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 University of Mumbai)

Master Of Computer Applications

Second Year MCA

(Sem. III Sem. IV)

Effective from Academic Year 2021-22

Proposed to Board of Studies for Approval: 14th August 2021

Proposed to Academic Council for Approval: 3rd September 2021

Dr. Prasenjit Bhavathankar	**Dr. Y.S Rao**	**Dr. B.N. Chaudhari**
HOD, CSE(MCA)	**Dean Academics**	**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	SVXX / STXX	SEVA/SATVA 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	SVXX / STXX	SEVA/SATVA 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): ***At the End of the course students will be able to***	
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

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create✓

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

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	SVXX / STXX	SEVA/SATVA 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	SVXX / STXX	SEVA/SATVA 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	SVXX / STXX	SEVA/SATVA	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**

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	**Testing**	Software Testing (MC514)	Quality Assurance (MC515)	Risk Analysis (MC516)
3	Any new thread approved by BoS			

PROGRAM ELECTIVES / MOOC

MC517	IoT and IIoT
MC518	Cloud Computing
MC519	Artificial Intelligence
MC520	Cyber Security
MC521	Block Chain Technology
MC522	Data Warehousing and Mining
MC523	Computer Graphics
MC524	Ethical Hacking
MC511	Machine Learning
MC514	Software Testing
	Any other Course approved by the Dean Academics and Principal

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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								
		Component	ISE		MSE		ESE		Total	
MC511		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	PO 10	PO 11	PO 12
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** 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.	1,2,4	8
2	**Supervised Learning** 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)	1,2,4	14
3	**Unsupervised Learning** Clustering basics: K-means clustering, K-Nearest Neighbor , Association Rule Learning , Hierarchical	1,2,3	6
4	**Dimensionality Reduction** Feature Engineering, Feature Selection methods, - Filters; Wrappers, Embedded, PCA, SVD, -tSNE -Case Study (Clustering/Anomaly/Fraud Detection)	2	6
5	**Reinforcement Learning** Markov Decision, Monte Carlo Prediction, -Case Study (next best offer, dynamic pricing)	2,4	4
6	**Machine Learning Applications across Industries** Healthcare, Retail, Financial Services, Hospitality	1,2	4
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**

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): ***At the End of the course students will be able to***	
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**

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 Courvile An MIT Press book2016
[2] Fundamentals of Deep Learning**1st** Edition Nikhil Buduma O'Reilly 2017
[3] Deep Learning using Python1st edition Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka Wiley2019

Reference Books

[4] Deep Learning: Methods and Applications1st edition Deng & Yu Now Publishers2013
[5] Deep Learning CookBook1st edition Douwe Osinga O'Reilly2017

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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 – over-plotting 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

Laboratory Component

Sr.	Title of the experiment	Marks
1.	Importing dataset, Cleaning and Preparing the data – - 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 - 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								
		Component	ISE		MSE		ESE		Total	
MC514		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**,** LoopTesting**,** 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		
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.

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								
		Component		ISE		MSE		ESE		Total
MC515		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): ***At the End of the course students will be able to***

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	-

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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** Definitions of Quality, Quality Attributes, Organizational Framework for Software Quality Assurance, Principles of Software Quality Assurance, Quality Assurance vs Quality Control	1,2,4	5
2	**Managing SQA operations** Quality Assurance indicators during SDLC phase, Contents of SQA Plan, Software Quality Assurance: - Organizational Initiatives, Need for SQA function benefits	1,2,5	5
3	**Quality Management** 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	1,2,6	8
4	**Quality Assurance in Agile** 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-	1,2,4	8
5	**Defect Management for Quality and Improvement** 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	1,2,5	8
6	**Metrics and Measurement** 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	1,2,5	8
7	**Self-study -**Quality Management System Tools, QMS stakeholders Expectations		5*
Total			**42**

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): ***At the End of the course students will be able to***	
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**	

