



Sardar Patel Institute of Technology
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous Institute Affiliated to University of Mumbai)

Bharatiya Vidya Bhavan's
Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to the University of Mumbai)



Master Of Computer Applications

Second Year MCA

(Sem. III Sem. IV)

Effective from Academic Year 2024-25

Proposed to Board of Studies for Approval: 8th May 2023

Proposed to Academic Council for Approval: 3rd February 2023

Dr. D.R. Kalbande
HOD, CSE(MCA)

Dr. Y.S Rao
Dean Academics

Dr. B.N. Chaudhari
Principal



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SUMMER TERM

SUMMER TERM (For Computer/IT Graduates)					
No	Type	Code	Course	E	C
1	MLC	AS601	Constitution of India	5	NC
2	SBC	AS602	Project-I (Project to address social problem)	8	3
3	ABL	LLC	LLC-II	5	1
TOTAL				13	4

SUMMER TERM (For Non-Computer/IT Graduates)					
No	Type	Code	Course	E	C
1	MLC	AS601	Constitution of India	5	NC
2	ABL	LLC	LLC- I	5	1
3	HSS	OEHXX	Open Elective from Humanities	10	NC
TOTAL				20	1



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
SBC	Project-I (Project to address social problem)	0	0	0	8	8	0	0	0	3
		Examination Scheme								
AS602		Component		ISE		MSE		ESE	Total	
		Theory		--		--		--	--	
		Laboratory		200		--		100	300	

Pre-requisite Course Codes, if any.	--
Course Objective: This course inculcates self-learning, research and entrepreneurship attitude in students. It aims to sharpen problem solving skills for societal benefits by solving real world problems. Students will be able to understand the formal project development process to complete a project in a team. It will help students to develop communication, organizational skills and maturity through discussion, presentation etc.	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
AS602.1	Conduct literature survey in the preferred domain and formulate problem statements
AS602.2	Design the prototype.
AS602.3	Test the prototype and Analyse findings from obtained results.
AS602.4	Develop research inclination to solve societal problems.
AS602.5	Communicate findings effectively to the range of audience.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS602.1	3	2	2	2	-	-	3	-	1	3	3	3
AS602.2	3	3	3	3	3	-	3	1	-	3	3	3
AS602.3	3	2	-	3	3	-	3	1	-	3	3	3
AS602.4	3	2	3	3	-	3	3	-	-	3	3	-
AS602.5	-	-	-	-	-	3	3	-	3	3	3	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
AS602.1	3	-	3	3	3
AS602.2	3	-	3	3	3
AS602.3	3	2	3	3	3
AS602.4	3	-	3	-	-
AS602.5	3	3	3	3	3



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BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Project I is an opportunity to inculcate the research aptitude in students. It helps them to identify research gaps and come up with possible solutions. Students should be able to analyze these solutions for feasibility of their implementation. Project I is based on a small research project correlating scientific knowledge and day to day experience which encourages research inclination among the students to solve societal problems.

Steps for Research:

- ✓ Keen observation of the surrounding/society
- ✓ Read existing Literature to understand and identify the research gaps
- ✓ Analysis of the problem
- ✓ Formulation of the problem statement
- ✓ Collection of relevant information by formulating research questions
- ✓ Suggesting plan of action
- ✓ Conducting experiments and draw conclusion
- ✓ To find the possible solution to rectify the problem
- ✓ To execute experiments and remedial measures wherever possible
- ✓ To publish results

Students can seek guidance from teachers, other experts and make effective use of other sources of information available around them. Students must ensure that the problem is manageable in one semester.

Criteria of a good project:

- ✓ Appropriate idea, clear understanding, and proper presentation of the concept
- ✓ Quality of work
- ✓ Project plan and its execution
- ✓ Credibility of the work
- ✓ Probable impact of the work on the attitude of students and society
- ✓ Scientific attitude, creativity and novelty reflected in project work and analysis of the situation
- ✓ Utility and innovation of the remedial measures
- ✓ Desirability, Feasibility and Viability in real life



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The H/W and S/W resources required to complete the Project I may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- ✓ Learning additional skills
- ✓ Development of ability to define and design the problem and lead to its accomplishment with proper planning
- ✓ Learn behavioral discipline. Students should function effectively as an individual

Evaluation:

Project report shall be submitted in a pdf copy. Other sections of the report shall be decided by the mentor based on projects. But it must have introduction, necessity of project, objectives, hypothesis, plan, observations, and analysis of results, conclusion, and references along with other sections related to technology.

The ISE and ESE evaluation will be carried out based on the rubrics framed by the Department. ISE marks will be based on the performance of the individual student in three phases of evaluation. The evaluation of the Phase I (ISE) will be based on Title approval where the domain and scope of the project will be evaluated. Phase II (ISE) will be on presentation of the selected approach, justification and Design and some part of implementation. Evaluation of Phase III (ESE) is based on demonstration of complete implementation, testing, presentation, and technical report.

The ESE marks will be based on demonstration in front of the expert appointed by the Department. In the ESE examination each individual student would be assessed for his/her contribution in selecting the originality of the problem statement, understanding and knowledge gained about the task completed through presentation/demonstration, work done, and preparing the technical report/poster/technical paper of the project in the standard format provided by the Department.



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Sem III (For Computer/IT Graduates)									
No	Type	Code	Course	L	T	P	O	E	C
1	OE*	OEXXX	Open Elective-I	3	0	0	5	8	3
2	PE	MC5XX-II	Thread Elective-II** /Program Elective-II	3	0	2	4	9	4
3	PE	MC5XX-III	Thread Elective-III /Program Elective-III	3	0	2	4	9	4
4	SBC	MC601	Project-II	0	0	8	8	16	4
5	HSSE	HSEX3	HSS-III	2	0	0	3	5	2
6	SBC	AS603	Selling and Negotiation Skills	2	0	0	3	5	2
7	ABL	LLC	LLC-III	0	0	0	2	2	1
			TOTAL	13	0	12	29	54	20

Sem III (For Non Computer/IT Graduates)									
No	Type	Code	Course	L	T	P	O	E	C
1	PC*	MC602	Computer Networks	2	0	0	3	5	2
2	OE*	OEXXX	Open Elective-I	3	0	0	5	8	3
3	PE	MC5XX-II	Thread Elective-II** /Program Elective-II	3	0	2	4	9	4
4	PE	MC5XX-III	Thread Elective-III /Program Elective-III	3	0	2	4	9	4
5	SBC	MC601	Project-II	0	0	8	8	16	4
6	SBC	AS603	Selling and Negotiation Skills	2	0	0	3	5	2
7	ABL	LLC	LLC-II	0	0	0	2	2	1
			TOTAL	13	0	12	29	54	20



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Sem IV									
No	Type	Code	Course	L	T	P	O	E	C
1	OE*	OEXXX	Open Elective-II	3	0	0	5	8	3
2	ABL	LLC	LLC-IV(Computer/IT) LLC-III (Non Computer/IT)	0	0	0	2	2	1
3	SBC	MC610	6-Month Industry Internship/Research internship at SPIT or Other Institute / Internship with Startup at TBI	0	0	0	0	45	12
TOTAL				3	0	0	7	55	16

* indicates MOOC course.

THREAD ELECTIVES

Sr. No.	Thread	Thread Elective I	Thread Elective II	Thread Elective III
1	Data Science	Machine Learning (MC511)	Deep Learning (MC512)	Data Visualization and Analytics (MC513)
2	Software Testing	Software Testing (MC514)	Quality Assurance (MC515)	Risk Analysis (MC516)
3	Design	Design Thinking** (MC517)	Human Machine Interaction (MC518)	User Experience Design (MC519)
4	Full Stack Development	DevOps (MC520)	React (MC521)	Springboot and Microservices (MC522)
5	Any new thread approved by BoS			

**MC517 of 4 credits will be offered with 2 credits for theory and 2 credits for laboratory.



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PROGRAM ELECTIVES / MOOC

MC523	IoT and I2oT
MC524	Cloud Computing
MC525	Artificial Intelligence and Soft Computing
MC526	Cyber Security
MC527	Block Chain Technology
MC528	Data Warehousing and Mining
MC529	Computer Graphics
MC530	Ethical Hacking
	Any other Course approved by the Dean Academics and Principal

OPEN ELECTIVES / MOOC

OEHXX	Management Principles
OEHXX	IPR and Patents
OEHXX	Law for Engineers
OEHXX	Organizational Behavior
OEHXX	Leadership, Innovation and Entrepreneurship
OEHXX	Project Management
OEHXX	Finance for Engineers
OEHXX	Research Methodology
OEHXX	Any course approved by Dean Academics and Principal



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SEMESTER III



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
TE	Machine Learning	3	-	2	4	9	3	-	1	4
		Examination Scheme								
MC511	Machine Learning	Component		ISE		MSE		ESE		Total
		Theory		75		75		150		300
		Laboratory		50		--		50		100

Pre-requisite Course Codes, if any.	Linear Algebra
Course Objective: To introduce basic concepts and techniques of machine learning and develop skills of using recent machine learning software for solving practical problems.	
Course Outcomes (CO): At the End of the course students will be able to	
MC511.1	Explain basic concept and need of machine learning
MC511.2	Apply machine learning algorithms to solve the given problem
MC511.3	Explain various reinforcement learning techniques
MC511.4	Apply Dimensionality reduction techniques.
MC511.5	Make use of basic concepts of Python/R to solve given problems.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC511.1	2	-	-	-	-	-	-	-	-	-	-	-
MC511.2	2	2	2	2	2	-	-	-	1	-	1	-
MC511.3	2	-	-	-	-	-	-	-	-	-	-	-
MC511.4	2	2	2	-	2	-	-	-	1	-	1	-
MC511.5	2	2	2	-	3	-	-	-	1	-	1	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC511.1	-	-	-	-	-
MC511.2	-	2	1	-	2
MC511.3	-	-	-	-	2
MC511.4	-	2	1	-	2
MC511.5	-	-	-	-	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Theory Component

Module No.	Topics	Ref.	Hrs.
1	Introduction To Machine Learning	1,2,4	8
	Need of machine learning, machine learning vs AI, machine learning vs Deep learning ,Learning types : Supervised Learning, Unsupervised learning, Reinforcement learning, What makes Machine Learning tick purpose or objectives, variety of algorithms- learning style, similarity style, Applications of machine learning, General Steps or Process of Machine Learning- SourceX -> Feature Extraction -> Feature Correlation -> Feature TransformX-> Train Model-> Ensemble-> Evaluate Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets. Estimators, Bias and Variance, likelihood, Stochastic Gradient Descent.		
2	Supervised Learning	1,2,4	14
	Hypothesis testing, Training versus Testing, Gradient Descent, Over fitting & Regularization ,Regression: Regression fundamentals, Linear Regression, Polynomial regression, Regularization technique (LASSO), Classification: Classification fundamentals, Logistic Regression, Decision trees,-CART,-Random Forest, Naïve Bayes , Support Vector Machine, Time Series, Neural Networks , Case Study(Classification)		
3	Unsupervised Learning	1,2,3	6
	Clustering basics: K-means clustering, K-Nearest Neighbor , Association Rule Learning , Hierarchical		
4	Dimensionality Reduction	2	6
	Feature Engineering, Feature Selection methods, - Filters; Wrappers, Embedded, PCA, SVD, -tSNE -Case Study (Clustering/Anomaly/Fraud Detection)		
5	Reinforcement Learning	2,4	4
	Markov Decision, Monte Carlo Prediction, -Case Study (next best offer, dynamic pricing)		
6	Machine Learning Applications across Industries	1,2	4
	Healthcare, Retail, Financial Services, Hospitality		
7	Self-Study Topics		
	Cloud Based ML Offerings, Comparing Machine Learning as a Service: Amazon, Microsoft Azure, Google Cloud AI, IBM		
	Watson, Explore tools used in ML, TensorFlow, Keras, Scikit learn		
Total			42



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Laboratory Component

Sr. No	Title of the Experiment
1	Introduction to Python/R Introduction Python/R, Python/R data types and objects, reading and writing data, Python/R Packages
2	Python/R flow control Control structures, scoping rules, dates and times, data manipulation in Python/R
3	Functions and Modules Loop functions, debugging tools, Mathematical Functions, Data Processing and handling
4	Apply Linear regression
5	Apply Logistic regression
6	Apply decision tree for given problems
7	Apply Random Forest for given problems
8	Apply Naïve Bayes for given problems
9	Apply K means clustering for given problem
10	Apply PCA for given problem

Text Books:

- [1] Shai Shalev-Shwartz and Shai Ben-David, " *Understanding Machine Learning: From Theory to Algorithms*", Cambridge University Press, 1st Edition, 2014
- [2] Mehryar Mohri Afshin , Rostamizadeh ,Ameet Talwalkar, " *Foundation of Machine Learning*", The MIT Press, 2nd Edition, 2018

Reference Books:

