to identify and prioritize security risks in software architectures. **(Understand)**
CO4	Develop the ability to perform risk-based security testing, identify vulnerabilities and assess the effectiveness of security controls. **(Understand)**
CO5	Acquire a comprehensive knowledge of software security and apply this knowledge to develop and implement effective software security strategies. **(Understand)**

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	L	L											L
CO2	M	M	M									M	M	L
CO3	M	M	M	M		L				M			M	L
CO4	M	M	M	M	M	L					M		M	L
CO5	M	M	M	M	M		M			M	M		M	L
18IPE$53	M	M	M	M	L	L	L			L	L	L	M	L
L –Low, M- Medium, H- High														

18IPE$54	**CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on Cryptography and Computer Networks	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, ★ Blockchain concepts and its types. ★ Blockchain networks and Block synchronization. ★ Basics of bitcoins in cryptocurrency. ★ Smart contracts and Ethereum networks. ★ Applications of Blockchain in financial and non financial projects.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Blockchain definitions- Database vs. Blockchain- History, motivations & Characteristics - Background of Distributed Ledger Technology- Different types of Blockchain- Building blocks- Moore's Law & Blockchain - Cryptography in Blockchain- Cryptographic hashing- Digital signatures in Blockchain.		
UNIT – II	**NETWORKS IN BLOCKCHAIN**	**(9 Periods)**
P2P networking architecture- Network discovery - Block synchronization - Building a simple blockchain in a P2P network - Blockchain structure - Blockchain networks - Bitcoin hard forks and altcoins - Cryptocurrency application.		
UNIT – III	**BITCOIN & CRYPTOCURRENCY**	**(9 Periods)**
Tokens in Cryptocurrency - Non-Fungible Tokens: Types, Extrinsic Elements, Creating and Minting, Buying and Selling - Fungible Tokens: Bitcoin basics, Keys and addresses, Transactions - Mining and consensus – Bitcoin Network and Payments- Bitcoin Clients and APIs - Alternative Coins- MultiChain platform - Setting up a blockchain environment.		
UNIT – IV	**SMART CONTRACTS & ETHEREUM**	**(9 Periods)**
Proof of Existence architecture - Building the Proof of Existence application - Digital assets and identity - Proof of ownership- Smart contracts- NEO blockchain - Choosing the smart contract platform – Ethereum network - Components of the Ethereum ecosystem- Test networks – Setting and Starting up a private network.		
UNIT – V	**BLOCKCHAIN APPLICATIONS**	**(9 Periods)**
Financial blockchain projects- Non-financial blockchain projects- Blockchain optimizations - Blockchain enhancements - Transaction security model- Decentralized security model - Attacks on the blockchain – Block in Financial system and crowdfunding.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Bashir Imran,* ***"Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained"*** *Packt publisher, 2017.*
2	*Koshik Raj,* ***"Foundations of Blockchain: The pathway to cryptocurrencies and decentralized blockchain applications"****, Packt publisher, 2019.*

REFERENCES:

1	*Fortnow Matt, Terry QuHarrison,* ***"The NFT Handbook: How to Create, Sell and Buy Non-Fungible Tokens",*** *Wiley, 2021.*
2	*Chris Dannen,* ***"Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners"****, Apress publisher, 2017.*
3	*S. Shukla, M. Dhawan, S. Sharma and S. Venkatesan,* ***"Blockchain Technology: Cryptocurrency and Applications"****, Oxford University Press, 2019.*
4	*Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder,* ***"Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction"****, Princeton University Press, 2016.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Understand the basics and apply cryptographic concepts in blockchain. **(Familiarize)**
CO2	Apply the concepts of P2P to achieve decentralization in the blockchain network. **(Understand)**
CO3	Demonstrate the concepts of Tokens and decentralized application development using MultiChain blockchain framework. **(Understand)**
CO4	Apply proof of existence and ownership through smart contracts. **(Understand)**
CO5	Examine blockchain concepts for various financial and Non-financial applications. **(Analyze)**

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	M	M		L									L	
CO2	M	M	L	L									L	
CO3	M	M	M	M	M								M	
CO4	M	M	M	M			L	M				L	M	L
CO5	M	M	M	M	M	L	L					L	M	L
18IPE$54	M	M	M	M	L	L	L	L				L	M	L
L –Low, M- Medium, H- High														

18IPE$12	**INFORMATION SECURITY** *(Common to CSE & IT)*

PREREQUISITES	CATEGORY	L	T	P	C
Knowledge on Information processing, Network Layers, Operating System and Cryptography.	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, ★ Threats, attacks and issues in a security model. ★ Cryptography to secure data. ★ Firewalls, wireless security and intrusions. ★ Security of operating systems, servers and mobile devices. ★ Ensuring availability of data.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
The History of Information Security - CNSS Security Model -Components of an Information System - Security Professionals and the Organization – the need for security – threats – attacks – Secure software development – Legal, Ethical, and Professional Issues in Information Security- Risk Analysis.		
UNIT – II	**DATA SECURITY**	**(9 Periods)**
Securing Unstructured Data – Overview of Information Rights Management – Encryption – Symmetric key cryptography – Public key cryptography – Public key Infrastructure - Modern Storage Security – Database security.		
UNIT – III	**NETWORK SECURITY**	**(9 Periods)**
Secure Network Design - Network Device Security – Firewalls – Virtual Private Network – Wireless Network Security - Intrusion Detection and Prevention Systems - Voice Over IP (Voip) And PBX Security.		
UNIT – IV	**COMPUTER SECURITY**	**(9 Periods)**
Operating System Security Models – Unix Security – Windows Security – Securing E-mail, Web servers, DNS servers, Proxy Servers – Protecting Virtual Storage and Networks - Securing Mobile Devices.		
UNIT – V	**SECURITY OPERATIONS AND PHYSICAL SECURITY**	**(9 Periods)**
Security Operations Management - Disaster Recovery - Business Continuity – Backups - High Availability - Incident Response - Forensic Analysis. Physical security: Physical Vulnerability Assessment - Choosing Site Location for Security - Locks and Entry Controls - Physical Intrusion Detection.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Mark Rhodes-Ousley* ***"Information Security The Complete Reference"*** *2nd edition, McGraw Hill Professional, 2013.*

REFERENCES:

1	*Michael E. Whitman, Herbert J. Mattord,* ***"Principles of Information Security"****, 4th edition, Cengage Learning, 2011.*
2	*Jason Andress, Steven Winterfeld,* ***"The Basics of Information Security – Understanding the Fundamentals of Infosec in Theory and Practice"****, 2nd edition, Syngress, 2014.*
3	*Michael Whitman, Herbert Mattord,* ***"Management of Information Security"****, 3rd edition, Nelson Education, 2013.*
4	*Richard E.Smith,* ***"Elementary Information Security"****, 2nd edition, Jones & Bartlett Publishers, 2015.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1	Identify threats and attacks to the information within systems. **(Familiarize)**
CO2	Secure information stored in servers, storage networks and databases using cryptography. **(Understand)**
CO3	Secure the network using proper design, firewalls and intrusion detection and prevention systems. **(Understand)**
CO4	Apply proper access control mechanisms to protect operating systems, e-mail, servers and mobile devices. **(Understand)**
CO5	Apply appropriate disaster recovery plan and backup to ensure high availability of data. **(Understand)**

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	H	H	L	L		H		M				M	H	M
CO2	H	H	L	M		H		M				M	H	M
CO3	H	H	L	H		H		M				M	H	M
CO4	H	H	L	H		H		M				M	H	M
CO5	H	H	L	H		H		M				M	H	M
18IPE$12	H	H	L	H		H		M				M	H	M
L –Low, M- Medium, H- High														

18IPE$48	SECURITY AND PRIVACY IN CLOUD *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To understand the evolution of Cloud Computing and IT infrastructure security capabilities at the network, host, and application levels 2. To familiarize with data security and storage of data in the cloud, identity and access management (IAM) 3. To learn about security management frameworks and the standards 4. To understand the fundamentals of privacy aspects to consider within the context of cloud computing 5. To know about the importance of audit and compliance functions within the cloud