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
PE	IOT and IIOT	3	-	2	4	9	3	-	1	4
		Examination Scheme								
MC517		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): ***At the End of the course students will be able to***	
MC517.1	Describe the Architectural Overview of IoT and IIOT
MC517.2	Analyze and select various IoT platforms with Security level
MC517.3	Standardize the importance of Data Analytics in IoT
MC517.4	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
MC517.1	2	-	-	-	-	-	-	-	-	-	-	-
MC517.2	2	-	-	-	-	-	2	-	-	-	-	-
MC517.3	2	-	-	-	-	-	-	-	-	-	-	-
MC517.4	2		2	2	-	-	2	-	-	-	-	-

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MC517.1	-	-	-	-	-	-	-
MC517.2	-	-	-	-	-	-	-
MC517.3	-	-	-	-	-	-	-
MC517.4	-	-	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** 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, 3,5**	**4**
2	**Sensor and Interfacing** 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	**2, 3**	**12**
3	**IoT layer protocols** 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	**2**	**10**
4	**Big data platform for the IOT** 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-	**4**	**8**
5	**Security in IoT** 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**	**4**
6	**Internet of Things Applications** Smart Metering, e-Health Body Area Networks, Smart Cards, City Automation, Automotive Applications, Home Automation, Plant Automation	**3**	**4**
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 withAlarm 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 Madisetti, "*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 (IoTs): 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
MC518		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): ***At the End of the course students will be able to***	
MC518.1	Illustrate fundamentals of Cloud Computing.
MC518.2	Analyze different virtualization techniques and their role in enabling the cloud computing system model.
MC518.3	Categorize various Cloud architecture and Infrastructure.
MC518.4	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
MC518.1	1	-		3	2	-	-	-	-	-	-	-
MC518.2	1	-	2	-	2	-	-	-	-	-	-	-
MC518.3	-	2	1	-	2	-	-	-	-	-	-	-
MC518.4	2	-	1	1	3	-	-	-	-	-	-	-

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

	PEO1	PEO2	PEO3	PSO1	PSO2
MC518.1	2	-	-	-	2
MC518.2	2	-	-	-	2
MC518.3	2	-	-	-	2
MC518.4	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** 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	**1,2, 3**	**7**
2	**Virtualization in Cloud** 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	**1,2, 3**	**6**
3	**Cloud Architecture** 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	**1,2**	**4**
4	**Cloud Security** 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	**2,4**	**8**
5	**Cloud Infrastructure Mechanisms** 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	**1,2**	**10**
6	**Synchronization in cloud environment** Clock synchronization protocols in cloud data centers, Leader Election protocols in cloud ,Gossip Protocols and its types	**3**	**7**
7	**Self-study Topics** Economics of Cloud ,Challenges in Cloud, Fog Computing, Edge Computing, Mobile Cloud Computing ,Business Transformation with Google Cloud Superpowers of Cloud	**1,2**	
	Total		**42**

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	3	-	2	4	9	3	-	1	4
		Examination Scheme								
MC519		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		300	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	
Course Objective: The course is designed to develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of Artificial Intelligence to address real-world problems.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
MC519.1	Explain basic architectures of AI intelligent agents.
MC519.2	Apply appropriate methods and knowledge representation techniques to solve problems.
MC519.3	Analyze the problem using logic, inferences and probabilistic reasoning model with uncertainty
MC519.4	Apply planning techniques to solve domain problems.
MC519.5	Design the AI applications in real world scenarios.