- [3] Gareth James, Daniela Witten, Trevor Hastie Robert Tibshirani, " *An Introduction to Statistical Learning*", Springer, 7th Edition, 2007
- [4] Andrew Ng, *Machine Learning Yearning*, DeepLearning.ai, Draft v0.5, 2018
- [5] Dr Dinesh Kumar, " *Machine-learning-using-python*", WileyIndia, 1st Edition, 2019

Web References:

- [6] <https://www.altexsoft.com/blog/datascience/comparing-machine-learning-as-a-service-amazon-microsoft-azure-google-cloud-ai-ibm-watson/>
- [7] <https://cloud.google.com/products/ai>



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(TE) MC512	Deep Learning	3	0	2	4	9	3	0	1	4
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
		Theory		75		75		150		300
Laboratory		50		--		50		100		

Pre-requisite Course Codes, if any.	Machine Learning
Course Objective: This course introduces Concepts of Deep learning focusing on the basics of machine learning. This course focuses on the architecture of Deep learning along with the application of the same.	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC512.1	Explain the basics of Deep Learning
MC512.2	Illustrate different models of deep learning
MC512.3	Evaluate deep learning techniques to a given problem
MC512.4	Develop the deep learning model based for real world problems

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC512.1	2	-	-	-	-	-	-	-	-	-	-	1
MC512.2	2	2	-	-	-	-	-	-	-	-	-	1
MC512.3	3	3	3	-	-	-	-	-	-	-	-	2
MC512.4	2	2	3	3	2	2	2	2	2	2	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC512.1	1	-	-	1	2
MC512.2	1	-	-	1	2
MC512.3	1	-	1	1	2
MC512.4	1	-	1	2	3

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	Machine Learning Basics	1	03
		Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimators, Bias and Variance, Basic Models of Artificial Neural Network, Basic terminologies and architecture of ANN, Linear Separability, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Descent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning		
2	Title	Deep Feedforward Networks	1, 2	11
		Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms, Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise, Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, dropout, adversarial training		
3	Title	Convolutional Networks	1, 2, 4	10
		The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features		
4	Title	Autoencoders	1, 2, 4, 5	6
		Architecture of Autoencoder, Under Complete v/s Overcomplete Autoencoder, Regularized Autoencoders, Representational Power, Layer Size and Depth, Stochastic Encoders and Decoders, Denoising Autoencoders, Learning Manifolds with Autoencoders, Contractive Autoencoders, Predictive Sparse Decomposition, Applications of Autoencoders		
5	Title	Sequence Modelling	1, 2, 4, 5	8
		Recurrent Neural Networks, Encoder-Decoder sequence to sequence architecture, Deep Recurrent Network, long short-term memory, other gated RNN		
6	Self-Study	Applications of Deep Learning Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications		4*
Total				42



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Laboratory Component:

** Lab experiments may be performed using any open-source, freely available deep learning frameworks.

Sr. No	Title of the Experiment	Marks
1	To implement basics of Machine Learning using python library	05
2	To implement real world problem using Deep Feedforward Networks	05
3	To implement a CNN for a given problem.	05
4	To implement different type of autoencoders mapping to different real-world problems	05
5	To process sequence modeling using RNN	05
6	To process sequence modeling using Encoder-Decoder/ LSTM	05
7-10	Develop a mini project for real world problem using deep learning technology 1. Custom models and training 2. Loading and pre-processing data 3. Implementation of the problem statement	20

Textbooks

[1] Deep Learning 1st Edition Ian Goodfellow, Yoshua Bengio, Aaron Courville An MIT Press book 2016

[2] Fundamentals of Deep Learning 1st Edition Nikhil Buduma O'Reilly 2017

[3] Deep Learning using Python 1st edition Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka Wiley 2019

Reference Books

[4] Deep Learning: Methods and Applications 1st edition Deng & Yu Now Publishers 2013

[5] Deep Learning CookBook 1st edition Douwe Osinga O'Reilly 2017



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
TE	Data Visualization and Analytics	3	0	2	4	9	3	0	1	4
		Examination Scheme								
MC513		Component		ISE	MSE	ESE	Total			
		Theory		75	75	150	300			
		Laboratory		50	--	50	100			

Pre-requisite Course	Machine Learning	
Course Objective:	To develop skills to visualize the data and get a clear opinion based on the data analysis using various advanced tools and techniques.	
	Student will be able to:	
Course Outcomes	MC513.1	Understand core principles of visual perception (Understand)
	MC513.2	Apply core skills for visual analysis (Apply)
	MC513.3	Apply visualization techniques for various data analysis tasks (Apply)
	MC513.4	Make use of various tools for data visualization (Apply)
	MC513.5	Design Information Dashboard (Create)

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC513.1	2	-	-	-	3	-	2	-	1	-	1	-
MC513.2	2	2	2	-	3	-	2	-	1	-	1	-
MC513.3	2	2	2	-	3	-	2	-	1	-	1	-
MC513.4	2	2	2	-	3	-	2	-	1	-	1	-
MC513.5	2	2	2	-	3	-	2	-	1	-	1	-

	PEO1	PEO2	PEO3	PSO1	PSO2
MC513.1	-	-	2	2	2
MC513.2	-	1	2	2	2
MC513.3	-	1	2	2	2
MC513.4	-	2	2	2	2
MC513.5	-	2	2	2	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Theory Component

Module No.	Topics	Ref	Hrs
1.	Core Skills for Visual Analysis		
	Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – overplotting reduction – analytical patterns – pattern examples, memory efficient data structures	1,3	8
2.	Time-Series, Ranking and Deviation Analysis	1,2,3	9
	Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.		
3.	Distribution, Correlation and Multivariate Analysis	1,2,3	9
	Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques		
4.	Information Dashboard Design	2	4
	Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence		
5.	Visualization	2,3	12
	Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization		
	Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information		
6.	Self-Study Topics:		5*
	Mining data streams, Cluster Analysis, Research Design in Cluster Analysis, Discriminant Analysis, Principal Component Analysis, collaborative visualizations, evaluating visualizations		
Total			42



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Laboratory Component

Sr.	Title of the experiment	Marks
1.	Importing dataset, Cleaning and Preparing the data – <ul style="list-style-type: none">- Understanding Domain, Dataset and importing dataset- Perform sanity and quality checks- Data Formatting- Data Normalization Sets- Binning	05
2.	Perform Exploratory Data Analysis using python	05
3.	Working with data in R	05
4.	Visualizations using ggplot2, aesthetics, and annotations in R	05
5.	Plotting and visualization- Plotting in Pandas vs Matplotlib, Seaborn <ul style="list-style-type: none">- Bar plots- Histograms- Box plots- Grouped plots- Scatterplots- Trellis plots- Heatmaps	05
6.-7	Design information dashboard	10
8-10	Capstone Project on: Data Visualization using advanced tool for any real world problem	15
Total		50

Textbooks

[1] Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.

[2] Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001

[3] Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

Reference Books

[1] Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd

[2] Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.

[3] Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.

[4] Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
TE	Software Testing	3	-	2	4	9	3	-	1	4
		Examination Scheme								
MC514	Software Testing	Component		ISE		MSE		ESE		Total
		Theory		75		75		150		300
		Laboratory		50		--		50		100

Pre-requisite Course Codes, if any.	
Course Objective: To study fundamental concept of Software Testing	
Course Outcomes (CO): At the End of the course students will be able to	
MC514.1	Apply various Software testing Techniques and strategies to find bugs in software
MC514.2	Design test cases suitable in testing
MC514.3	Apply test management and automation in testing environment
MC514.4	Illustrate Agile Testing approach

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
MC514.1	2	2	-	2	2	-	-	-	2	-	-	-
MC514.2	2	-	2	-	1	-	-	-	2	-	-	-
MC514.3	-	2	-	-	3	-	-	1	2	-	2	-
MC514.4	-	-	2	-	1	-	-	-	2	-	2	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC514.1	1	-	-	-	2
MC514.2	1	-	-	-	2
MC514.3	1	-	-	-	2
MC514.4	1	-	-	-	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate✓	Create
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Theory Component			
Module No.	Topics	Ref.	Hrs.
1	Introduction to Software Testing	1,2	4
	Evolution of Software Testing, Goals of Software Testing, Software Testing Definitions, Effective Software Testing vs. Exhaustive Software Testing, Software Failure Case Studies, Principles of Testing.		
2	Software Testing Methodology	1,2	5
	Software Testing Life Cycle (STLC), Software Testing Methodology, Verification and Validation (V&V), Verification of Requirements, High-level Design, Low-level Design, Generic types of Testing-Functional, Non Functional		
3	Dynamic Testing: Black-Box Testing Techniques	1,2	6
	Equivalence Class Partitioning, State Transition Test, Cause Effect Graphing, Boundary Value Analysis, Decision Table Technique		
4	Dynamic Testing: White-Box Testing Techniques	1,2	6
	Need of White-Box Testing, Logic Coverage Criteria, Basis Path Testing, Graph Matrices, Loop Testing, Data Flow Testing, Mutation Testing		
5	Static Testing	1,2	3
	Structured Group Examinations – Reviews, types of reviews, General process, Roles and responsibilities, Selection criteria. The compiler as a static analysis tool		
6	Test Levels	1,2,5	4
	Unit Testing, Integration Testing, System Testing, Test Point Analysis, Acceptance Testing, Performance Testing, Regression Testing, Ad-hoc testing, Alpha, Beta Tests		
7	Test Management	1,2,4	5
	Test organization, Test Planning, Test plan hierarchy Detailed test design and test specifications. Incident Management – Test Log, Incident Reporting, Classification, Status		



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8	Test automation	1,2,4	4
	Need for automation, Categorization of testing tools, Selection of testing tools, Costs incurred in testing tools, Guidelines for automated testing, Overview of some commercial testing tools		
9	Agile Testing	3	5
	Agile Testing Lifecycle, Agile Testing Quadrants, Agile Testing Techniques: Behavior Driven Development, Session Based testing, Acceptance Driven testing, Exploratory Testing		
10	Self-Study Topics		
	Distributed Testing, Outsourced Testing, Insourced Testing, Role of Tester in Risk based Testing, Orthogonal Array Testing System, keyword-driven automation approach		
	Total		42

Laboratory Component

Sr. No	Title of the Experiment
1	Write and test a program using Black box Testing methods
2	Write and test a program using White box Testing methods
3	Study of automation tool, run test cases and use Base URL to run test cases in different domains
4	Selenium commands-selenese, Matching Text Patterns, Performance Testing Concepts :Load Testing, Stress Testing
5	Web Driver Implicit & Explicit Wait, Cross Browser Testing, API Testing
6	Apply of bug tracking tool.
7	Study of mobile apps testing tool.
8	Run test cases on mobile devices and emulators.
9	Study of Behavior Driven development tool
10	Study of test management tool.



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Text Books:

- [1] Andreas Spillner, "*Software Testing Foundations*", Shoff, 4th Edition, 2014.
- [2] Naresh Chauhan, "*Software Testing: Principles and Practices*", Oxford University Press, 1st Edition, 2010.
- [3] Lisa Crispin, Janet Gregory, "*Agile Testing: a brief Introduction*", Library and Archives Canada, 3rd edition 2019.

Reference Books:

- [4] Aditya P. Mathur, "*Foundations of Software Testing*", Pearson Education, 2nd edition, 2013.
- [5] Rex Black, Erik Van, "*Foundations of Software Testing ISTQB certification*", Cengage Learning, 3rd edition, 2012.