UNIT – I	**INTRODUCTION AND SECURITY LEVELS**	**(9 Periods)**
The Evolution of Cloud Computing, Key Drivers to Adopting the Cloud,The Impact of Cloud Computing on Users, Governance in the Cloud Barriers to Cloud Computing Adoption in the Enterprise. Infrastructure Security - The Network Level, The Host Level, The Application Level.		
UNIT – II	**DATA SECURITY AND STORAGE**	**(9 Periods)**
Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security identity and access management- Trust Boundaries and IAM, IAM Challenges, IAM Definitions, IAM Architecture and Practice, IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management, Cloud Service Provider IAM Practice		
UNIT – III	**SECURITY MANAGEMENT IN THE CLOUD**	**(9 Periods)**
Security Management Standards, Security Management in the Cloud - Availability Management, SaaS Availability Management, PaaS Availability Management, IaaS Availability Management, Access Control - Security Vulnerability, Patch, and Configuration Management.		
UNIT – IV	**PRIVACY**	**(9 Periods)**
Privacy, Data Life Cycle, Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications		
UNIT – V	**AUDIT AND COMPLIANCE**	**(9 Periods)**
Internal Policy Compliance - Governance, Risk, and Compliance (GRC), Illustrative Control Objectives for Cloud Computing, Incremental CSP-Specific Control Objectives, Additional Key Management Control Objectives, Control Considerations for CSP Users, Regulatory/External Compliance, Other Requirements, Cloud Security Alliance, Auditing the Cloud for Compliance.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK :

1	*Tim Mather, Subra Kumaraswamy, and Shahed LatifCopyright**, "Cloud Security and Privacy",** O'Reilly Media, 2009.*

REFERENCES:

1	John R. Vacca, **"*Cloud Computing Security Foundations and Challenges",*** CRC Press, 2nd Edition, 2020.
2	*Siani Pearson, George Yee* ***"Privacy and Security for Cloud Computing"*** *Computer Communications and Networks, Springer, 2013.*
3	Ronald L. Krutz, Russell Dean Vines, **"Cloud Security: A Comprehensive Guide to Secure Cloud Computing"**, Wiley Publishing, 2010
4	Ben Halper, **"Auditing Cloud Computing: A Security and Privacy Guide"** John Wiley & Sons, Inc. Publications, 2011.

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Describe the evolution of cloud computing and IT infrastructure security capabilities that cloud services generally offer. **(Familiarize)**
CO2	Examine the current state of data security and the storage of data in the cloud and explain the identity and access management (IAM) practice and support capabilities for authentication, authorization, and auditing of users who access cloud services. **(Understand)**
CO3	Depicts security management frameworks and the standards that are relevant for the cloud. **(Familiarize)**
CO4	Explain the privacy aspects to be consider within the context of cloud computing and analyzes the similarities and differences with traditional computing models. **(Familiarize)**
CO5	Enumerate the importance of audit and compliance functions within the cloud along with the various standards and frameworks. **(Analyze)**

COURSE ARTICULATION MATRIX :

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	M	M	L	M	L					M	L	L	M
CO2	L	M	M	L	M	L					M	L	L	M
CO3	L	M	M	L	M	L					M	L	L	M
CO4	L	M	M	L	M	L					M	L	L	M
CO5	L	M	M	L	M	L					M	L	L	M
18IPE$48	L	M	M	L	M	L					M	L	L	M
L –Low, M- Medium, H- High														

VERTICAL – V

CREATIVE MEDIA

18IPE$20	VIRTUAL AND AUGMENTED REALITY

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, * Basic components, input devices and output devices of Virtual Reality systems. * Computing architecture, Modeling and programming toolkits of VR systems. * Various applications of VR systems. * Basics and functional components of AR systems. * Content, Interaction and applications of AR systems.	
UNIT – I	**INTRODUCTION TO VIRTUAL REALITY**	**(9 Periods)**
The three I's of VR – Basic components of a VR system – VR input devices – 3D position trackers – Navigation and manipulation interfaces – Gesture interfaces – Output devices – Graphics – Sound – Haptic feedback.		
UNIT – II	**VR ARCHITECTURE, MODELING AND PROGRAMMING**	**(9 Periods)**
VR computing architecture – Rendering pipeline – PC graphics architecture – Workstation based architecture – Distributed architecture – Modeling – Geometric modeling – Kinematics modeling – Behaviour modeling – VR Programming – Toolkits and scene graphs – Worldtoolkit – Java 3D – General haptics open software toolkits – Peopleshop.		
UNIT – III	**VR APPLICATIONS**	**(9 Periods)**
Medical applications of VR – Education, Art and entertainment – Military applications – VR applications in manufacturing – VR in Robotics – Information visualization.		
UNIT – IV	**AUGMENTED REALITY**	**(9 Periods)**
Introduction to Augmented Reality – Working of AR – Ingredients of AR –Hardware components of AR systems – Software components of AR systems.		
UNIT – V	**AR APPLICATIONS**	**(9 Periods)**
Creating visual, audio and sensible contents – Interaction in AR – Application areas of Augmented Reality – Applying and evaluating augmented reality – Introduction to Mobile AR – Architecture of Mobile AR systems – Advantages/Disadvantages of Mobile AR.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Grigore C.Burdea, Philippe coiffet,* ***"Virtual Reality: Technology",*** *Wiley India, 2nd edition, 2003.*
2	*Alan B.Craig,* ***"Understanding Augmented Reality: Concepts and Applications",*** *Morgan Kaufmann publications, 1st edition, 2013.*

REFERENCES :

1	*Sherman, William R. and Alan B. Craig,* ***"Understanding Virtual Reality – Interface, Application, and Design",*** *Morgan Kaufmann, 2002.*
2	*Fei GAO,* ***"Design and Development of Virtual Reality Application System",*** *Tsinghua Press, March 2012.*
3	*Greg Kipper, Joseph Rampolla,* ***"Augmented Reality: An Emerging Technologies Guide to AR",*** *Syngress, 2013.*
4	*Jon Peddie,* ***"Augmented Reality",*** *where we will all live, sprnget, 2017.*
5	*Johb Bucher,* ***"Stongtelling for virtual reality : Methods and principles for crafting immersive narratives",*** *Focal Press Book 2018.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Identify and explain the components of VR systems. **[Understand]**
CO2	Model and program the VR systems. **[Understand]**
CO3	Realize the importance and applications of VR systems. **[Understand]**
CO4	Identify and explain the components of AR systems. **[Understand]**
CO5	Realize the importance and applications of AR systems. **[Understand]**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H		M		L	L	L			L	L	L	M	L
CO2	H	H	H	M	L					L	L	L	H	L
CO3	H					M	L			L	L	L	L	L
CO4	H		M		L	L	L			L	L	L	M	L
CO5	H	M	H	L	L	L	L			L	L	L	M	L
18IPE$20	H	L	M	L	L	L	L			L	L	L	M	L
L –Low, M- Medium, H- High														

18IPE$55	MULTIMEDIA AND ANIMATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To learn the basics and Fundamentals of Multimedia. 2. To introduce Multimedia components and Tools 3. To understand how Multimedia can be incorporated 4. To provide a holistic view about the core and advanced animation principles 5. To explore the application avenues for the Multimedia and Animation concepts.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Introduction to mulitmedia and animation- Multimedia systems - Design Fundamentals - ELements of Multimedia and animation and their use - Background of art, color theory overview - sketching and illustration - storyboarding - Different tools for animation.		
UNIT – II	**MULTIMEDIA FILE FORMATS**	**(9 Periods)**
Overview of vector and raster graphics - Image file formats -Text and Typography -Audio ,Music and Sound Effects : audio fundamentals - MIDI and Digital Music -Audio file formats and compression schemes- Video: Analog and Digital video -Display standards and playback options - video compression schemes and file formats		
UNIT – III	**MULTIMEDIA AUTHORING AND PROJECTS**	**(9 Periods)**
Paint and draw applications -Graphic effects and techniques - Anti aliasing -morphing -multimedia authoring tools - professional development tools -Multimedia Projects: planning and costing - Designing and producing -contents and talent- Delivering		
UNIT – IV	**INTRODUCTION TO ANIMATION**	**(9 Periods)**
Introduction - Definition -The History of Animation - Techniques behind Animation -Difference between film and animation - Principles of animation -Approaches of animation -Basic animation techniques - advanced animation techniques - Bitmapped and shape elements -Recording animation		
UNIT – V	**ANIMATION FILE FORMATS**	**(9 Periods)**
Classification of Animation - Difference between conventional method of animation and -digital animation - Types of animation - Hardware and software requirements-Difference between 2D and 3D animation film, cartoon movie, animation and broadcasting		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Atul P. Godse, Dr. Deepali A. Godse, **"Multimedia and Animation",** Technical publications,2020
2	Ze-Nian Li and Mark S.Drew, **"Fundamentals of Multimedia",** Pearson Education, 2 nd edition, 2014.