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(TE)	Quality Assurance	3	0	2	4	9	3	0	1	4
		Examination Scheme								
MC515		Component		ISE		MSE		ESE	Total	
		Theory		75		75		150	300	
		Laboratory		50		--		50	100	

Pre-requisite Course Codes, if any. Software Engineering ,Software Testing	
Course Objective: To study fundamental concept of Quality Assurance of Software	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC515.1	Illustrate the fundamentals of Software Quality Assurance and its operations.
MC515.2	Analyze different Techniques of Software Quality Management.
MC515.3	Apply various techniques to identify and manage defects for improvement in quality for given software
MC515.4	Solve the Problems using different Measurements and Metrics for Software Project Quality

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC515.1	1	-	-	-	-	-	-	-	1	-	1	--
MC515.2	1	2	2	-	1	-	-	2	1	-	1	-
MC515.3	2	3	-	-	2	-	-	2	1	-	1	-
MC515.4	2	3	-	-	1	-	-	2	1	-	1	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC515.1	-	-	1	2	1
MC515.2	-	2	1	2	1
MC515.3	-	2	3	2	3
MC515.4	-	-	3	2	3

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create
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Theory Component

Module No.	Topics	Ref.	Hrs
1	Introduction to Software Quality Principles and Concepts	1,2,4	5
	Definitions of Quality, Quality Attributes, Organizational Framework for Software Quality Assurance, Principles of Software Quality Assurance, Quality Assurance vs Quality Control		
2	Managing SQA operations	1,2,5	5
	Quality Assurance indicators during SDLC phase, Contents of SQA Plan, Software Quality Assurance: - Organizational Initiatives, Need for SQA function benefits		
3	Quality Management	1,2,6	8
	Total Quality Management, Quality Planning, Improvement, and Control, Cause and Effect of Diagrams, Pareto Charts, and Flow Charts, Quality Plan, Quality Standards and Metric, Audits, and different types of Audits		
4	Quality Assurance in Agile	1,2,4	8
	Quality Assurance in Requirement Analysis -Identify missing user stories, identify what is out of scope, Identify dependencies between user stories, Identify edge cases, Generate Acceptance Criteria, Identify gaps in details on the detailed story documents Estimations and Planning-Identify functionality the developers may not have considered, Provide overall system knowledge, particularly around inter-dependencies, Story Estimations, Identify edge cases. Documentation- acceptance criteria Contains specific details and/or test data, Detailed Story Document Works with BA / Product Owner to ensure that any issues or gaps are captured, Day to Day sprint ,Defining and Testing Phase in agile Methodology-		
5	Defect Management for Quality and Improvement	1,2,5	8
	Defect Life Cycle, Defect Classification with Bug Tracking Process, Importance of Defect Leakage Prevention, Residual Defect Density, Detecting and Analyzing Software Defects - Techniques for Root Cause Analysis, Orthogonal Defect Classification		
6	Metrics and Measurement	1,2,5	8
	Understanding Measurement and Metrics, Metrics for Tracking System Test, Metrics for Defect Management, Metrics for Software Maintenance, Metrics for Requirement, Defect Causal Analysis, Metrics for SDLC phases		
7	Self-study -Quality Management System Tools, QMS stakeholders Expectations		5*
Total			42



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Laboratory Component:

Sr. No	Title of the Experiment
1	Develop SQA Plan for given Case study
2	Develop Pareto Charts for a given Case study
3	Identifying McCall's criteria and factors for software
4	Analyzing various Quality Indicators for SDLC phases
5	Detecting and Analyzing Software Defects using any one Root cause Analysis Technique
6	Analyzing various Quality Indicators for Agile process
7	Apply Requirement Stability Index and Traceability Matrix for given case study using Tool
8	Apply Metrics for Defect Management for a given Scenario
9	Apply Metrics for Software Maintenance for a given Scenario
10	Perform different types of Audits for given case study

Textbooks

- [1] Kshisagar Naik Priyadarshini Tripathy "Software Testing and Quality Assurance: Theory and Practice", WILEY,2017.
- [2] Nina S. Godbole" Software Quality Assurance", Alpha Science International Ltd.,2nd Edition,June 2017.
- [3] Jack T. Marchewka" Information Technology Project Management", Wiley India,4th Edition,2014.

References

- [4] M.G.Limaye" Software Testing Principles, Techniques and Tools", Tata McGraw Hill,July2017.
- [5] Solis Tech, "Quality Assurance: Software Quality Assurance Made Easy", Createspace Independent Publishing Platform, January 2016.
- [6] Ivan Mistrik ,Richard M Soley ,Nour Ali , John Grundy , Bedir Tekinerdogan," Software Quality Assurance: In Large Scale and Complex Software -intensive", Morgan Kaufmann,First,October



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned				
		L	T	P	O	E	L	T	P	Total	
(TE)	Risk Analysis	3	0	2	4	9	3	0	1	4	
		Examination Scheme									
		Component	ISE		MSE		ESE		Total		
MC516		Theory		75		75		150		300	
		Laboratory		50		--		50		100	

Pre-requisite Course Codes, if any.	Software Engineering
Course Objective:	To study fundamental concept of Risk Analysis
Course Outcomes (CO):	<i>At the End of the course students will be able to</i>
MC516.1	Illustrate the fundamentals of Planning and Identifying Risk
MC516.2	Identify various Qualitative and Quantitative Risk Analysis Technique
MC516.3	Applying various strategies for Planning Risk Response
MC516.4	Make Use of different techniques for Monitoring and Controlling Risk

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC516.1	2	-	-	-	-	-	-	2	1	2	-	-
MC516.2	2	2	-	-	-	-	-	2	1	2	-	-
MC516.3	-	-	-	2	-	-	-	2	2	2	-	-
MC516.4	-	2	-	-	-	1	-	2	2	2	-	-

	PEO1	PEO2	PEO3	PSO1	PSO2
MC516.1	-	-	2	2	2
MC516.2	-	-	2	2	2
MC516.3	-	-	2	2	2
MC516.4	-	-	2	2	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create
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Theory Component

Module No.	Topics	Ref.	Hrs.
1	Overview of Risk Management	1,2,4	6
	Risk and its Nature, Types of Risk, Process of Risk Management Importance of Risk Management, Risk Management, Perspectives Elements of Software Risk.		
2	Planning and Identification of Risk	1,2,3	8
	Plan Risk Management, Tools and techniques for Planning Risk Management, Common Software Project Risk, Inputs for Identifying Risk, Tools for Risk Identification, Techniques for Risk Identification		
3	Risk Analysis and Assessment	1,2,3	10
	Objectives and Goals of Risk Analysis and Risk Assessment, Qualitative vs Quantitative Risk Analysis, Techniques for Qualitative and Quantitative Risk Analysis, Tools used for Qualitative and Quantitative Risk Analysis, Methods for Risk Assessment		
4	Planning of Risk Responses	1,2,4	10
	Strategies for Risk Response, Response strategy for Threats Response Strategy for Opportunities, Response Strategy for Both Threats and Opportunities, Output of Plan Risk Response		
5	Monitoring and Controlling Risk	1,2,4	8
	Tools for Implementing Risk, Techniques for Implementing Risk Developing a process for Monitoring Risk, formulating a Project Risk Register, Managing and Tracking Risk, Role of Risk Governance and Culture		
6	Self-Study - Tools for Risk Management, different vulnerabilities for Operating system, Application vulnerabilities	1,2,4	5
Total			42



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Laboratory Component,

Sr. No	Title of the Experiment
1	Develop Risk Management Plan
2	Identify the different Risk for a given Case study
3	Perform Qualitative Risk Analysis
4	Perform Quantitative Risk Analysis
5	Analyze Risk Assessment method
6	Identify Response Risk Strategy for Given case study
7	Perform Risk Monitoring activity
8	Formulate Risk in Project Risk Register
9	Perform Risk Audit
10	Study of Risk Management Tool

Textbooks

[1] John Mc Manus" Risk Management in Software Development Projects", Routledge, September 2016.

[2] David Hillson and Peter," Practical Project Risk Management: The ATOM Methodology", Management Concepts ,2nd Edition,2012.

References

[3]"A guide to Project Management Book Of Knowledge", Project Management Institute, Sixth, 2016.

[4]" Project Risk Analysis and Management Guide", Association for Project Management, Second, October2015.



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
TE	Design Thinking	2	0	4	4	9	2	0	2	4
		Examination Scheme								
Component		ISE		MSE		ESE		Total		
Theory		50		50		100		200		
MC517		Laboratory		100		--		100	100	

Pre-requisite Course Codes, if any.	
Course Objective:	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC517.1	Understand the principles and foundations of design thinking
MC517.2	Foster a user-centric mindset to drive innovation using design thinking
MC517.3	Design solutions that address real-world problem
MC517.4	Create the prototype for proposed design.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC517.1	-	2	-	-	-	-	-	-	-	-	-	-
MC517.2	-	-	3	-	2	-	-	-	-	-	-	-
MC517.3	-	-	3	-	-	-	2	-	-	2	-	-
MC517.4	-	-	3	-	2	-	-	-	-	2	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC517.1	1	-	-	-	-
MC517.2	2	-	2	-	-
MC517.3	-	-	2	-	-
MC517.4	-	-	2	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
Theory Component					



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Module No.	Topics	Ref.	Hrs.
1	Introduction	1,2	3
	Why Design? – Four Questions, Ten Tools – Principles of Design Thinking – The process of Design Thinking – How to plan a Design Thinking project		
2	UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM	1,2	8
	Search field determination – Problem Clarification – Understanding of the problem – Problem Analysis – Reformulation of the problem – Observation Phase – Empathetic design – Tips for Observing – Methods for Empathetic Design – Point – of – View – Phase – Characterization of the target group – Description of customer needs.		
3	IDEATION AND PROTOTYPING	1,2	6
	Ideate Phase – The creative process and creative principles – Creativity techniques – Evaluation of Ideas – Prototype Phase –Lean Start-up Method for Prototype Development – Visualization and Presentation techniques		
4	TESTING AND IMPLEMENTATION	1,2	7
	Test Phase – Tips for interviews – Tips for surveys – Kano Model – Desirability Testing – How to Conduct workshop – Requirements for the space – Material requirements – Agility for Design Thinking		
5	FUTURE	1,2	4
	Design Thinking meets the corporation – The New Social Contract - Design Activism – Designing Tomorrow.		
6	Self-Study Topics		4
	Case Study of Airbnb, Pepsico, few case studies from Stanford University and CMU		
Total			28



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Laboratory Component

Sr. No	Title of the Experiment
1.	Redesigning a Transportation System for a Smart City using stakeholder Mapping.
2.	Enhancing User Safety in a Medical Device using Usability Testing and Human Factors Analysis
3.	Designing a Sustainable Packaging Solution for a Product using Life Cycle Assessment and Material Exploration
4.	Improving Energy Efficiency in a Building using Energy Monitoring and Retrofit Analysis
5.	Creating an Autonomous Drone for Agricultural Monitoring using Rapid Prototyping and Field Testing
6.	Redesigning a Public Space for Community Engagement using Observation and Participatory Design
7.	Developing a Renewable Energy Microgrid System using System Modeling and Simulation
8.	Designing an Augmented Reality (AR) Training Tool for Industrial Maintenance using User Research and Prototyping
9.	Enhancing education system in an Urban Area using Data Analytics and Sensor Technology
10.	Creating a User-Friendly Interface for Industrial Automation Equipment using User-Centered Design and Usability Testing

Text Books:

1. Christian Mueller-Roterberg, Handbook of Design Thinking – Tips & Tools for how to design thinking, Nov..2018 ,paperback.
2. Designing for Growth: a design thinking tool kit for managers By Jeanne Liedtka and Tim Ogilvie. ,Columbia Business School publishing, 2011.
3. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown, HarperCollins e-books; 1st edition (16 September 2009)

REFERENCES:

1. Johny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand-Improve – Apply". Springer, 2011.

WEB REFERENCES:

4. <http://ajjuliani.com/design-thinking-activities/>
5. <https://venturewell.org/class-exercises>



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
MC518	Human Machine Interaction (HMI)	3	0	2	4	9	3	0	1	4
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
		Theory		75		75		150		300
TE		Laboratory		50		--		50		100

Pre-requisite Course Codes	MC503, MC 504, MC509
Course Objectives	This course provides an opportunity to learn and apply the design principles of Human-Machine Interaction. Learners will learn the basic human psychology of everyday actions and will be able to design a UI prototype of an application. This course covers the discussion of various interaction design concepts. The laboratory experiments are designed to practice the concepts and to adopt the systematic approach for interface design using various UX tools.
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC518.1	Identify the various design principles used for interacting between humans and machines.
MC518.2	Apply human psychology of everyday actions and UI design process for real-world applications.
MC518.3	Implement mobile, windows, and web-based application
MC518.4	Evaluate and justify UI design
MC518.5	Create applications for social and technical tasks.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC518.1	-	-	3	-	2	-	-	-	-	-	-	-
MC518.2	-	-	3	-	3	-	-	-	-	-	-	-
MC518.3	-	-	3	-	3	-	-	-	-	-	-	-
MC518.4	-	-	3	-	3	-	-	-	-	-	-	-
MC518.5	-	-	3	-	3	-	-	-	-	3	-	-



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CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC518.1	-	1	3	-	-
MC518.2	-	1	3	-	-
MC518.3	-	1	3	-	-
MC518.4	-	2	3	-	-
MC518.5	-	2	2	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Theory Component

Module No.	Unit No.	Topics	Ref .	Hrs.
1	Title	Introduction	T1-T4	06
	1.1	Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields.		
	1.2	The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction		
	1.3	The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction;		
2	Title	Graphical User Interface and Web Interface	T1, T2, T4	08
	2.1	The Graphical User Interface: Popularity of graphics, the concept of direct manipulation, characteristics of GUI,		
	2.2	Web user Interface: Interface popularity, characteristics. Principles of user interface design.		
3	Title	Understanding Goal-Directed Design:	T1, T2, T4	06
	3.1	Goal-directed design; Implementation models and mental models; Beginners, experts, and intermediates – designing for different experience levels;		
	3.2	Understanding users; Modeling users – personas and goals.		
4	Title	Design Guidelines	T1, T2, T3, T4	08
	4.1	perception, Gestalt principles, visual structure, reading is unnatural		
	4.2	color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, time.		
5	Title	Interaction Styles and Communication	T2, T4	10
	5.1	Interaction Styles 1: Menus, Windows,		
	5.2	Interaction Styles 2: Device-based and Screen-based Controls.		
	5.3	Communication: Text messages, Feedback, and Guidance, Icons, Multimedia and colors.		