REFERENCES :

1	Prabhat K Andleigh, Kiran Thakrar, **"Multimedia systems design",** PHI, 1 st edition, 1996
2	Sreeparna Banerjee, **"Elements of Multimedia",** CRC Press, 2019
3	Jennifer Coleman Dowling, **"Multimedia Demystified",** McGraw Hill LLC,2011
4	Tay Vaughan, **"Multimedia: Making it Work",** McGraw Hill Publication, Eighth Edition, 2010

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand multimedia components using various tools and techniques. **(Understand)**
CO2	Discuss about different types of media format and their properties. **(Familiarize)**
CO3	Design and Develop multimedia applications and projects. **(Analyze)**
CO4	Identify the fundamental animation features and functions. **(Understand)**
CO5	Develop vector graphics and 2D animations, making use of various tools and animation techniques. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L	M	L		L	L	L	L	L	L	L
CO2	L	L	L	L	M	L		L	L	L	L	L	L	L
CO3	M	M	M	M	H	L		M	H	M	L	L	L	L
CO4	M	M	M	M	M	L		L	H	M	L	L	L	L
CO5	M	M	M	M	H	L		L	H	M	L	L	L	L
18IPE$55	M	M	M	M	H	L		L	H	M	L	L	L	L
L –Low, M- Medium, H- High														

18IPE$56	VIDEO CREATION AND EDITING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To introduce students to the principles and techniques of video creation and editing. 2. To provide hands-on experience with video production equipment and software. 3. To teach students the basics of visual storytelling and video production. 4. To give students practical experience with planning, executing, and editing video projects. 5. To foster critical thinking and creativity in developing and executing video projects.	
UNIT – I	**INTRODUCTION TO VIDEO CREATION AND EDITING**	**(9 Periods)**
Overview of video creation and editing -Brief history of video and film production -Understanding visual storytelling: developing documentary and dramatic projects- introduction to digital systems		
UNIT – II	**PRE-PRODUCTION**	**(9 Periods)**
Developing a concept and idea - Scriptwriting and storytelling -The Digital image - Film systems and cameras -The film image		
UNIT – III	**PRODUCTION**	**(9 Periods)**
Camera operation and techniques: The video camcorder- The Lens - Lighting and sound recording techniques - Directing actors and crew -Conducting interviews -Shooting the movie		
UNIT – IV	**POST-PRODUCTION**	**(9 Periods)**
Picture and Dialogue editing - Editing digital video -sound editing and mixing -Color grading and correction-Sound editing and mixing		
UNIT – V	**DISTRIBUTION AND PROMOTION**	**(9 Periods)**
Presenting the project - funding sources - budgets- business arrangements- legal and copyright issues-distribution and marketing - publicity and the marketing campaigns-building and sustaining a career		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Steven Ascher and Edward Pincus,The Filmmaker's Handbook: A Comprehensive Guide for the Digital Age,Fifth edition Penguin Publishing Group, 2012

REFERENCES :

1	Walter Murch, **"In the Blink of an Eye: A Perspective on Film Editing",** Silman-James Press,2001
2	Karel Reisz and Gavin Millar, **"The Technique of Film Editing",** second edition ,Taylor and Francis Group 2017
3	Ken Dancyger, **"The technique of film and video editing"**, fifth edition , Elsevier 2011.
4	Chris Kenworthy, **"Digital video production cookbook",** OReillyMedia , 2006
5	Mark Brindle, **"The Digital Filmmaking Handbook",** Quercus Publishing, 2014

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Demonstrate an understanding of the history and evolution of video production and editing. **(Understand)**
CO2	Develop and execute a concept, script, and storyboard for a video project. **(Analyze)**
CO3	Plan and prepare for a video shoot, including casting, location scouting, and budgeting. **(Analyze)**
CO4	Edit and assemble video footage using basic and advanced editing techniques. **(Understand)**
CO5	Promote and distribute the final video on various platforms. **(Familiarize)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L	L	L		L	L	L	L	L	M	L
CO2	L	L	L	L	M	L		H	H	H	M	L	M	M
CO3	M	M	M	M	M	M		H	H	M	H	L	M	H
CO4	M	M	M	M	H	M		H	H	M	M	L	M	H
CO5	M	M	M	M	H	M		H	H	H	H	L	M	H
18IPE$56	M	M	M	M	H	M		H	H	M	M	L	M	H
L –Low, M- Medium, H- High														

18IPE$41	**UI AND UX DESIGN** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	**Upon completion of this course, the students will be familiar with,** • Principles of UX design, such as user research, user personas and user journey mapping • Importance of color theory, typography, layout, and visual hierarchy • Usage of design tools and software, such as Sketch, Figma, Adobe XD and Invision • Usage of wireframes and prototypes using design software to communicate design ideas • Methods for evaluating user interfaces

UNIT – I	**INTRODUCTION TO UI DESIGN**	**(9Periods)**

Basics of HCI - Design process- HCI in software process – Basics of interaction design - UI Design and Why it matters – UI disasters – Case studies – Design Process – Introduction – Usability Engineering – Task centered approaches – Use cases – Personas – Tasks – Scenarios –Design centered approaches – Psychology and human factors for UI Design – Fitts Law – Short-term – long-term – attention – perception – conceptual models – Design principles – visibility – feedback – mappings – constraints – High-level models – distributed cognition – activity theory – situated action

UNIT – II	**USER RESEARCH**	**(9Periods)**

UserCentered Approaches to Interaction Design -User Research methods – Interview and Focus groups – Observations – Contextual inquiry – Ethics and Consent – User Research Protocol – Log Analysis – Surveys and Questionnaires – Translating User Research to Support design – Qualitative analysis – Quantitative analysis – Examples - Implications for Design – From Research to Ideas – Ideation – Selection – Communicating to Stakeholders

UNIT – III	**PROTOTYPING**	**(9Periods)**

Interface Prototying techniques – Low fidelity – Paper prototype – Wireframing – Tool-based – Physical low fidelity prototyping – Introduction to Design principles and patterns – Layout – Color and consistency – Cultural factors – Interaction design patterns – Google Material design – Design critiques – eliciting and giving feedback

UNIT – IV	**UNIVERSAL DESIGN**	**(9Periods)**

Introduction – Sensory and Cognitive Impairments – Physical limitations – tools and standards – Design for older adults and children – Socio-economic differences – Design for different platforms and contexts – Mobile UI design – Wearable – Automotive User Interfaces – IoT and Physical Computing

UNIT – V	**EVALUATING USER INTERFACES AND TOOLS**	**(9Periods)**

Introduction to Evaluating User interfaces and Evaluation in UI Design process – Evaluation without users – Action Analysis – Cognitive Walkthroughs – Heuristic Evaluation – Nielsen's heuristics – Evaluation with Users – User Testing – Goals – Formative and Summative Evaluation – Ethics in evaluation – Tools – Adobe XD – Figma –Invision -Sketch