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6	Title	Interface Design For Mobile Devices	R2	04
	6.1	Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications.		
7	Self Study	Multimodal Interaction, Adaptive interfaces, Ethical and Responsible HMI, Human Robot Interaction.		04
			Total	42

Laboratory Component:

Sr. No	Title of the Experiment
1	To Study of open-source UX tools (Justinmind Prototype, Pidoco, Marvel ,Figma Prototype) and create a simple design for a given problem definition.
2	<p>Know your client.</p> <ol style="list-style-type: none"> Design an app that can teach mathematics to children of 4-5 years age in schools in Rural Sector. Design an app that can teach mathematics to children of 4-5 years age in schools in Urban Sector. Design a site that can help people to sell their handmade products in metro cities. Design a site that can connect housewives and keep them engaged. <p>Note : Students should be able to do the following for any given problem statement</p> <ol style="list-style-type: none"> Analysis of user's/client's behavior eg their preferences, interests etc What kind of interfaces will they like and why? Existing apps - analyze and rate them. What will be your choice of screen elements? How will your app/web design be better than the existing one?
3	Goal-oriented design - Design an experience for passengers whose flight /train is delayed.
4	Design Principles - Understand principles of good UI design by heuristic evaluation. Design UI for a given problem statement.
5	Menus & Navigation – Redesign of a user interface (Suggest and implement changes in Existing User Interface) for a given problem statement.
6	<p>Windows & Screen controls – Design UI for a given problem statement.</p> <ol style="list-style-type: none"> Design a navigator for a student new in your Institute. Design a navigator for a person new in tourist city/ village. Motor paralysis for differently able people. Vaccination App design with localization



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7	Icons - Design appropriate icons pertaining to a given domain. (Eg. Greeting cards, Travelling, restaurants, Education, Medical, security at Airport, Malls etc)
8	Colors – Design a personal website for any socio-technical problem. Use color guidelines with statistical graphics for better visualization.
9	Design a Map-based UI(Web User) for the given problem statement. Example: Mumbai Dabbawallas with localization feature. Pet Care New Visitors to Hospital
10	To calculate the screen complexity of the existing Graphical User Interface and redesign the interface to minimize the screen complexity.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Human Computer Interaction	3 rd	Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale	Peason,Prentice Hall	2003
2	The Essential Guide to User Interface Design	3 rd	Wilbert O. Galitz,	Wiley publication	2007
3	Design of everyday things	2 nd	Donald A. Normann	Basic Books; Reprint edition	2013
4	Galitz's Human Machine Interaction	1st	Kalbande,Kanade,Iyer	Wiley Publications	2015

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Interaction Design: Beyond Human Computer Interaction	5th	Rogers Sharp Preece	Wiley publications	2019
2	Mobile Design and Development	1 st	Brian Fling	, O'Reilly Media Inc.,	2009.



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
TE	User Experience Design	3	0	2	4	9	3	0	1	4
MC519		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
	Theory	75		75		150		300		
	Laboratory	50		--		50		100		

Pre-requisite Course Codes	MC503, MC 504, MC509
Course Objectives	This course provides an opportunity to learn and apply User experience design principles in day-to-day life. Learners will understand and identify the steps in the life cycle template of UX Design. Learners will be able to design a UI prototype of an application with UX design guidelines. This course covers the discussion of various UX design concepts. The laboratory experiments are designed to practice the concepts and to adopt the systematic approach for gaining user experience via interface design using various UX tools.
Course Outcomes (CO): At the End of the course students will be able to	
MC519.1	Analyze the UX design life cycle and its process for users.
MC519.2	Apply the UX design process for the given scenario
MC519.3	Create a real-life application with an end-to-end understanding of User experience practices.
MC519.4	Evaluate the UX design process the for best experience.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC519.1	-	-	3	-	-	-	-	-	-	-	-	-
MC519.2	-	-	3	-	-	-	-	-	-	2	2	-
MC519.3	-	-	2	-	-	-	-	-	-	2	2	-
MC519.4	-	-	3	-	3	-	-	-	-	2	-	-



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CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC519.1	-	2	2	-	-
MC519.2	-	2	2	-	-
MC519.3	-	2	2	-	-
MC519.4	-	2	2	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	Introduction to Human Machine Interaction	T3,T4	4
	1.1	Introduction, History of User interface designing, Usability, GUI Vs Web Interface, UI Vs UX, UI Design Goals		
2	Title	UX Design and Life Cycle	T1,T2	4
	2.1	What is UX (User Experience), Ubiquitous interaction, A UX process lifecycle template, The system complexity space, Meet the user interface team		
3	Title	The UX Design Process – Understand Users	T1,T2	8
	3.1	Contextual Inquiry: Introduction, the system concept statement, User work activity gathering, Abridged contextual inquiry process		
	3.2	Contextual analysis: Introduction, Creating and managing work activity notes, Constructing your WAAD (Work Activity Affinity Diagram)		
	3.3	Extracting Design Interaction requirements: Formal Requirements Extraction, Abridged method for requirement extraction		
	3.4	Design Informing Model: User Model (Social Model), Usage Model (Flow Model, Task Interaction Model), Work Environment Model.		
4	Title	The UX Design Process-Design Thinking, Ideation and Sketching	T1,T2	10
	4.1	Design Paradigm, Design Thinking, Design perspective, User personas, Ideation, Sketching		
	4.2	Mental Models and Conceptual Design		
	4.3	Storyboards, Wireframes		
5	Title	The UX Design Process- Prototyping, Evaluation and Agile development	T1,T2	10
	5.1	Fidelity of Prototype, To make effective paper prototype,		
	5.2	UX Evaluation and Improve UX Goals, Metrics and Targets		
	5.3	UX Evaluation Techniques- Formative vs Summative		
	5.4	UX Method for Agile Development: Introduction, Basics of agile SE methods, drawbacks of agile SE methods from UX perspective, what is needed on the UX side.		
6	Title	Study of UX Tools		
	6.1	Design and prototype tool (Sketch app, Figma, Adobe Illustrator)	w1,w2,w3	08
	6.2	Wireframe tools (Pencil, Lucidchart)	w4,w5	
	6.3	App for Sketch, Design changes and Feedback (Invision app)	w6	
	6.4	Tools/Apps for research, ideation, persona and customer journey map (Miro, Uxpressia, Xtensio)	w7,w8,w9	
7	Self Study	Self-Learning contents		4
		Affordance, Integration of UX into agile SE methods, translations.		
			Total	42



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Laboratory Component

Sr. No.	Title of the Experiment
1	To Study of open source UX tools (Justinmind Prototype, Pidoco, Marvel Prototype) and create UX design for a given problem definition.
2	Design Mobile/Web UI for your own Travelling agent considering adding map and localization features along with descriptions if required. (e.g, Make my Trip, Tripadvisor, thrillophilia etc.)
3	Design an experience for the user whose flight or train is delayed.
4	Pick a website/app that you use on a daily basis (eg. facebook, gmail, whatsapp, zomato, etc). Evaluate the product based on user experience principles and give suggestions for improvement. Explain usability testing process for the same.
5	Analyze and redesign the (IRCTC/IndianRail) website for a better User Experience and create the heuristic report using Nielsen's Heuristic principles.
6	Design UI to teach mathematics in rural areas/ to sell the products of farmers directly to consumers.
7	Design a UI-based navigator for school children to check various sports events in local and different cities of India.
8	Design UI/UX Mobile App along with making a logo/ICONS for the same for your own newly opened restaurant. (Consider all the UX Parameters while designing).
9	Design UI for any differently-abled users/new-age women's safety app for Indian citizens.
10	Design UI for analysis of the number of children suffering from juvenile diabetic children in India. The design aims at providing solutions for improving quality treatment and making the treatment affordable.

Note: All the experiments need to be tested for usability. The problem statement for any experiment can be changed by the instructor during the laboratory with different example.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	The UX Book	1 st	Rex Hartson and Pardha Pyla	MK Publication	2012
2	A Project Guide to UX Design: For user experience designers in the field or in the making.	2 nd	Russ Unger and Carolyn Chandler	O'reilly, Series Editor	2012
3	Galitz's Human Machine Interaction	1 st	Kalbande, Iyer, Kanade	Wiley Publication	2015
4	The Essential Guide to User Interface Design	3 rd	Wilbert O. Galitz,	Wiley publication	2007



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Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Smashing UX Design	1 st	Jesmond Allen and James Chudley	John Wiley & Sons	2012
2	Agile Experience Design	1 st	Brian Fling	, O'Reilly Media Inc.,	2009.

Online Web Resources for conceptualizing and practicing the UX tools as:

[w1] <https://www.sketch.com/>

[w2] <https://www.figma.com/>

[w3] <https://www.adobe.com/in/products/illustrator.html>

[w4] <https://pencil.evolus.vn/>

[w5] <https://www.lucidchart.com/pages/>

[w6] <https://www.invisionapp.com/>

[w7] <https://xtensio.com/>

[w8] <https://miro.com/>

[w9] <https://uxpressia.com/>



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE	DevOps	3	0	2	4	9	4	-	-	3
		Examination Scheme								
MC520		Component		ISE		MSE		ESE	Total	
		Theory		75		75		150	300	
		Laboratory		50		--		50	100	

Pre-requisite Course Codes, if any.	Web Technology Lab
Course Objective: This course is designed to provide the core knowledge necessary to understand DevOps concepts, its principles and practices and tools.	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC520.1	To understand basic concepts of DevOps
MC520.2	Install, configure & use container technologies
MC520.3	Apply testing tools for software, quality code & security testing
MC520.4	Deploy and continuous monitoring of systems

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC520.1	2	2	-	-	2	-	1	-	-	-	-	-
MC520.2	2	2	2	2	3	-	-	-	-	-	-	-
MC520.3	2	2	-	-	3	-	2	1	-	-	-	-
MC520.4	2	2	2	2	3	-	2	2	-	-	1	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC520.1	-	-	-	1	1
MC520.2	-	-	-	2	2
MC520.3	-	-	-	2	2
MC520.4	-	-	-	2	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Theory Component

Module No.	Topics	Ref.	Hrs.
1	Overview of DevOps	1,2	6
	Introduction to DevOps: Define the concept of DevOps, explain its origins, and describe its benefits and challenges., DevOps Delivery Pipeline, DevOps Ecosystem Version Control with Git –version control basics, Git fundamentals, Git for your organization, Installation of Git, Common commands in Git,		
2	Git, Jenkins, Ansible, SonarQube & Maven Integration	1,2	8
	2.1 Branching and Merging in Git, Git workflows, Git cheat sheet, CI introduction, introduction to Jenkins (With Architecture), Introduction to Maven 2.2 Continuous Integration using Jenkins Jenkins Management, Adding a slave node to Jenkins, Building Delivery Pipeline, Pipeline as a Code, SonarQube- Quality code testing, Puppet, Ansible		
3	Containerization with Docker	1,2	10
	Introducing Docker, Understanding images and containers, Running Hello World in Docker, Introduction to Container, Container Life Cycle, Sharing and Copying Base Image, Docker File Working with containers		
4	Containerization using Kubernetes	1,2,3	6
	Revisiting Kubernetes, Cluster Architecture, Spinning up a Kubernetes Cluster on Ubuntu VMs, Exploring your Cluster Understanding YAML, Creating a Deployment in Kubernetes using YAML, Creating a Service in Kubernetes, Installing Kubernetes Dashboard, Deploying an App using Dashboard, Using Rolling Updates in Kubernetes, Containers and Container Orchestration		
5	Functional Testing, Security Testing and Continuous Monitoring with Nagios	1,2	6
	5.1 Security Testing- Auditing, Analyzing Vulnerabilities OpenVAS, Burpsuite, OWASP-ZAP 5.2 Continuous Monitoring, Introduction to Nagios, Installing Nagios, Nagios Plugins (NRPE) and Objects, Nagios Commands and Notification		
6	Introduction to DevOps on Cloud	1,2	4
	Introduction to Cloud Computing, Why DevOps on Cloud, Introduction to AWS Various		
7	Self-Study Topics		
	Microservices, virtual machine configurations using Vagrant, container configuration using Docker, container deployment/orchestration using Docker Swarm and Kubernetes, automated deployments using Terraform, continuous integration and deployment (CI/CD) using Jenkins, cloud-deployments in Amazon Web Services. Infrastructure as Code (IAC)		
Total			42



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Laboratory Component

Sr. No	Title of the Experiment
1	Setup Virtualization Software: Docker, Proxmox, KVM, VirtualBox, VMware
2	Version Control Basics: Create a new repository on GitHub or GitLab and practice basic version control operations like committing changes, branching, merging, and resolving conflicts. This lab can teach the basics of source code management and collaboration
3	Containerization Basics: Use Docker Compose to define a multi-container application and run it locally. This lab can teach the basics of container orchestration and networking.
4	Continuous Deployment (CD) Basics: Use a CD tool like Travis CI or CircleCI to deploy a simple application to a cloud provider like Heroku or AWS. This lab can teach the basics of automated deployment and continuous delivery
5	To perform Jenkins/Ansible/Qualitycode testing using SonarQube
6	To perform functional testing using selenium.
7	To perform Security testing using OpenVAS
8	Performance monitoring using Nagios
9	Securing & Monitoring container with Kubernetes
10	Implement zero trust architecture