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Rex Hartson, Pardha S Pyla,* ***"The UX Book: Agile UX Design for a Quality User Experience"****, Morgan Kaufmann, Second Edition, 2018*
2	*Joel Marsh,* ***"UX for beginners"****, O'Reilly Media, 2015*

REFERENCES:

1	*Alan Cooper, Robert Riemann, David Cronin, Christopher Noessel,* ***"About Face: The Essentials of Interaction Design"****, Wiley, Fourth Edition, 2014*
2	*Ben Coleman, and Dan Goodwin,* ***"Designing UX: Prototyping: Because Modern Design is Never Static"****, SitePoint , 2017*
3	*Westley Knight,* ***"UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work"****, Apress, 2018*
4	*https://in.coursera.org/specializations/user-interface-design*
5	*Helen Sharp, Yvonne Rogers, Jenny Preece,* ***"Interaction design – beyond human computer interaction"****, Wiley, Fifth Edition, 2019*
6	*Elizabeth Goodman, Mike Kuniavsky, Andrea Moed,* ***"Observing the User Experience – A Practitioner's Guide to User Research"****, Morgan Kaufmann, Second Edition, 2012*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Articulate UI/UX design principles, tools, and best practices, and apply them to real-world scenarios. **(Understand)**
CO2	Conduct user research to gain insights into user needs and behaviors, and apply these insights to inform design decisions. **(Understand)**
CO3	Create wireframes and prototypes using design software to communicate design ideas. **(Understand)**
CO4	Design interfaces that adapt to different devices and screen sizes using responsive design principles. **(Understand)**
CO5	Collaboratively design and evaluate interfaces for web and mobile applications using tools like Adobe XD, Figma ,Invisionand Sketch. (Analyze)

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1			M	L	L							L	H	M
CO2			H	L	L					L		L	H	M
CO3		L	H	L	H					L		L	H	M
CO4			H	L	H							L	H	M
CO5		L	H	L	H					M		L	H	M
18IPE$41		L	H	L	H					L		L	H	M
L –Low, M- Medium, H- High														

18IPE$57	DIGITAL MARKETING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1.To give insight on the significance of digital marketing 2.To articulate the value of integrated marketing compaigns across SEO,Paid search, Social, mobile , Email, Display Media and Marketing Analytics 3. To recognize key performance indicators tied to any digital marketing program 4. To caliber to improve Return on Investment (ROI) for any digital marketing program 5. To incorporate search engine optimization in the business growth opportunities

UNIT – I	**INTRODUCTION TO DIGITAL MARKETING**	**(9 Periods)**
Basics of Digital Marketing - online marketplace analysis: digital marketing environment - consumer choice and digital influence online consumer behavior-competitors -suppliers- new channel structures - rate of environment change - economic force-political force -legal force - social force- cultural force.		
UNIT – II	**DIGITAL MARKETING STRATEGY DEVELOPMENT**	**(9 Periods)**
Digital marketing strategy - The impact of digital media and technology on the marketing mix: product- price-place-promotion -people, process and physical evidence - relationship marketing using digital platforms: the challenge of customer engagement - customer lifecycle management		
UNIT – III	**DIGITAL MARKETING IMPLEMENTATION AND PRACTICE**	**(9 Periods)**
Delivering the online customer experience: planning website design and redesign projects - initiation of the website project - defining site or app requirement - designing the user experience - development and testing of content - site promotion or traffic building - campaign planning for digital media		
UNIT – IV	**MARKETING COMMUNICATIONS USING DIGITAL MEDIA CHANNELS**	**(9 Periods)**
Search engine marketing - online public relations - affiliated marketing - interactive display advertising -email marketing and mobile text messaging- social media and viral marketing - offline promotion techniques		
UNIT – V	**EVALUATION OF DIGITAL CHANNEL PERFORMANCE**	**(9 Periods)**
Create a performance management system - performance metric framework - tools and techniques for collecting metrics -customer experience and content management - online consumer behavior- online retailing - customer acquisition in B2B marketing -online inter- organizational trading		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Dave Chaffey Fiona Ellis-Chadwick, Digital Marketing, sixth edition, 2016

REFERENCES :

1	Puneet singh Bhatia, Fundamentals of Digital Marketing , Pearson India Education services,2017
2	Mathur, Vibha, Arora, Saloni,"Digital Marketing",PHI Learning Pvt. Ltd.,2020
3	Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Compaigns, Wiley 2016
4	Dr.Shakti Kundu, Digital Marketing Trends and Prospects:Develop an effective Digital Marketing strategy with SEO, SEM, PPC, Digital Display Ads & Email Marketing techniques,BPB PUBN,2021
5	Seema Gupta, Digital Marketing,Third Edition, McGraw Hill 2022
6.	Simon Kingsnorth, Digital Marketing Strategy:An Integrated Approach to Online Marketing, Kogan page, 2022

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Explain the role and importance of digital marketing in a rapidly changing business landscape. **(Familiarize)**
CO2	Discuss the key elements of a digital marketing strategy. **(Understand)**
CO3	Demonstrate advanced practical skills in common digital marketing tools such as Social media and Blogs. **(Understand)**
CO4	Demonstrate advanced practical skills in common digital marketing tools such as SEM. **(Understand)**
CO5	understand online consumer behavior and influence the extent to which individuals are likely to engage with the digital marketplace. **(Understand)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L	L	L		L	L	L	L	L	M	L
CO2	M	M	H	L	H	L		L	M	L	L	L	M	L
CO3	M	M	H	L	H	L		L	M	L	L	L	M	H
CO4	M	M	H	L	H	L		M	M	L	L	L	M	M
CO5	M	M	H	L	H	L		M	M	L	L	L	M	H
18IPE$57	M	M	H	L	H	L		M	M	L	L	L	M	M
L –Low, M- Medium, H- High														

18IPE$58	VISUAL EFFECTS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To introduce the principles and techniques of visual effects used in film, television, and other media. 2. To provide an understanding of the visual effects pipeline, including industry-standard software and processes. 3. To teach the basics of compositing, 3D modeling and animation, special effects, and advanced techniques. 4. To give hands-on experience with industry-standard software and tools for visual effects production. 5. To foster critical thinking and creativity in developing and executing visual effects projects.	
UNIT – I	**INTRODUCTION TO VISUAL EFFECTS**	**(9 Periods)**
History and evolution of visual effects - visual effects pipeline- Different types of visual effects : matte painting, compositing and 3D modeling - VFX cues - Digital formats -VFX concepts Introduction to industry-standard software (e.g. Adobe After Effects, Nuke, Maya)		
UNIT – II	**COMPOSITING**	**(9 Periods)**
Photoshop selection methods -Grime maps- cloning - 2D VFX - compositing - Rotoscoping -2D motion tracking - 2D Matchmoving -2D motion tracking and CG integration		
UNIT – III	**3D MODELING AND ANIMATION**	**(9 Periods)**
Introduction to 3D modeling software: Maya, 3dsMax and Blender -Basic 3D tracking and match moving CG- -Card Trick VFX- Bread and Butter VFX-		
UNIT – IV	**SPECIAL EFFECTS**	**(9 Periods)**
Particle systems - Dynamics - -2.5D Vs 3D particle based crowd Replications - Digital matte painting and environment- Beauty and restoration VFX		
UNIT – V	**ADVANCED TECHNIQUES**	**(9 Periods)**
3D particle based debris systems - Digital destruction -Stereoscopic 3D- 2D to 3D stereoscopic conversion -advanced 3D and Photoshop Magic - Displacement modeling		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Jon Gress, Visual effects and compositing , Pearson education,2014

REFERENCES :

1	Steve Wright, Digital compositing for film and video, Taylor and Francis , 2013
2	Luke Ahearn , 3D Game Textures Create Professional Game Art Using Photoshop, CRC Press, Taylor & Francis Group, 2019
3	Mitch Mittel, Visual effects for film and television, Taylor and Francis, 2013
4	Sam vila, Blender for visual effects, CRC press,2015
5.	Brie Gynclid & Lisa fridsma, Adobe after effects, Adobe release, 2020
6	Ron Brinkkman, The Art and science of Digital compositing , Elsevier science , 2008

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Explain the history and evolution of visual effects in the film and television industry. **(Familiarize)**
CO2	Understand the visual effects pipeline and the roles of different team members in the production process. **(Understand)**
CO3	Use industry-standard software for compositing, 3D modeling and animation, special effects, and advanced techniques. **(Understand)**
CO4	Analyze and critique visual effects used in film, television, and other media. **(Analyze)**
CO5	Create and execute visual effects projects using techniques learned. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L	L	L		L	L	L	L	L	M	L
CO2	L	L	L	L	M	L		H	H	H	M	L	M	M
CO3	M	M	M	M	M	M		H	H	M	H	L	M	H
CO4	M	M	M	M	H	M		H	H	M	M	L	M	H
CO5	M	M	M	M	H	M		H	H	H	H	L	M	H
18IPE$58	M	M	M	M	H	M		H	H	M	M	L	M	H
L –Low, M- Medium, H- High														

18IPE$59	GAME DEVELOPMENT

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To gain programming capability to develop games 2. To Provide mathematical background of game development 3. To develop creativity and individuality by providing cutting-edge, ready-to-use tools and techniques in game development. 4. To define the principles of game development and production. 5. To provide practical experience to computer game development using unity game engine.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
History of video games - games and society - Game Design - game writing and Interactive story telling - Game Programming: Languages and Architecture -Programming Fundamentals Memory and I/O systems - Debugging games		
UNIT – II	**GAME PROGRAMMING**	**(9 Periods)**
Mathematical concepts- Collision Detection and Resolution - Real Time Game Physics- Graphics- Character Animation - Artificial Intelligence: Agents, Architecture and Techniques - Path finding overview - Audio Programming- Networking and Multiplayer		
UNIT – III	**AUDIO VISUAL DESIGN AND PRODUCTION**	**(9 Periods)**
Visual Design - 3D Modeling -3D Environments -2D textures and Texture Mapping - Special Effects- Lighting -Animation - Cinematography- Audio Design and Production		
UNIT – IV	**GAME PRODUCTION**	**(9 Periods)**
Game Production and Project Management - Game Industry Roles and Economics - The Publisher-Developer Relationship - Marketing - Intellectual Property content -Law and Practice - Content Regulation		
UNIT – V	**GAME DEVELOPMENT USING UNITY**	**(9 Periods)**
Introduction to Unity and Game Engines - Unity Scripting and Unity Libraries -Building Game Worlds / Levels (Scenes) in Unity-Types of Assets (game objects), and Unity Asset Store- Modifying and Creating your own Assets and Prefabs-Adding Components to Assets-Interaction between Assets and Scripts-The Player Character, Camera Views, and Movement-Gameplay Mechanics (and Effects)		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Steve Rabin, "Introduction to Game Development", Second edition ,Cengage Learning ,2010
2	Will Goldstone, Unity Game development Essentials, PACKT Publishing ,2009

REFERENCES :

1	Kenneth C. Finney, 3D Game Programming: All in One, 3rd Ed, Course Technology,2013
2	Adam Lake, Game Programming Gems 8, Course Technology, Cengage Learning,2011
3	Eric Lengyel, Mathematics for 3D Game Programming and Computer Graphics, 3rd Edition, Course Technology, Cengage Learning, 2012
4	Michelle Menard, Game Development with unity, Course Technology ,2012
5	Paris Buttfield-Addison, Jon Manning, Tim Nugent, Unity Game Development Cookbook Essentials for Every Game, O'Reilly Media,2019

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Create multiple gaming applications, utilizing industry-standard tools and software. **(Understand)**
CO2	Explain the AI algorithms and Physical Laws involved in generating computer games. **(Understand)**
CO3	Apply Object Oriented Programming concepts into creating their own games and other application. **(Analyze)**
CO4	lead or participate in an interdisciplinary team-oriented game production project. **(Understand)**
CO5	Engage with gaming industry best practices to enable an entrepreneurial position in the gaming marketplace. **(Understand)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	M	M	M	M	H	M		L	M	M	L	M	M	M
CO2	M	M	M	M	H	M		L	M	M	L	M	M	M
CO3	M	M	M	M	H	M		L	M	M	L	M	M	M
CO4	M	M	M	M	H	M		L	M	M	L	M	M	M
CO5	M	M	M	M	H	M		L	M	M	L	M	M	M
18IPE$59	M	M	M	M	H	M		L	M	M	L	M	M	M
L –Low, M- Medium, H- High														

18IPE$60	MULTIMEDIA DATA COMPRESSION AND STORAGE

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. learn the principles and algorithms behind various compression and storage methods for images, data 2. learn the principles and algorithms behind various compression and storage methods for video data 3. learn the principles and algorithms behind various compression and storage methods for audio data 4. comprehend the challenges associated with multimedia data storage and retrieval 5. learn the principles about MPEG system..	
UNIT – I	**MULTIMEDIA COMPRESSION FUNDAMENTALS**	**(9 Periods)**
Needs for image and video compression - Feasibility of image and video compression : statistical redundancy, psychovisual redundancy, visual quality measurement - information theory - uniform quantization -non uniform quantization -adaptive quantization		
UNIT – II	**IMAGE COMPRESSION AND STORAGE**	**(9 Periods)**
Still image coding : standard JPEG - Wavelet transform for image coding: JPEG 2000: a review of wavelet transform - digital wavelet transform for image compression Non standard still image coding : vector quantization - fractal image coding -model based coding - image storage and retrieval systems		
UNIT – III	**VIDEO COMPRESSION AND STORAGE**	**(9 Periods)**
Digital video representation - Digital video formats - digital video coding standards : MPEG1 features- MPEG2 enhancements -MPEG2 video encoding -rate control - optimum mode decision - ITUT video coding standards: H.261 -H.263 -streaming video and adaptive bit rate technologies - video storage and retrieval systems		
UNIT – IV	**AUDIO COMPRESSION AND STORAGE**	**(9 Periods)**
Audio file formats and standards - MP3 and AAC audio compression - audio metadata and ID3 tags - perceptual audio coding - audio storage and retrieval systems- transform based audio coding		
UNIT – V	**ADVANCED COMPRESSION STANDARDS AND MPEG SYSTEM**	**(9 Periods)**
MPEG 4 Requirements and functionalities - technical description of MPEG4 video - MPEG4 visual bitstream syntax and semantics - MPEG4 video verification model - overview of H.264 codec structure -MPEG2 system - MPEG4 system.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Yun Q. Shi, Huifang Sun , Image and Video Compression for Multimedia Engineering Fundamentals, Algorithms, and Standards, Second Edition, CRC Press,2008
2	Khalid sayood , Introduction to Data Compression, Elsevier science ,2006

REFERENCES :

1	Huifang Sun, Tihao Chiang, Xuemin Chen , Digital Video Transcoding for Transmission and Storage, CRC Press,2018
2	Marina Bosi, Richard E. Goldberg, Introduction to Digital Audio Coding and Standards, Springer US,2012
3	Ida Mengyi Pu, Fundamental Data Compression, Elsevier Science,2005
4	Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Rich Baker, David Lindbergh, Digital Compression for Multimedia Principles and Standards, Elsevier Science,1998

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the basic principles and concepts of multimedia compression and data storage. **(Understand)**
CO2	Analyze and compare different compression and storage methods for Image data. **(Analyze)**
CO3	Analyze and compare different compression and storage methods for video data. **(Analyze)**
CO4	Analyze and compare different compression and storage methods for audio data. **(Analyze)**
CO5	Apply compression and storage techniques to multimedia data in a variety of formats and settings. **(Understand)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	L	L	L	M	L		L	L	L	L	L	M	L
CO2	M	M	M	L	M	L		L	L	L	L	L	M	L
CO3	M	M	M	L	M	L		L	L	L	L	L	M	L
CO4	M	M	M	L	M	L		L	L	L	L	L	M	L
CO5	M	M	M	L	M	L		L	L	L	L	L	M	L
18IPE$60	M	M	M	L	M	L		L	L	L	L	L	M	L
L –Low, M- Medium, H- High														

VERTICAL – VI

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

18IPE$61	KNOWLEDGE ENGINEERING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	understanding the application domain, modeling problem solving in that domain, developing the ontology, learning the reasoning rules, and testing the agent

UNIT – I	**INTRODUCTION**	**(9 Periods)**

Introduction: Understanding the World through Evidence-based Reasoning, Abductive Reasoning, Probabilistic Reasoning, Evidence-based Reasoning, Artificial Intelligence, Knowledge Engineering, Obtaining Disciple-EBR. Evidence-based Reasoning: Connecting the Dots, How Easy Is It to Connect the Dots?, Sample Evidence-based Reasoning Task: Intelligence Analysis, Other Evidence-based Reasoning Tasks, Hands On: Browsing an Argumentation.