Text Books:

[1] Implementing DevSecOps with Docker and Kubernetes by José Manuel Ortega Candel, BPB Publications

[2] Visualizing Google Cloud by Priyanka Vergadia, Wiley Publication

Reference Books:

[3] Kubernetes in Action (Second Edition) by Marko Luksa, Manning Publication

Web References:

<https://devops.com/>



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
TE	React	3	-	2	4	9	3	-	1	4
		Examination Scheme								
Component		ISE		MSE	ESE	Total				
MC521		Theory	75		75	150	300			
		Laboratory	50		--	50	100			

Pre-requisite Course Codes, if any.	
Course Objective:	To gain the skills and knowledge needed to develop dynamic, high-performance, and scalable user interfaces for web applications.
Course Outcomes (CO):	<i>At the End of the course students will be able to</i>
MC521.1	Understand the fundamentals of React and its core concepts, such as components, JSX, and the virtual DOM.
MC521.2	Build an application using States, Props and Forms.
MC521.3	Create Navigation structure using nested routes.
MC521.4	Create custom Hooks to handle side effects such as network requests and data fetching.
MC521.5	Understand the basic principles and concepts of Redux and how it works with React.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC521.1	3	2	-	-	3	-	-	-	-	-	1	-
MC521.2	3	3	3	-	3	-	-	-	-	-	1	-
MC521.3	-	3	3	-	3	-	-	-	-	-	1	-
MC521.4	-	3	3	-	3	-	-	-	-	-	1	-
MC521.5	2	3	-	-	3	-	-	-	-	-	1	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC521.1	-	-	2	-	-
MC521.2	-	-	2	2	2
MC521.3	-	-	2	2	2
MC521.4	-	-	2	2	2
MC521.5	-	-	2	2	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Theory Component

Module No.	Topics	Ref.	Hrs.
1	Introduction to React	1,2	4
	What is React, Setting up the development environment, React components, JSX syntax, Rendering components		
2	State and Props	1,2	8
	State and lifecycle methods, Read state and Set state, Props and its types, Passing data to component using Props, Validating props using propTypes, Supplying default values to props using defaultProps, Handling events(onBlur, onKeyUp, onChange), Conditional rendering, Lists and Keys, Flow of States, Initialize states and update states		
3	Forms and User Inputs	2,3	7
	Controlled components, Uncontrolled components, Form submission and Validation, Using react ref prop to get access to DOM element		
4	React Router and Navigation	1,2	8
	React Router and its components, Navigation with links and buttons, Nested routes and parameters, Redirects and Authentication		
5	React Hooks	2	8
	useState, useEffect and other built-in hooks, Custom hooks, Using hooks to manage state and side effects, Hooks best practices		
6	Redux and State Management	1,2,3	7
	Introduction to Redux, The Redux store and actions, Reducers and Selectors, Connecting Components to the store		
Self Study	Server side rendering, React performance and optimization, Higher order components, Context API		
Total			42

The above topics will be taught using Function based components.



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Laboratory Component

Sr. No	Title of the Experiment
1	Set up the environment and understand the React Component.
2	Create and run the basic application.
3	Create an application using Props and States.
4	Create an application that applies all lists of events.
5	Create an application using React Form by applying form component, submit and reset the form and validate the form,
6	Create a single page application. Apply Routing, Dynamically render the components based on the URL.
7	Create an application that demonstrates Hooks.
8	Test the application using Enzyme library.
9	Deploy the application on Github and test it.
10	Mini Project based on above concepts.

Text Books:

- [1] Kirupa Chinnathambi, "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux", O'Reilly, Second Edition, 2018
- [2] Anthony Accomazzo, "Fullstack React: The Complete Guide to ReactJS and Friends", Fullstack.io, First Edition, 2017
- [3] Mark Tielens Thomas, "React in Action", Manning Publications, First Edition. 2018

Web References:

- [4] 30 Days of React, Fullstack.io
- [5] <https://react.dev/learn>



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
TE MC522	Springboot and Microservices Thread Elective	3	-	2	4	9	3	-	1	4
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
		Theory		75		75		150		300
Laboratory		50		--		50		100		

Pre-requisite Course Codes, if any.	
Course Objective: To learn fundamentals of Data Structures.	
Course Outcomes (CO): At the End of the course students will be able to	
MC522.1	To understand structure of servlet and JSP
MC522.2	Analyse Spring Framework for Security and REST API
MC522.3	learn architecture Technical Micro and Macro Architecture
MC522.4	design and develop Microservices and Dockers

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC522.1	3	3	-	-	-	-	-	-	1	-	2	-
MC522.2	3	3	-	-	-	-	-	-	1	-	2	-
MC522.3	-	-	-	3	-	-	-	-	1	-	2	-
MC522.4	-	3	-	-	-	-	-	-	1	-	2	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC522.1	3	1	-	-	1
MC522.2	3	1	-	-	1
MC522.3	3	1	-	-	-
MC522.4	3	1	-	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create
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Theory Component

Module No.	Topics	Ref.	Hrs.
Unit 1	Introduction to Servlets & JSP	2	06
	Web Applications and JSP Architecture, Servlet Architecture, HttpServlet, Request & Response,		
	Servlets Lifecycle, Interactive Web Applications, Types of software architectures		
Unit 2	Spring Framework, Spring Security, Spring Boot, REST API	1	10
	SOA and Monolith Architecture, Need of Spring Boot, Difference between Spring & Spring Boot, Building Spring Boot Application		
	Rest Annotation with In Memory Database & CRUD Operations, Rest Annotation with Relation DB, JPA Repository Concepts, Spring Boot with Multiple SQL Show Hibernate/JPA SQL Statements from Spring Boot, Spring Boot With H2 Database		
Unit 3	Spring Cloud	1	04
	Spring Cloud Config, Spring Cloud Circuit Breaker, Spring Cloud Gateway, Spring Cloud OpenFeign, Spring Cloud Sleuth,		
Unit 4	Micro Services	3	10
	Principles of Micro services Architecture, Micro and Macro Architecture, Bounded Context and Strategic Design, Technical Micro and Macro Architecture, Organizational Aspects, Independent Systems Architecture Principles (ISA)		
	Deploying and Maintaining Microservices		
	Explore the intersection of DevOps and microservices, Learn to leverage virtual, cloud, and containerized environments for microservice deployment,		
Unit 5	Technology Stacks : Docker	3	06
	Docker for Microservices: Reasons, Docker Basics, Dockerfiles		
	Docker Compose Publishing Image on Docker Hub, Docker Ecosystem		
Unit 6	Self-Study Topics	3	06
	NOSQL technologies (Redis, MONGODB, Neo4j, Elastic search), Distributed Transactions with JTA (using Atomikos, Bitronix, Narayana)		
		Total	42



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Laboratory Component

Sr. No	Title of the Experiment
1	Developing web applications using Spring
2	Creating REST services: sending messages asynchronously
3	Creating REACTIVE services:
4	CLOUD NATIVE Spring
5	Work on the Open-source Project Sagan
6	Use LDAP to Authenticate a User
7	Create a Contact Us Page (Handle Form Submission)
8	Docker Basics : Docker Installation and Docker Commands, Installing Docker Hosts with Docker Machine,
9	Handling Dockerfiles
10	M- Queue active M Quesr Rabbit queue

Text Books:

- [1] Spring in Action 5th Edition by Craig Walls (Author)
- [2] Murach's Java Servlets and JSP, 3rd Edition (Mirach: Training & Reference) 3rd Edition by Joel Mirach (Author), Michael Urban (Author)
- [3] Microservices - A Practical Guide Principles, Concepts, and Recipes by Eberhard Wolff



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE	IOT and IIOT	3	-	2	4	9	3	-	1	4
		Examination Scheme								
MC523	IOT and IIOT	Component		ISE	MSE	ESE	Total			
		Theory		75	75	150	300			
		Laboratory		50	--	50	100			

Pre-requisite Course Codes, if any.		
Course Objective:		
Course Outcomes (CO): <i>At the End of the course students will be able to</i>		
MC523.1	Describe the Architectural Overview of IoT and IIOT	
MC523.2	Analyze and select various IoT platforms with Security level	
MC523.3	Standardize the importance of Data Analytics in IoT	
MC523.4	Design IoT system based on the real time problem statement	

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC523.1	2	-	-	-	-	-	-	-	-	-	-	-
MC523.2	2	-	-	-	-	-	2	-	-	-	-	-
MC523.3	2	-	-	-	-	-	-	-	-	-	-	-
MC523.4	2		2	2	-	-	2	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MC523.1	-	-	-	-	-	-	-
MC523.2	-	-	-	-	-	-	-
MC523.3	-	-	-	-	-	-	-
MC523.4	-	-	2	-	-	2	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create
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Theory Component			
Module No.	Topics	Ref.	Hrs.
1	Introduction to IOT, and IIOT	2, 3,5	4
	Architectures of IOT and IIOT Advantages & disadvantages, Components of IIOT - Sensors, Interface, Networks, People & Process, Hype cycle, IOT Market, Trends & future Real life examples, Key terms – IOT Platform, Interfaces, API, clouds Core IoT Functional Stack, Business processes in IoT, Everything as a Service(XaaS)		
2	Sensor and Interfacing	2, 3	12
	Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT , Various types of sensors , Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet , Current, M2M etc		
3	IoT layer protocols	2	10
	Need of protocols; Types of Protocols, Network Layer-IPv4, IPv6, 6LoWPAN, DHCP, ICMP, Session Layer HTTP, CoAP, XMPP, AMQP, MQTT, Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL		
4	Big data platform for the IOT	4	8
	Big Data Platforms for the Internet of Things: network protocol- data dissemination, Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context-		
5	Security in IoT	6	4
	Vulnerabilities of IOT, Security requirements, Challenges for a secure Internet of Things, Threat modeling, Threat analysis, Security Architecture, Security Model, Attacks Modeling, Security attacks, Key Elements of IOT Security		
6	Internet of Things Applications	3	4
	Smart Metering, e-Health Body Area Networks, Smart Cards, City Automation, Automotive Applications, Home Automation, Plant Automation		



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7	Self-Study Topics		
	Role of IIOT in Manufacturing Processes, Wireless sensor network (WSN) and Internet of Things (IoT), Business models: Saas, Paas, Iaas., big-data analytics infrastructures 5.4 Secure IoT Higher Layers, Secure Communication Links in IoTs, Real life examples of IIOT in Manufacturing Sector Business Models For The Internet Of Things: Business Models and Business Model Innovation Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things.		
		Total	42

Laboratory Component

Sr. No	Title of the Experiment
1	Introduction to Programming the Arduino, Basic electronic components
2	Programs based on interfacing with LED's, Switches
3	Programs based on interfacing with Alarm sensors
4	Programs based on interfacing with Display sensors
5	Programs based on interfacing with Photo resistor
6	Programs based on interfacing with temperature sensor
7	Programs based on interfacing with Passive infrared sensors (PIR), Ultrasonic sensors
8	Programs based on interfacing Potentiometer, servo motors
9	Interfacing IoT device with Cloud using mobile phone demonstrating MQTT protocol
10	Mini projects such as Home automation, Robots, Wearable projects, art projects etc

Text Books

- [1] Daniel minoli “*Building the Internet of Things with Ipv6 and Mipv6*” ISBN No. 978-1-118-47347-4, WILEY
- [2] “*Enterprise IoT*” Grayscale edition O'REILLY
- [3] Arshdeep Bahga, Vijay Madiseti, “*Internet of Things A hands-on approach*” Universities Press 2015

Reference Books :

- [4] Stackowiak, R., Licht, A., Mantha, V., Nagode, L “*Big Data and The Internet of Things Enterprise Information Architecture for A New Age*” Apress 2015
- [5] David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry “*IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things*” Cisco Press 2017
- [6] Fei Hu “*Security and Privacy in Internet of Things (IoT): Models, Algorithms, and Implementations*” Kindle
- [7] Olivier Hersent, David Boswarthick, Omar Elloumi, “*The Internet of Things: Key Applications and Protocols*” ISBN: 978-1-119-99435-0, Second edition Willy Publications



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE	Cloud Computing	3	-	2	4	9	3	-	1	4
		Examination Scheme								
Component		ISE		MSE		ESE		Total		
MC524		Theory	75		75		150		300	
	Laboratory	50		--		50		100		

Pre-requisite Course Codes, if any.		
Course Objective: To have a comprehensive understanding of Cloud computing.		
Course Outcomes (CO): <i>At the End of the course students will be able to</i>		
MC524.1	Illustrate fundamentals of Cloud Computing.	
MC524.2	Analyze different virtualization techniques and their role in enabling the cloud computing system model.	
MC524.3	Categorize various Cloud architecture and Infrastructure.	
MC524.4	Analyze security issues and synchronization protocols of cloud.	

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC524.1	1	-		3	2	-	-	-	-	-	-	-
MC524.2	1	-	2	-	2	-	-	-	-	-	-	-
MC524.3	-	2	1	-	2	-	-	-	-	-	-	-
MC524.4	2	-	1	1	3	-	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC524.1	2	-	-	-	2
MC524.2	2	-	-	-	2
MC524.3	2	-	-	-	2
MC524.4	2	-	-	-	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create
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Theory Component			
Module No.	Topics	Ref.	Hrs.
1	Introduction to Cloud Computing	1,2,3	7
	Trends in computing - Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing Defining a Cloud ,Vision of Cloud,Cloud Computing Reference Model, Characteristics and benefits ,Challenges of Cloud		
2	Virtualization in Cloud	1,2,3	6
	Introduction & benefit of Virtualization, Implementation Levels of Virtualization, Types: Full and para virtualization Taxonomy of virtualization techniques - Execution Virtualization, Virtualization and cloud computing, Pros and cons of virtualization		
3	Cloud Architecture	1,2	4
	Cloud Types: Private Cloud, Public cloud,Hybrid cloud, community cloud. Cloud as a service : Infrastructure as a service, Platform as a service, Software as a service,Xaas		
4	Cloud Security	2,4	8
	Identity and access management, security challenges, Storage basics, Storage as a service providers, aspects of data security AAA model, SSO model,Threat Agents - Anonymous Attacker, Malicious Service Agent, Trusted Attacker, Malicious Insider Cloud Security Threats - Traffic Eavesdropping, Malicious Intermediary, Denial of Service, Insufficient Authorization, Virtualization Attack, Overlapping Trust Boundaries, Common Attacks, Cloud-Specific Attacks,Flawed Implementations, Risk Management		
5	Cloud Infrastructure Mechanisms	1,2	10
	Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication Ready-Made Environment. Specialized Cloud Mechanisms - Automated Scaling Listener, Load Balancer, SLA Monitor, Pay-Per-Use Monitor Monitor, Pay-Per-Use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, MultiDevice Broker, State Management Database.Types of Data Center – Enterprise Data Centers; managed ServicesData Centers; Colocation; Cloud Data CentersDesign consideration for Private Cloud (Enterprise Data Centers),On Premise vs. Cloud propositions		
6	Synchronization in cloud environment	3	7
	Clock synchronization protocols in cloud data centers, Leader Election protocols in cloud ,Gossip Protocols and its types		
7	Self-study Topics	1,2	
	Economics of Cloud ,Challenges in Cloud, Fog Computing, Edge Computing, Mobile Cloud Computing ,Business Transformation with Google Cloud Superpowers of Cloud		
Total			42



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Laboratory Component

Sr. No	Title of the Experiment
1	Study and implementation of Infrastructure as a Service.
2	Implementation of identity management.
3	Study and installation of Storage as Service.
4	User Management in Cloud.
5	Study and implementation of Single-Sign-On
6	Study of containerization tool
7	Analyze various Clock synchronization
8	Analyze various mutual exclusion algorithm
9	Analyze various Election Algorithms.
10	Case study :Google/Ms Azure/Amazon

Textbooks:

- [1] RajkumarBuyya, Christian Vecchiola, “*Mastering Cloud Computing Foundations and Applications Programming*”, Morgan Kaufmann, 2nd Edition, 2013.
- [2] Thomas Erl, Zaigham Mahood, Ricardo Puttini, “*Cloud Computing, Concept, Technology and Architecture*”, Prentice Hall, 1st Edition, 2013.

Reference Books:

- [3] Rajiv Mishra, Yashwant Singh Patel, “*Cloud and Distributed Algorithms and systems*”, Wiley publications, 1st edition 2020.
- [4] Zaigham Mahmood, “*Cloud Computing - Challenges, Limitations and R&D Solutions*”, Springer International Publishing, 1st edition, 2014.



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE	Artificial Intelligence and Soft Computing	3	0	2	4	9	3	-	1	4
		Examination Scheme								
MC525		Component		ISE		MSE		ESE	Total	
		Theory		75		75		150	300	
		Laboratory		50		--		50	100	

Pre-requisite Course Codes, if any.	
Course Objective: To learn fundamentals of Data Structures.	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC525.1	To conceptualize the basic ideas and techniques of AI and SC.
MC525.2	Identify and describe Fuzzy Logic techniques in building intelligent machines
MC525.3	Identify and describe Artificial Neural Network techniques to solve real time problems
MC525.4	To familiarize with Hybrid systems and to build expert system.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC525.1	3	3	-	-	-	-	-	-	1	-	2	-
MC525.2	3	3	-	-	-	-	-	-	1	-	2	-
MC525.3	-	-	-	3	-	-	-	-	1	-	2	-
MC525.4	-	3	-	-	-	-	-	-	1	-	2	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC525.1	3	1	-	-	1
MC525.2	3	1	-	-	1
MC525.3	3	1	-	-	-
MC525.4	3	1	-	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create
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Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1		Introduction to Artificial Intelligence(AI) and Soft Computing		05
	1.1	Introduction and Definition of Artificial Intelligence.		
	1.2	Intelligent Agents : Agents and Environments ,Rationality, Nature of Environment, Structure of Agent		
	1.3	Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques.		
2		Problem Solving		05
	2.1	Problem Solving Agent, Formulating Problems, Example Problems		
	2.2	Uninformed Search Methods: Depth Limited Search, Depth First Iterative Deepening (DFID)		
	2.3	Informed Search Method: A* Search		
3		Fuzzy Logic		06
	3.1	Introduction to Fuzzy Logic: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, membership functions, Fuzzy Reasoning.		
	3.2	Fuzzy inference systems: Mamdani FIS and Sugeno FIS, fuzzy decision making & Applications of fuzzy logic		
	3.3	Fuzzy System Design: Fuzzification, defuzzification and Fuzzy controllers.		
4		Artificial Neural Network		10
	4.1	Introduction – Fundamental concept– Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron, Activation Functions		
	4.2	Supervised Learning algorithms: Perceptron SLP, MLP, Delta learning rule, Back Propagation algorithm.		
	4.3	Un-Supervised Learning algorithms: Hebbian Learning, KSOFM, LVQ		
5		Hybrid Approaches and Expert System		6
	5.1	Neuro Fuzzy System,		
	5.2	Expert system : Introduction, Characteristics, Architecture, Stages in the development of expert system,		
		Total		42



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Laboratory Component

Sr. No	Title of the Experiment
1	Study of Prolog programming lang for simple real time problems like temperature conversion, Monkey banana problem, fibonacci series.
2	Design ANN to implement logic gates.
3	Implement SLP Create a perceptron with an appropriate number of inputs and outputs. Train it using a fixed increment learning algorithm until no change in weights is required. Output the final weights
4	Implement MLP Write a program to implement artificial neural networks without back propagation. Write a program to implement artificial neural networks with back propagation.
5	Hebb's rule and Delta Rule for a given problem statement
6	Operations on fuzzy Sets: Implement Union, Intersection, Complement and Difference operations on fuzzy sets.
7	Operations on Fuzzy Relations: Implement Max-min, max-product composition
8	Design of Fuzzy Logic controller for a given problem statement
9 -10	Mini Project on : Hybrid system

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.
2. Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.
3. Timothy J.Ross "Fuzzy Logic With Engineering Applications" Wiley.
4. S. N. Sivanandam, S. N. Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
5. S. Rajasekaran and G. A. Vijayalakshmi Pai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
6. Jacek M. Zurada "Introduction to Artificial Neural Sytems" Jaico Publishing House.

Reference Books:

1. Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.
3. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
4. Zimmermann H.S "Fuzzy Set Theory and its Applications"Kluwer Academic Publishers.
5. Hagan, Demuth, Beale,"Neural Network Design" CENGAGE Learning, India Edition.
6. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	Cyber Security	3	0	2	4	9	3	0	1	4
		Examination Scheme								
Component		ISE	MSE	ESE	Total					
MC526		Theory	75	75	150	300				
	Laboratory	50	--	50	100					

Pre-requisite Course Codes, if any.	
Course Objective: To give insights to students about cyber crimes , importance of cyber security ,laws for various crimes and forensics to analyze the given scenario.	
Course Outcomes (CO): At the End of the course students will be able to	
MC526.1	Analyze the issues and challenges in cybercrimes and cyber offenses.
MC526.2	Explain the methods used in cybercrimes and its countermeasures.
MC526.3	Analyze the Cyber Laws which are used against cybercrimes and cyber criminals.
MC526.4	Explain the basics of computer forensics.
MC526.5	Analyze the forensics of hand-held devices.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC526.1	-	3	-	-	-	-	-	-	-	-	-	-
MC526.2	-	-	-	3	3	-	-	-	-	-	-	-
MC526.3	-	2	-	-	-	-	-	-	-	-	-	-
MC526.4	2	-	-	2	-	-	-	-	-	-	-	-
MC526.5	-	-	-	3	3	-	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC526.1	1	-	-	-	1
MC526.2	-	-	2	-	2
MC526.3	1	-	-	1	-
MC526.4	1	-	-	-	1
MC526.5	-	-	2	-	2

BLOOM'S Levels Targeted

Remember	Understand	Apply	Analyze ✓	Evaluate ✓	Create ✓
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Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	Cyber offenses & Cybercrime: Issues and challenges	1,2	8
	1.1	Cybercrime definition and origins of the world		
	1.2	Classifications of cybercrime		
	1.3	How criminals plan the attacks, Social Engineering		
	1.4	Cyber stalking, Botnets,		
	1.5	Attack vector, Cloud computing		
	1.6	Credit Card Frauds in Mobile and Wireless Computing Era		
	1.7	Attacks on Mobile/Cell Phones		
	1.8	Web Treats for Organizations: The Evils and Perils		
2	Title	Tools and Methods Used in Cybercrime	1,2	10
	2.1	Proxy Servers and Anonymizers		
	2.2	Password Cracking		
	2.3	Keyloggers and Spywares		
	2.4	Virus and Worms		
	2.5	Steganography		
	2.6	DoS, DDoS Attacks		
	2.7	SQL Injection		
	2.8	Buffer Overflow		
	2.9	Attacks on Wireless Networks		
	2.10	Phishing (Methods, Techniques, Countermeasures)		
	2.11	Identity Theft (Types, Techniques, Countermeasures)		
2.12	Vulnerability Assessment and Penetration Testing (VAPT)			
3	Title	Cyber Laws : ITA, Security Standards and International Laws.	1,2	8
	3.1	The Legal Perspectives Why do we need Cyber law: The Indian Context		
	3.2	Positive and Weak areas of ITA 2000		
	3.3	Information Security Standard compliances: SOX, GLBA, HIPAA, ISO.		
	3.4	International Laws: E-Sign, CIPA and COPPA		
4	Title	Understanding Computer Forensics	1,2	10
	4.1	Historical background of cyber forensic		
	4.2	Need for computer forensic		
	4.3	Cyber forensic and Digital Evidence, Forensic Analysis of E-mail		
	4.4	Digital Forensic life cycle.		



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	4.5	Chain of custody, network forensic		
	4.6	Approaching a forensic Investigation		
	4.7	Computer Forensic and Steganography		
	4.8	Relevance of OSI 7 layer model to computer forensic		
	4.9	Forensic and social networking sites: The security/ privacy threats		
5	Title	Forensics of Hand-held devices	1,2	6
	5.1	Mobile Phone Forensics, Printer and scanner forensics, Smartphone.		
	5.2	Challenges in Forensics of Digital Images and Still Camera.		
	5.3	Toolkits for Hand-Held Device Forensics (EnCase,Forensic card reader, MOBILedit)		
	5.4	Organizational Guidelines on Cell Phone Forensics.		
6	Self-Study	1.10 Ransomware 2.12 Credit card and debit card security Social Media Security Mobile banking security Digital infrastructure security Security Risk Assessment and Risk Analysis		
			Total	42

Laboratory Component

Sr. No	Title of the Experiment
1	Demonstrate password cracking tools
2	Performing SQL injection and suggest its countermeasures. A. Manual SQL Injection, John the Ripper. B. Automate SQL Injection with Sql Map.
3	Demonstrate Proxy Server
4	Demonstrate Social Engineering attack and suggest its countermeasures.
5	Implement Key logger software and suggest its countermeasures.
6	Implement steganography and suggest its countermeasures.
7	Demonstrate email spoofing and phishing attack and suggest its countermeasures.
8	Part 1: Demonstrate Cloning and imaging using commands Part 2: Demonstrate EnCase forensic toolkit
9	Demonstrate MobileEdit forensic toolkit
10	Demonstrate and analyze Email forensics



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Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	ISBN: 9788126521791	Nina Godbole, Sunit Belapure	Wiley India	2012
2	Cybersecurity: The Essential Body of Knowledge	-	Dan Shoemaker, William Arthur Conklin, Wm Arthur Conklin	Cengage Learning	2011