UNIT – II	**METHODOLOGIES AND TOOLS FOR AGENT DESIGN AND DEVELOPMENT AND MODELING THE PROBLEM-SOLVING PROCESS**	**(9 Periods)**

A Conventional Design and Development Scenario, Development Tools and Reusable Ontologies, Agent Design and Development Using Learning Technology, Hands On: Loading, Saving, and Closing Knowledge Bases, Knowledge Base Guidelines. Modeling the Problem-Solving Process: Problem Solving through Analysis and Synthesis, Inquiry-driven Analysis and Synthesis, Inquiry-driven Analysis and Synthesis for Evidence-based Reasoning, Evidence-based Assessment, Hands On: Was the Cesium Stolen?, Hands On: Hypothesis Analysis and Evidence Search and representation, Believability Assessment, Hands On: Believability Analysis, Drill-Down Analysis, Assumption-based Reasoning and What-If Scenarios, Hands On: Modeling, Formalization, and Pattern Learning, Hands On: Analysis Based on Learned Patterns

UNIT – III	**ONTOLOGIES**	**(9 Periods)**

Ontologies :What Is an Ontology?, Concepts and Instances, Generalization Hierarchies, Object Features, Defining Features, Representation of N-ary Features, Transitivity, Inheritance, Concepts as Feature Values, Ontology Matching, Hands On: Browsing an Ontology. Ontology Design and Development: Design and Development Methodology, Steps in Ontology Development, Domain Understanding and Concept Elicitation, Modeling-based Ontology Specification, Hands On: Developing a Hierarchy of Concepts and Instances, Guidelines for Developing Generalization Hierarchies, Hands On: Developing a Hierarchy of Features, Hands On: Defining Instances and Their Features, Guidelines for Defining Features and Values, Ontology Maintenance.

UNIT – IV	**RULE LEARNING AND RULE REFINEMENT**	**(9 Periods)**

Rule Learning: Modeling, Learning, and Problem Solving, An Illustration of Rule Learning and Refinement, The Rule-Learning Problem, Overview of the Rule-Learning Method, Mixed-Initiative Example Understanding, Example Reformulation, Analogy-based Generalization, Rule Generation and Analysis, Generalized Examples, Hypothesis Learning, Hands On: Rule and Hypotheses Learning, Explanation Generation Operations. Rule Refinement: Incremental Rule Refinement, Learning with an Evolving Ontology, Hypothesis Refinement, Characterization of Rule Learning and Refinement, Hands On: Rule Refinement.

UNIT – V	**DISCIPLE AGENTS**	**(9 Periods)**

Introduction, Disciple-WA: Military Engineering Planning, Disciple-COA: Course of Action Critiquing, Disciple-COG: Center of Gravity Analysis, Disciple-VPT: Multi-Agent Collaborative Planning.

Contact Periods:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*GHEORGHE TECUCI,George Mason University,DORIN MARCU,George Mason University, MIHAI BOICU,George Mason University,,DAVID A. SCHUM,,George Mason University,* ***"Building Cognitive Assistants for Evidence-Based Reasoning"****, Cambridge university press, 2016*

REFERENCES :

1	*Ronald J. Brachman, Hector J. Levesque,* ***" knowledge representation and Reasoning"*** *c 2004 by Elsevier, Inc*
2	*S. L. Kendal , M. Creen,* ***"An Introduction to Knowledge Engineering"****, springer,2007*
3	*John Debenham, Knowledge Engineering: Unifying Knowledge Base and Database Design, Springer, 1998.*
4	*Kendal, Simon, Creen, Malcolm, An Introduction to Knowledge engineering, Springer first edition, 2007*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Develop agents through teaching and learning. **(Understand)**
CO2	Apply different knowledge representation methods. **(Analyze)**
CO3	Understand representation of knowledge through ontologies, as well as their design and development. **(Analyze)**
CO4	Analyze the basic operations of minimal and maximal generalizations and specialization of concepts, which are at the basis of rule learning and refinement. **(Analyze)**
CO5	find the quickest way for the military unit to bypass the encountered obstacle by using Disciple-WA. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	H	H	H									H	
CO2	H	H	H	H									H	
CO3	H	H	H	H									H	
CO4	H	H	H	H									H	
CO5	H	H	H	H									H	
18IPE$61	H	H	H	H									H	
L –Low, M- Medium, H- High														

18IPE$14	SOFT COMPUTING AND ITS APPLICATIONS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, * Learn the various soft computing frame works * Be familiar with design of various neural networks * Be exposed to fuzzy logic * Learn genetic programming * Learn the Hybrid soft computing techniques and applications

UNIT – I	**INTRODUCTION**	**(9 Periods)**

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models – important technologies – applications. Fuzzy logic: Introduction – crisp sets- fuzzy sets – crisp relations and fuzzy relations: cartesian product of relation – classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction – biological background – traditional optimization and search techniques – Genetic basic concepts.

UNIT – II	**NEURAL NETWORKS**	**(9 Periods)**

McCulloch-Pitts neuron – linear separability – hebb network – supervised learning network: perceptron networks – adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN-associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network –unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network.

UNIT – III	**FUZZY LOGIC**	**(9 Periods)**

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic – extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals – fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making

UNIT – IV	**GENETIC ALGORITHM**	**(9 Periods)**

Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle – stopping condition – constraints – classification – genetic programming – multilevel optimization – real life problem- advances in GA.

UNIT – V	**HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS**	**(9 Periods)**

Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

Contact Periods:
Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*J.S.R.Jang, C.T. Sun and E.Mizutani,* ***"Neuro-Fuzzy and Soft Computing",*** *PHI / Pearson Education 2015.*
2	*S.N.Sivanandam and S.N.Deepa,* ***"Principles of Soft Computing",*** *Wiley India Pvt Ltd, 2011.*

REFERENCES :

1	*S.Rajasekaran and G.A.VijayalakshmiPai,* ***"Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications",*** *Prentice-Hall of India Pvt. Ltd., 2006.*
2	*George J. Klir, Ute St. Clair, Bo Yuan,* ***"Fuzzy Set Theory: Foundations and Applications"*** *Prentice Hall, 1997.*
3	*David E. Goldberg,* ***"Genetic Algorithm in Search Optimization and Machine Learning",*** *Pearson Education India, 2013.*
4	*James A. Freeman, David M. Skapura,* ***"Neural Networks Algorithms, Applications, and Programming Techniques"****, Pearson Education India, 1991.*
5	*Simon Haykin,* ***"Neural Networks Comprehensive Foundation",*** *Second Edition, Pearson Education, 2005.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Apply various soft computing frame works.**[Analyze]**
CO2	Design of various neural networks.**[Analyze]**
CO3	Use fuzzy logic.**[Analyze]**
CO4	Apply genetic programming.**[Analyze]**
CO5	Discuss hybrid soft computing.**[Analyze]**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	H	H	H	H	H	L					H	H	L
CO2	H	H	H	H	H	H	L					H	H	L
CO3	H	H	H	H	H	H	L					H	H	L
CO4	H	H	H	H	H	H	L					H	H	L
CO5	H	H	H	H	H	H	L					H	H	L
18IPE$14	H	H	H	H	H	H	L					H	H	L
L –Low, M- Medium, H- High														

18IPE$33	NEURAL NETWORKS AND DEEP LEARNING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	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 autoencoders and generative models for suitable applications.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An IntroductionEvolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.		
UNIT – II	**ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS**	**(9 Periods)**
Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative 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**	**(9 Periods)**
Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.		
UNIT – IV	**DEEP FEEDFORWARD NETWORKS**	**(9 Periods)**
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**	**(9 Periods)**
Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville***, "Deep Learning"***, MIT Press, 2016
2	Francois Chollet, ***"Deep Learning with Python",*** Second Edition, Manning Publications, 2021.