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
3	Digital Forensics with open source tools	-	Cory Altheide and Harlan Carvey	Elsevier Publications	2011
4	Cyber Security	First Edition	Edward Amoroso	Silicon Press	2007
5	Information Systems Security	-	Nina Godbole	Wiley India	2008



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE MC527	Block Chain Technology	3	-	2	4	9	3	-	1	4
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
		Theory		75		75		150		300
Laboratory		50		--		50		100		

Pre-requisite Course Codes, if any.	
Course Objective: To give insights to students about blockchain and its various technologies to gain knowledge	
Course Outcomes (CO): At the End of the course students will be able to	
MC527.1	Explain the basics of Block chain
MC527.2	Analyze various block chain Technology
MC527.3	Demonstrate the working of Bitcoin and Ethereum
MC527.4	Explain the basic of Multichain technology
MC527.5	Explain the use of IoT in block chain

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC527.1	3	-	-	-	-	-	-	-	-	-	-	-
MC527.2	-	2	-	1	-	-	-	-	-	-	-	-
MC527.3	-	-	2	-	3	-	1	-	-	-	-	-
MC527.4	2	1	-	-	-	-	-	-	-	-	-	-
MC527.5	3	-	-	-	-	-	1	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MC527.1	-	-	-	-	-	-	-
MC527.2	-	-	-	-	-	-	-
MC527.3	-	-	-	-	-	-	3
MC527.4	-	-	-	-	-	-	-
MC527.5	-	-	-	-	-	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand ✓	Apply	Analyze ✓	Evaluate	Create ✓
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Theory Component			
Module No.	Topics	Ref.	Hrs
1	Introduction	1,2	7
	Blockchain Basic , Four Core building blocks of blockchain, , Life cycle of Blockchain, Blockchain working, Difference between blockchain and databases, Centralized, De-Centralized and Distributed system, Distributed Ledger Technology, Blockchain ecosystem and structure, Features of Blockchain, Advantages of Blockchain.		
2	Blockchain Technology	1,2	9
	Generation and evolution of Blockchain, Blockchain Solutions beyond Finance, Types of Blockchain Technology, Difference between public blockchain and private blockchain, Blockchain characteristics comparison, Blockchain requirement flowchart, Consensus Algorithm: introduction and objectives, Types of Consensus Algorithm: Proof of Work and Proof of Stake, Comparison between POW and POS, Blockchain Wallets introduction		
3	Bitcoin and Ethereum	1,2	10
	History of Cryptocurrency, Cryptography in blockchain, Hash Functions, SHA hash Function, Merkle Tree, Digital Signatures, How does bitcoin transaction works, Bitcoin improvement Proposal (BIP) introduction, Types of BIP, BIP Lifecycle, Introduction to ethereum, Ethereum Technology Stack, Advantages and Drawbacks of ethereum, Smart Contract, ether, solidity.		
4	Introduction to Multichain	1,2	9
	Multichain helping enterprise in blockchain, Multichain development timeline, Bitcoin to private blockchain, Aim of Multichain, The Handshaking Process, Use Cases of Multichain, Multichain permissions, Multichain assets, Multichain streams, Mining in multichain Technology and its flexibility, Security, speed and scalability in Multichain.		
5	IoT in Blockchain	1,2	7
	Introduction to IoT, IoT Schematic Diagram, Challenges in IoT devices, Benefits of using Blockchain with IoT, Use Cases of blockchain IoT connected devices(Automotive industry ,Smart Vehicle monitoring system)		
6	Self-Study Topics		
	Use Cases Of Blockchain Technology: <ul style="list-style-type: none"> ● Blockchain in Supply Chain ● Blockchain in Manufacturing ● Blockchain in Automobiles 		



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	<ul style="list-style-type: none">● Blockchain in Healthcare● Blockchain in Cyber security● Blockchain in Financial Industry Use Cases of blockchain IoT connected devices: <ul style="list-style-type: none">● Agri-food supply chain management● Smart Environmental Monitoring● Smart Waste Management system● Smart Street Lightening		
Total			42

Laboratory Component

Sr. No	Title of the Experiment
1	Demonstrating secret key cryptography techniques
2	Demonstrating public key cryptography techniques
3	Demonstrating Hashing Techniques (SHA and MD5)
4	Demonstrate the working of the Merkle tree.
5	Implementing basic program using solidity
6	Implementing calculator using solidity
7	Implementing and demonstrating smart contract
8	Demonstrating Tokens in ethereum
9	Working with Web3.js in ethereum
10	Case study on bitcoin

Text Books :

- [1] Tiana Laurence, "Blockchain For Dummies", First Edition, John Wiley & Sons, Inc, 2017.
- [2] Mark Gates, "Blockchain :Ultimate guide to understanding blockchain, bitcoin, cryptocurrencies smart contracts and the future of money", First Edition, Wise Fox Publishing and Mark Gates, 2017.

Reference Books :

- [3] Joseph J. Bambara Paul R. Allen, "Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions", McGraw-Hill Education, 2018.
- [4] Ritesh Modi, "Solidity Programming", Packt Publishing, 2018.
- [5] Mayukh Mokhopadhyay, "Ethereum Smart Contract Development", Packt Publishing, 2018

Web References

- [6] <https://ethereum.org/en/>
- [7] <https://web3js.readthedocs.io/en/v1.2.9/>
- [8] <https://studio.ethereum.org/>



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE MC528	Data Warehousing and Mining	3	-	2	4	9	3	-	1	4
		Examination Scheme								
		Component		ISE	MSE	ESE	Total			
		Theory		75	75	150	300			
		Laboratory		50	--	50	100			

Pre-requisite Course Codes, if any.	DBMS, Mathematics
Course Objective:	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC528.1	Identify the scope and essentiality of Data Warehousing and Mining.
MC528.2	Compare different data mining techniques like classification, prediction, clustering and association rule mining
MC528.3	Build Data ware house for real time problems
MC528.4	Identify appropriate data mining algorithms to solve real world problems

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC528.1	-	2	-	-	-	-	-	-	-	-	-	-
MC528.2	2	-	2	-	-	-	-	-	-	-	-	-
MC528.3	-	-	-	2	-	-	-	-	-	2	-	-
MC528.4	-	-	-	2	2	-	2	-	-	2	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC528.1	2	-	-	2	-
MC528.2	2	-	-	2	-
MC528.3	2	-	-	-	2
MC528.4	2	-	-	-	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate ✓	Create
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Theory Component			
Module No.	Topics	Ref.	Hrs.
1	Basic Concepts of Data Warehousing	3, 4	8
	Introduction to Data Warehouse, Differences between operational database systems and data Warehouse, Data Warehouse characteristics, Data Warehouse Architecture and its components, Extraction-Transformation-Loading, Logical (Multi-Dimensional), Data Modeling		
2	Data Warehouse and OLAP Technology for Data Mining	1, 2	8
	Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures, Dimension Table characteristics; Fact-Less-Facts, Dimension Table characteristics, OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP		
3	Introduction to Data Mining	1,2	8
	Data Mining, Definition, KDD, Challenges, Data Mining Tasks Data Preprocessing- Data Cleaning, Missing Data Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of similarity and dissimilarity-Basics		
4	Association Rules	2	6
	Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set-Maximal Frequent Item Set, Closed Frequent Item Set		
5	Classification	2	6
	Problem definition, General Approaches to solving a classification problem, Evaluation of Classifiers, Classification techniques, Decision trees-Decision Tree Construction, Methods for expressing attribute test conditions, Algorithm for Decision tree Induction, Naïve-Bayes Classifier, K-nearest neighbor classification-Algorithm and characteristics		
6	Clustering	2	6
	Problem Definition, Clustering overview, Evaluation of clustering algorithms, Partitioning clustering K-Means Algorithm, K-Means Additional Issues, PAM Algorithm, Hierarchical Clustering-Algorithm-Agglomerative Methods and Divisive Methods, Key Issues in Hierarchical Clustering, Outlier Detection		



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7	Self-Study Topics		
	Data warehouse models: Enterprise warehouse, Data mart and virtual warehouse, Data warehouse models: Enterprise warehouse, Data mart and virtual warehouse, Modeling for Data Mining, general principles including model scoring, search and optimization, Advanced Apriori algorithm, Measures for Selecting the Best split, Bayesian Belief Networks, Basic Agglomerative Hierarchical Clustering Algorithm, Multimedia Data Mining, Text Mining, Spatial Data Mining, Data Mining Applications, Data Mining System Products and Research Prototypes,.		
		Total	42

Laboratory Component

Sr. No	Title of the Experiment
1	Design Data ware house : Build a simple DW using SQL queries, Design multi-dimensional data models namely Star, Snowflake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, manufacturing, Automobiles, sales etc). Write ETL scripts and implement using data warehouse tools.
2	Build Data Warehouse – Part 1: Setting Up and Starting Warehouse Builder, Defining Source Metadata, Ensuring Data Quality Using Data Profiling
3	Build Data Warehouse – Part II: Defining Staging Metadata and Mapping Tables, Deriving Data Rules and Running Correction Mappings, Defining a Relational Dimensional Model, Handling Slowly Changing Dimensions
4	Study of OLAP: OLAP operations such slice, dice, roll up, drill up and pivot, Analytical Queries, Grouping Functions, Windowing Functions, RollUp and Cube
5	Open source tool for study of Association Rules
6	Open source tool for study of Classification Models
7	Open source tool for study of Regression Models
8	Open source tool for study of Clustering Models
9	ETL working with open source tool
10	Dimensional modelling tool working
11	Beyond the Syllabus -Simple Project on Data Preprocessing



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Text Books

- [1] Jiawei Han, Micheline Kamber, Morgan Kaufmann "*Data Mining-Concepts and Techniques*"
Second Edition Elsevier 2006
- [2] Ning Tan, Vipin Kumar, Michael Steinbach "*Introduction to Data Mining*", Pang Pearson
Education.

Reference Books

- [3] Paulraj Ponnaiah "*Data Warehousing Fundamentals*" Student Edition Wiley
- [4] Arun K Pujari "*Data Mining Techniques*" Universities Press Second Edition 2015



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE MC529	Computer Graphics	3	-	2	4	9	3	-	1	4
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
		Theory		75		75		150		300
Laboratory		50		--		50		100		

Pre-requisite Course Codes, if any.	Linear Algebra
Course Objective: To give students knowledge about the basics of graphics, its operations and applications which they can apply in real world problems.	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC529.1	Apply output primitive algorithms on a given scenario
MC529.2	Apply 2D geometric transformation functions and clipping algorithms.
MC529.3	Apply basics of 3D concepts and Fractals.
MC529.4	Apply image processing techniques in a given scenario

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC529.1	2	1	-	-	2	-	-	-	-	-	-	-
MC529.2	2	2	-	-	3	-	-	-	-	-	-	-
MC529.3	-	3	-	2	-	-	-	-	-	-	-	-
MC529.4	-	-	2	-	3	-	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC529.1	-	-	-	-	2
MC529.2	-	-	-	-	2
MC529.3	-	-	-	-	-
MC529.4	-	-	-	-	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create
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Theory Component			
Module No.	Topics	Ref.	Hrs.
1	Introduction	1,2	2
	Introduction to Computer Graphics, Elements of Computer Graphics, Graphics display systems.		
2	Output primitives & its Algorithms	1,2	10
	Points and Lines, Line Drawing algorithms: DDA line drawing algorithm, Bresenham's drawing algorithm, Circle and Ellipse generating algorithms :Mid-point Circle algorithm ,Mid-point Ellipse algorithm, Parametric Cubic Curves :Bezier curves Fill area algorithms: Scan line polygon fill algorithm ,Inside-Outside Tests, Boundary fill algorithms, Flood fill algorithms		
3	2D Geometric Transformations & Clipping	1,2	11
	Basic transformations, Matrix representation and Homogeneous Coordinates, Composite transformation, shear & reflection. Transformation between coordinate systems, Window to Viewport coordinate transformation, Clipping operations – Point clipping, Line clipping : Cohen – Sutherland line clipping, Midpoint subdivision, Polygon Clipping: Sutherland – Hodgeman polygon clipping, Weiler – Atherton polygon clipping		
4	Basic 3D Concepts & Fractals	1,2	8
	3D object representation methods: B-REP Fractals, Sweep representations, CSG, Basic transformations, Reflection, shear, Projections – Parallel and Perspective Halftone and Dithering technique, Self-similarity: Koch Curves/snowflake, Sierpinski Triangle		
5	Introduction to Image Processing and image enhancement	3	11
	Fundamental Steps in Digital Image Processing ,Components of an Image Processing System, Some Basic Intensity, Transformation Functions: Image Negatives, Log Transformations, and Power Law Transformations, Piecewise Linear Transformation Functions: Contrast stretching, Gray-level slicing, Bit plane slicing, Introduction to Histogram, Image Histogram and Histogram, Equalization, Image Subtraction, and Image Averaging		
6	Self-Study Topics		
	Color and shading models, Ray tracing		
Total			42



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Laboratory Component

Sr. No	Title of the Experiment
1	Implement Line drawing algorithms
2	Implement Mid-point circle algorithm
3	Implement boundary fill algorithm
4	Implement flood fill algorithm
5	Implement transformation, shear and reflection in a given scenario.
6	Implement Sutherland line clipping algorithm
7	Implement Sutherland – Hodgeman polygon clipping algorithm
8	Implement Koch Curves in a given scenario
9	Implement basic intensity transformation function on an image
10	Implement Histogram on an image

Text Books:

- [1] Donald Hearn and M Pauline Baker,"*Computer Graphics C Version*", Second edition, Pearson Education,2012.
- [2] David F. Rogers, James Alan Adams,"*Mathematical elements for computer graphics*", Second edition, McGraw-Hill,2011.
- [3] Rafael C. Gonzalez and Richard E. Woods,"*Digital Image Processing*", Third Edition, Pearson Education,2009.

Reference Books:

- [4] S. Sridhar, "*Digital image Processing*", Second Edition, Oxford University Press,2011.
- [5] Zhigang Xiang, Roy.A. Plastock, "*Schaum's outline of theory and problems of computer graphics*", Second Edition, McGraw-Hill,2000.



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned				
		L	T	P	O	E	L	T	P	Total	
PE MC530	Ethical Hacking	3	-	2	4	9	3	-	1	4	
		Examination Scheme									
		Component		ISE		MSE		ESE		Total	
		Theory		75		75		150		300	
Laboratory		50		--		50		100			

Pre-requisite Course Codes, if any.	
Course Objective: To give students the knowledge about ethical hacking, its techniques and the countermeasures to prevent themselves from any kind of attacks.	
Course Outcomes (CO): At the End of the course students will be able to	
MC530.1	Explain the basics of ethical hacking.
MC530.2	Analyze various types of attacks in ethical hacking.
MC530.3	Explain hijacking techniques and its countermeasures.
MC530.4	Analyze network and Web attacks and its countermeasures
MC530.5	Explain mobile and wireless attacks and its countermeasures.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC530.1	3	-	-	-	-	-	-	-	-	-	-	-
MC530.2	-	2	-	2	3	-	1	-	-	-	-	-
MC530.3	2	-	-	2	2	-	1	-	-	-	-	-
MC530.4	1	-	-	2	2	-	1	-	-	-	-	-
MC530.5	1	-	-	1	2	-	1	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC530.1	-	-	-	-	-
MC530.2	-	-	-	-	2
MC530.3	-	-	-	-	1
MC530.4	-	-	-	-	1
MC530.5	-	-	-	-	1

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate ✓	Create ✓
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Theory Component

Module No.	Topics	Ref.	Hrs.
1	Introduction to Ethical Hacking	1,3	8
	Basics of Ethical Hacking, White, Grey, Black hat hackers, Various types of footprinting, footprinting tools, and countermeasures, Network scanning techniques and scanning countermeasures, Enumeration, System Hacking		
2	Various types of attacks	1,3	9
	Malware Threats, Packet sniffing techniques and how to defend against sniffing, Social Engineering techniques and social engineering countermeasures, Identify theft, DoS/DDoS attack techniques, , DDoS attack tools, and DoS/DDoS countermeasures Botnets		
3	Hijacking and Hacking	1,3	8
	Session Hijacking introduction, Session hijacking techniques and countermeasures, Different types of web server attacks, Web server attack methodology, Web server countermeasures		
4	Wireless and SQL injection attack	1,3	9
	Working of viruses , Virus analysis, Malware analysis procedure, Computer worms, Countermeasures, SQL Injection attacks and detection tools, Firewall : Introduction and Configuration		
5	Mobile and Network attack	1,3	8
	Hacking Mobile Platforms, Wireless Encryption , Wireless hacking methodology, IDS and honeypot evasion techniques, Evasion tools, Countermeasures		
6	Self-Study Topics		
	Hacking Web Applications, Wireless hacking tools, Wi-Fi security tools, Various cloud computing concepts, threats, attacks, and security techniques and tools, Cryptography attacks and cryptanalysis tools		
Total			42



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Laboratory Component

Sr. No	Title of the Experiment
1	Demonstrating Network Scanning Tools (nmap,netstat,nessus)
2	Demonstrating Enumeration tools (Metasploit,Hydra)
3	Demonstrating Packet sniffing tools (wireshark, tcpdump)
4	Demonstrating Social Engineering Toolkit
5	Demonstrating DOS and DDOS tools
6	Demonstrating SQL injection tools
7	Demonstrating Web Application Hacking (XSS and CSRF)
8	Demonstrating Mobile Hacking techniques
9	Demonstrating wireless Hacking Techniques
10	Demonstrating snort and firewall configuration

Text Books :

- [1] Patrick Engebretson,"*The Basics of hacking and penetration testing*", First Edition, Syngress Press, 2011.
- [2] Dafydd Stuttard, Marcus Pinto," *The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws*", Second Edition, Wiley Publication, 2011.
- [3] Jon Erickson," *Hacking: the art of exploitation* ",Second edition, No Starch Press, Inc.,2008.
- [4] Rafay baloch," *Ethical hacking and penetration testing guide*", First Edition, CRC press,2015.

Web References:

- [5] <https://www.kali.org/>
- [6] <https://www.social-engineer.org/framework/se-tools/computer-based/social-engineer-toolkit-set/>
- [7] <https://owasp.org/>
- [8] <https://portswigger.net/research>



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
SBC	Project-II	0	0	8	8	16	0	0	0	4
		Examination Scheme								
MC601		Component		ISE		MSE		ESE		Total
		Theory		--		--		--		--
		Laboratory		300		--		100		400

Pre-requisite Course Codes, if any.	
Course Objective: This course inculcates self-learning, research, and entrepreneurship attitude in students. It aims to sharpen problem solving skills and application development by taking up real world problems. Students will be able to understand the formal project development process to complete a project in a team. It will help students to develop communication, organizational skills and maturity through discussions, presentations etc.	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC601.1	Conduct a requirement analysis and formulate requirements in the preferred domain.
MC601.2	Develop the solution based on the requirement analysis.
MC601.3	Test prototypical solution using advanced tools
MC601.4	Develop effective interpersonal and communication skills in project development.
MC601.5	Understand professional, ethical, legal, industry practices and responsibilities.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC601.1	2	3	3	3	-	-	3	3	3	3	3	2
MC601.2	2	2	3	2	3	-	3	-	3	3	3	2
MC601.3	2	3	3	2	3	-	3	-	3	3	3	-
MC601.4	-	-	-	-	2	3	3	-	3	3	3	-
MC601.5	-	-	-	-	-	3	3	3	3	3	3	-



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CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC601.1	3	3	3	3	2
MC601.2	2	2	3	3	3
MC601.3	2	2	3	3	3
MC601.4	3	3	3	2	-
MC601.5	3	3	3	3	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓
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Project II is an opportunity to inculcate problem solving aptitude in students. It helps them to identify requirements and come up with feasible solutions. Students should be able to analyze these solutions for feasibility of their implementation. Project II is based on an application development project correlating industry practices, tools and methodologies and day to day experience which encourages development of interpersonal skills among students to solve real life problems.

Steps for Project:

- ✓ Keen observation of the surrounding/society
- ✓ Read existing Literature to understand and identify the research gaps
- ✓ Analysis and formulation of the problem
- ✓ Design/ Develop the solution
- ✓ Conducting experiments and draw conclusion
- ✓ Perform testing by creating test cases
- ✓ Prepare the documentation in each phases
- ✓ Submit the final project report

Students can seek guidance from teachers, other experts and make effective use of other sources of information available around them. Students must ensure that the problem is manageable in one semester.



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Criteria of a good project:

- ✓ Appropriate idea, clear understanding, and proper presentation of the concept
- ✓ Quality of work
- ✓ Project plan and its execution
- ✓ Credibility of the work
- ✓ Probable impact of the work on the attitude of students and society
- ✓ Scientific attitude, creativity and novelty reflected in project work and analysis of the situation
- ✓ Utility and innovation of the remedial measures
- ✓ Desirability, Feasibility and Viability in real life

The H/W and S/W resources required to complete the Project II may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- ✓ Learning additional skills
- ✓ Development of ability to define and design the problem and lead to its accomplishment with proper planning
- ✓ Learn behavioral discipline by working in a team. Students should work in groups of three on Project-II.

Evaluation:

Project report shall be submitted in a pdf copy. Other sections of the report shall be decided by the mentor based on projects. But it must have introduction, necessity of project, objectives, hypothesis, plan, observations, and analysis of results, conclusion, and references along with other sections related to technology.

The ISE and ESE evaluation will be carried out based on the rubrics framed by the Department. ISE marks will be based on the performance of the individual student in three phases of evaluation. The evaluation of the Phase I (ISE) will be based on Title approval where the domain and scope of the project will be evaluated. Phase II (ISE) will be on presentation of the selected approach, justification and Design and some part of implementation. Evaluation of Phase III (ESE) is based on demonstration of complete implementation, testing, presentation, and technical report.

The ESE marks will be based on demonstration in front of the expert appointed by the Department. In the ESE examination each individual student would be assessed for her contribution in selecting the originality of the problem statement, understanding and knowledge gained about the task completed through presentation/demonstration, work done, and preparing the technical report/poster/technical paper of the project in the standard format provided by the Department.

Research Paper Publication and participation in Research / Project Competition is mandatory for Project II to earn the required credits.



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Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Computer Networks	2	0	0	3	5	2	0	0	2
		Examination Scheme								
MC602	Computer Networks	Component		ISE		MSE		ESE		Total
		Theory		50		50		100		200
		Laboratory		-		--		-		-

Pre-requisite Course Codes, if any.	-
Course Objective:	
Course Outcomes (CO): <i>At the End of the course students will be able to</i>	
MC602.1	Apply different networking concepts for implementing network solution
MC602.2	Categorize different Internetworking devices, topologies and their functions
MC602.3	Analyze the various Protocols, Services and features of the layered architecture of Networking
MC602.4	Compare different Algorithms for Networking.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC602.1	2	2	3	-	-	-	-	-	-	-	-	-
MC602.2	-	2	2	3	-	-	-	-	-	-	-	-
MC602.3	-	2	2	3	-	-	-	-	-	-	-	-
MC602.4	1	2	-	2	-	--	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
MC602.1	-	-	-	1	-
MC602.2	-	-	-	1	-
MC602.3	-	-	-	1	-
MC602.3	-	-	-	1	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create
			✓		



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Theory Component

Module No.	Topics	Ref.	Hrs.
1	Basics of Computer Network Topology & types of topologies, types of networks, LAN, MAN, WAN, types of communication, Modes of communications: Simplex, Half Duplex, Full Duplex, Overview of Switching Techniques	1,2	3
2	Networking models ISO-OSI Reference Model, Internet Model (TCP/IP), Comparison of ISO-OSI & TCP/IP Model, Connectivity Devices, Passive & Active Hubs, Switch, Bridges, Gateways	1, 2	5
3	Overview of Media Layers Physical Layer components, Data Link Layer –Logical Link control, Framing Methods, Error Detection & Correction techniques, Data Link Layer – Medium Access control protocols, CSMA (CD and CA), Reservation, Polling, Token Passing, IP addressing - Addressing Subnets, IP – IPv4, IPv6, Address mapping -ARP, RARP, BOOTP, Internet Control Management Protocol, Internet Group Management Protocol, VLAN Routing Protocols –RIP, EIGRP and OSPF.	2,4	12
4	Overview of Host Layers Transport layer -The TCP protocol and the TCP Segment Header, UDP, Congestion control techniques, Application layer – Simple Network Management, Protocol, Electronic Mail on the Internet	1,2,3	8
5	Self-study Software Defined Networking, ALOHA and its types, NAT. Static NAT, Dynamic NAT	1,2	
Total			28



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Note :- The course will also introduce the students to Simulation software of Networking to have a hands on experience.

Textbooks:

- [1] Kurose & Ross, “Computer Networking: A Top-Down Approach”, Pearson,6th Edition, 2017.
- [2] Behrouz Forouzan, “Data communication and Networking”, Tata McGraw Hill,4th Edition2012.

Reference Books:

- [3] Behrouz Forouzan, “TCP/IP Protocol Suite”, Tata McGraw Hill,4th Edition,2010
- [4] Andrew Tanenbaun, “Computer Networks”, PHI,5th Edition, 2012.



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SEMESTER IV



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Sem IV									
No	Type	Code	Course	L	T	P	O	E	C
1	OE*	OEXXX	Open Elective-II	3	0	0	5	8	3
2	ABL	LLC	LLC-IV(Computer/IT) LLC-III (Non Computer/IT)	0	0	0	2	2	1
3	SBC	MC610	6-Month Industry Internship/Research internship at SPIT or Other Institute / Internship with Startup at TBI	0	0	0	0	45	12
			TOTAL	3	0	0	7	55	16

*indicates course taken on on-line mode

6-Month Industry Internship/Research internship at SPIT or Other Institute /
Internship with Startup at TBI

Monitored and executed at Institute Level by Coordinator Training and Internships