REFERENCES :

1	Aurélien Géron***, "Hands-On Machine Learning with Scikit-Learn and TensorFlow"***, Oreilly, 2018
2	Josh Patterson, Adam Gibson, ***"Deep Learning: A Practitioner's Approach"***, O'Reilly Media, 2017.
3	Charu C. Aggarwal, ***"Neural Networks and Deep Learning: A Textbook"***, Springer International Publishing, 1st Edition, 2018.
4	Jojo Moolayil ***,"Learn Keras for Deep Neural Networks"***, Apress,2018
5	Vinita Silaparasetty , ***"Deep Learning Projects Using TensorFlow 2"***, Apress, 2020

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1	Apply Convolution Neural Network for image processing. **(Analyze)**
CO2	Understand the basics of associative memory and unsupervised learning networks. **(Familiarize)**
CO3	Apply CNN and its variants for suitable applications. **(Analyze)**
CO4	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks. **(Analyze)**
CO5	Apply autoencoders and generative models for suitable applications. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	M	H	M	H	L			M	L			M	L
CO2	H	L	M	L						L	M	M	L	L
CO3	H	H	H	H	H	L			M	L			H	L
CO4	H	H	H	H	H				M		M	H	H	L
CO5	L	L	H	M	H				M				M	L
18IPE$33	H	M	H	H	M	L			M	L	L	L	H	L
L –Low, M- Medium, H- High														

18IPE$34	TEXT AND SPEECH ANALYSIS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	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	
UNIT – I	**NATURAL LANGUAGE BASICS**	**(9 Periods)**
Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model		
UNIT – II	**TEXT CLASSIFICATION**	**(9 Periods)**
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		
UNIT – III	**QUESTION ANSWERING AND DIALOGUE SYSTEMS**	**(9 Periods)**
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		
UNIT – IV	**TEXT-TO-SPEECH SYNTHESIS**	**(9 Periods)**
Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems		
UNIT – V	**AUTOMATIC SPEECH RECOGNITION**	**(9 Periods)**
Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems		
Contact Periods: **Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

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.*

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	*. Steven Bird, Ewan Klein, and Edward Loper,* ***"Natural language processing with Python"****, O'REILLY.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Explain existing and emerging deep learning architectures for text and speech processing. **(Familiarize)**
CO2	Apply deep learning techniques for NLP tasks, language modelling and machine translation. **(Analyze)**
CO3	Explain coreference and coherence for text processing. **(Familiarize)**
CO4	Build question-answering systems, chatbots and dialogue systems. **(Analyze)**
CO5	Apply deep learning models for building speech recognition and text-to-speech systems. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	M	H	L	H				L	M	L	M	H	L
CO2	H	L	M	L	H				M	M	L	H	H	L
CO3	M	M	L	H	L				H	H	L	M	H	L
CO4	M	L	L	L	M				M	L	M	M	H	L
CO5	L	H	M	M	L				H	M	L	L	H	L
18IPE$34	M	M	M	M	M				M	M	L	M	H	L
L –Low, M- Medium, H- High														

18IPE$62	OPTIMIZATION TECHNIQUES AND APPLICATIONS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To Understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function.	
UNIT – I	**INTRODUCTION TO CLASSICAL OPTIMIZATION TECHNIQUES**	**(9 Periods)**
Introduction to Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.**Classical Optimization Techniques:**Single variable Optimization, Multi variable Optimization with and without constraints, Multivariable Optimization with equality constraints - solution by method of Lagrange multipliers, Multivariable Optimization with inequality constraints - Kuhn – Tucker conditions.		
UNIT – II	**LINEAR PROGRAMMING AND SIMPLEX METHOD**	**(9 Periods)**
Linear Programming: Various definitions, statements of basic theorems and properties, Advantages, Limitations and Application areas of Linear Programming, Graphical method of Linear Programming problem. **Simplex Method :** Phase I and Phase II of the Simplex Method, The Revised Simplex method, Primal and Dual Simplex Method, Big –M method.		
UNIT – III	**TRANSPORTATION PROBLEM AND QUEUING**	**(9 Periods)**
Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. (Including assignment and travelling salesman problems) (No degeneracy problems). **Queuing:**Queuing Models : Essential features of queuing systems, operating characteristics of queuing system, probability distribution in queuing systems, classification of queuing models.		
UNIT – IV	**DYNAMIC PROGRAMMING AND INTEGER PROGRAMMING**	**(9 Periods)**
Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.**Integer Programming:**Pure and mixed integer programming problems, Solution of Integer programming problems – Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-one programming.		
UNIT – V	**SIMULATION MODELING**	**(9 Periods)**
Simulation Modeling: Introduction, Definition and types, Limitations, Various phases of modeling, Monte Carlo method, Applications, advantages and limitations of simulation.		
Contact Periods: **Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*S.S.Rao, **"Engineering optimization: Theory and practice"**, New Age International (P) Limited.*
2	*H A Taha ,**"Operations Research: An Introduction"** , 5th Edition, Macmillan, New York.*

REFERENCES :

1	*K.V. Mittal and C. Mohan,* ***"Optimization Methods in Operations Research and systems Analysis"*** *New Age, International (P) Limited, Publishers*
2	*by S.D.Sharma, KedarnathRamanath& Co ,* ***"Operations Research "***
3	*G. Hadley,* ***"Linear programming ",*** *Narosa Publishing House, New Delhi.*
4	*M. Mahajan, DhanpatRai& co,* ***" Industrial Engineering and Production Management".***
5	*by NVR Naidu, G Rajendra, T Krishna Rao,* ***"Operations Research"*** *, I K International Publishing house, New Delhi.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function. Review differential calculus in finding the maxima and minima of functions of several variables. **(Understand)**
CO2	Formulate real-life problems with Linear Programming. Solve the Linear Programming models using graphical and simplex methods. **(Analyze)**
CO3	Formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms. Analyze the Queuing model for effective customer satisfaction. **(Analyze)**
CO4	Apply dynamic programming to optimize multi stage decision problems. **(Analyze)**
CO5	Construct precedence diagram for series of activities in a huge project to find out probability of expected completion time using PERT-CPM networks. Also reduce the duration of project by method of crashing. **(Analyze)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	H	H	H									H	
CO2	H	H	H	H									H	
CO3	H	H	H	H									H	
CO4	H	H	H	H									H	
CO5	H	H	H	H									H	
18IPE$62														
L –Low, M- Medium, H- High														

18IPE$63	**GAME THEORY** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To understand the fundamentals of game theory. 2. To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in modeling applications 3. To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues. 4. To introduce contemporary topics in the intersection of game theory, computer science, and economics. 5. To apply game theory in Coalitional games.	
UNIT – I	**INTRODUCTION**	**9**
Introduction: What is Game Theory - An outline of the history of game theory- Definition of Games- Actions, Strategies, Preferences, Payoffs – Examples - Strategic form games and examples: Prisoner's Dilemma, Bach or Stravinsky, Matching Pennies - Notion of Nash Equilibrium - Examples of Nash Equilibrium - Best Response Functions - Dominated Actions - Symmetric Games and Symmetric Equilibria.		
UNIT – II	**GAMES WITH PERFECT INFORMATION**	**(9 Periods)**
Mixed Strategy Nash Equilibrium- Randomization of Actions, Mixed strategy Nash equilibrium, Dominated actions, Pure strategy equilibria in the presence of randomization, Illustrations: expert diagnosis reporting a crime - Finding all mixed strategy Nash equilibria of some representative games.		
UNIT – III	**EXTENSIVE GAMES WITH PERFECT INFORMATION**	**(9 Periods)**
Extensive games with Perfect Information- Extensive games, Strategies and outcomes, Nash equilibrium, Subgame perfect equilibrium, finding subgame perfect equilibria using backward induction - Allowing for simultaneous moves in extensive games with perfect information - Example of committee decision making - Two Player Zerosum Games: Maxminimization and Nash Equilibrium - Strictly competitive games - Nash equilibrium in strictly competitive games - Minimax theorem - Solution via linear programming - Examples.		
UNIT – IV	**GAMES WITH IMPERFECT INFORMATION**	**(9 Periods)**
Bayesian and Repeated Games - Motivational Examples - Definition of a Bayesian Game and Bayesian Nash Equilibrium and examples - Auctions: Independent private values, Nash equilibrium of first price auction and second price auction, common valuations, revenue equivalence of auctions - Idea of repeated games - Finitely repeated prisoner's dilemma, infinitely repeated prisoner's dilemma, strategies in a repeated prisoner's dilemma, Nash equilibria and equilibria payoffs in infinitely repeated prisoner's dilemma, sub-game perfect equilibria and equilibria payoffs in infintely repeated prisoner's dilemma.		
UNIT – V	**COALITIONAL GAMES**	**(9 Periods)**
Coalitional Games - The Core - Illustrations: Ownership and distribution of wealth - exchanging homogeneous items - exchanging heterogeneous items - voting – matching - Shapley value and examples.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*M. J. Osborne, **"An Introduction to Game Theory"**, Oxford University Press, 2004.*

REFERENCES :

1	*M. Machler, E. Solan, S. Zamir,* ***"Game Theory",*** *Cambridge University Press, 2013*
2	*N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani (Editors),* ***"Algorithmic Game Theory"*** *Cambridge University Press, 2007.*
3	*A.Dixit and S. Skeath,* ***"Games of Strategy",*** *Second Edition, W W Norton & Co Inc, 2004.*
4	*YoavShoham, Kevin Leyton-Brown,* ***"Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations",*** *Cambridge University Press 2008.*
5	*Zhu Han, Dusit Niyato, Walid Saad, Tamer Basar and Hjorungnes,* ***"Game Theory in Wireless and Communication Networks",*** *Cambridge University Press, 2012.*
	Y.Narahari, ***"Game Theory and Mechanism Design",*** *IISC Press, World Scientific.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Summarize the fundamentals of game theory and concepts. **[Familiarity]**
CO2	Discuss the use of Nash Equilibrium for other problems. **[Familiarity]**
CO3	Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation. **[Understand]**
CO4	Identify some applications that need aspects of Bayesian Games. **[Understand]**
CO5	Use various Coalitional games concepts. **[Usage]**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	L	M	L	M	M							M	M	M
CO2	L	M	L	M	M				L	M	L	M	M	M
CO3	L	M	M	M	H					M	M	L	M	M
CO4	L	M	M	M	H				L	M	M	L	M	M
CO5	L	M	M	M	H			L	M	M	M	M	M	M
18IPE$63	L	M	M	M	H				L	M	M	M	M	M
L –Low, M- Medium, H- High														

18IPE$64	COGNITIVE SCIENCE *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

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

UNIT – I	**PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE**	**(9 Periods)**
Philosophy: Mental-physical Relation – From Materialism to Mental Science – Detour before the naturalistic turn – The Philosophy of Science – The Mind in Cognitive Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing – Neurosciences: Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.		
UNIT – II	**COMPUTATIONAL INTELLIGENCE**	**(9 Periods)**
Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Decision making under Uncertainty – Learning – Language – Vision – Robotics.		
UNIT – III	**PROBABILISTIC PROGRAMMING LANGUAGE**	**(9 Periods)**
WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration – Other basic computation.		
UNIT – IV	**IMPLEMENTING THE INFERENCE MODELS OF COGNITION**	**(9 Periods)**
Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.		
UNIT – V	**IMPLEMENTING THE LEARNING MODELS OF COGNITION**	**(9 Periods)**
Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Occam's Razor – Learning (Deep) Continuous Functions – Mixture Models.		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:

1	*Robert A. Wilson, Frank C. Keil,* ***"The MIT Encyclopedia of the Cognitive Sciences"****, The MIT Press, 1999.*

REFERENCES:

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

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the underlying theory behind cognition. **(Familiarize)**
CO2	Connect to the cognition elements computationally. **[Understand]**
CO3	Implement mathematical functions through WebPPL. **[Understand]**
CO4	Develop a cognitive inference model. **[Understand]**
CO5	Develop a cognitive learning model. **[Understand]**
CO6	Explore the recent trends in cognitive computing. **[Understand]**

COURSE ARTICULATION MATRIX:

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	H	H											L	
CO2	H	H			H								M	
CO3		H			H								L	
CO4		H	H										L	
CO5	H	H	H		H								H	
CO6	H	H	H		H								H	
18IPE$64														
L –Low, M- Medium, H- High														

18IPE$65	**ETHICS AND AI** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Understand the need for ensuring ethics in Artificial Intelligence 2. Understand AI governance by human rights and other fundamental values. 3. Issues with accountability of AI systems 4. Technology driven perspectives to integrate ethics and economic values. 5. Futuristic applications	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Role of Artificial Intelligence in human life – Understanding Ethics – Need for Ethics in Artificial Intelligence – Ethical considerations of AI – Current initiatives of Ethics in AI – Ethical issues and artificial entities.		
UNIT – II	**FRAMEWORKS AND MODELS**	**(9 Periods)**
AI Governance by human rights – Incompatible initiatives of private sector AI – Normative Models – Codes and Standards – The role of professional norms in the governance of Artificial Intelligence.		
UNIT – III	**CONCEPTS AND ISSUES**	**(9 Periods)**
Accountability in Computing Systems – Transparency – Responsibility an AI – Ethical analysis and design – Race and Gender- AI as a moral right holder – autonomy.		
UNIT – IV	**PERSPECTIVES AND APPROACHES**	**(9 Periods)**
Social failure modes of technology and the Ethics of AI – A human centered approach for AI Ethics – Integrating Ethical values and economical values - Fairness – The complexity of otherness – Calculative composition		
UNIT – V	**CASES AND APPLICATIONS**	**(9 Periods)**
Ethics of AI in Transport – The case for Ethical AI in Military – Ethics of AI in Biomedical research, patient care and public health- Ethics of AI in Law – Robot teaching: pedagogy and policy – Smart City Ethics.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Markus D Dubber, Frank Pasquale, Sunil Das,* ***"The Oxford Handbook of Ethics of AI",*** *Oxford University Press, 2020.*
2	*Paula Beddington,* ***"Towards a Code of Ethics for Artificial Intelligence",*** *Springer, 2017.*

REFERENCES :

1	*S. Matthew Liao,* ***"Ethics of Artificial Intelligence",*** *Oxford University Press, 2020.*
2	*Nick Bostrom andEliezer Yudkowsky,* ***"The Ethics of Artificial Intelligence",*** *Cambrige University Press, 2014.*
3	*Wallach W and Allen C,* ***"Moral Machines: Ceaching Robots Right From Wrong",*** *Oxford Univeristy Press, 2008*
4	*Mark Coeckelbergh,* ***"AI Ethics",*** *MIT Press, 2020.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Identify the need for Ethics in Artificial Intelligence. **(Familiarity)**
CO2	Summarize frameworks for normative assessment and governance. **(Familiarity)**
CO3	Describe the ethical dimensions of Artificial Intelligence. **(Familiarity)**
CO4	Criticize selection of methodological approached for AI Ethics. **(Familiarity)**
CO5	Argue Ethics in AI for selected Artificial Intelligence applications. **(Understand)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1						H		H				M		
CO2						H		H				M		
CO3						H		H				M		
CO4						H		H				M		
CO5						H		H				M		
18IPE$65						H		H				M		
L –Low, M- Medium, H- High														