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	1	1	1	2	-	-	-	-	-	1	-	-
MC519.2	2	2	2	2	1	-	-	-	-	-	-	-
MC519.3	2	3	2	2	1	-	-	-	-	-	-	-
MC519.4	3	3	2	2	1	-	-	-	-	-	-	-
MC519.5	3	3	3	3	3	-	-	-	-	2	-	-

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MC519.1	-	-	-	-	-	-	-
MC519.2	-	-	-	-	-	-	-
MC519.3	-	-	-	-	-	-	-
MC519.4	-	-	-	-	-	-	-
MC519.5	-	-	-	-	-	-	-

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 to AI** Introduction to Artificial Intelligence, Computational Intelligence and Artificial Intelligence, **AI**: Applications, Features, Limitations, Intelligent Agent: Agent, specify the task environment using PEAS, Properties of task environments , The structure of agents and their architecture	**1, 3**	**5**
2	**Problem Solving** Problem solving agents, toy problems, real world problems, state space search, **Uninformed Search Methods**: Comparison of Breadth First Search and Depth First Search, Depth Limited Search, Depth First Iterative Deepening (DFID), **Heuristic Search Methods:** Heuristic functions, Best First Search, Hill Climbing, Local Maxima, Beam search, Randomized Search and **Emergent Systems**: Iterated Hill, Climbing, Simulated Annealing, Genetic algorithms, Travelling salesman problem, Emergent systems, Ant colony optimization, Finding Optimal Path: Branch & bound, A* search, Admissibility of A*, Iterative deepening A*, Recursive best first search, AND-OR graph, AO* search, **Game Playing**: Game trees, Optimal strategies, The minimax algorithm, Alpha-Beta Pruning, SSS* example.	**1,2**	**13**
3	**Knowledge Representation** Semantic networks, Description logics, Circumscription and default logic, Truth maintenance systems, The internet shopping world, Rete Network	**1,2,4**	**3**
4	**Logic and Inferences** JSP architecture, JSP page life cycle, JSP Directives, JSP scripting elements, JSP Actions, Error handling in JSP, Session tracking techniques in JSP	**1,2,4**	**6**
5	**Uncertain Knowledge and Reasoning** Uncertainty, Representing knowledge in an uncertain domain, Top down and bottom up reasoning, A-box reasoning, Muddy Children puzzle	**1,3,4**	**4**
6	**Planning**	**1,2**	**6**

	The STRIPS and PDDL domain, Blocks world domain, forward state space planning, backward state space planning, Goal stack planning, Plan space planning, NOAH, Hierarchical planning, The planning graph.		
7	**Introduction to Expert Systems**	**1,2**	**5**
	Introduction, Difference between expert system and conventional program, Expert systems - Architecture of expert systems, Roles of expert systems, Knowledge Acquisition – Meta knowledge, Heuristics. Expert systems shells.		
8	**Self-Study Topics**		
	Natural Language Processing, Object detection , Chatbot, Expert Systems		
		Total	**42**

Laboratory Component

Sr. No	Title of the Experiment
1	Implement uninformed search algorithm
2	Implement knowledge based reasoning
3	Implement informed search methods
4	Program on Local Search Algorithm
5	Program on planning algorithm
6	Program on Adversarial Search
7	Lisp and prolog programming problems
8	One case study on Expert system based papers published in IEEE/ACM/Springer or any prominent journal

Text Books:

[1] StuartJ.Russell and Peter Norvig," *Artificial Intelligence A Modern Approach*", Fourth Edition, Pearson,2020.

[2] Deepak Khemani," *A first course in Artificial Intelligence*", First Edition, McGraw Hill,2017.

Reference Books:

[3] Patrick Henry Winston," *Artificial Intelligence*", Third edition, Addison-Wesley.

[4] Deepak Khemani," *Artificial Intelligence- Knowledge Representation and Reasoning*", McGraw Hill.

[5] Elain Rich, Kevin Knight, Shivshankar Nair, "*Artificial Intelligence*", McGraw Hill, 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
(PE)	Cyber Security	3	0	2	4	9	3	0	1	4
		Examination Scheme								
MC520		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 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***	
MC520.1	Analyze the issues and challenges in cybercrimes and cyber offenses.
MC520.2	Explain the methods used in cybercrimes and its countermeasures.
MC520.3	Analyze the Cyber Laws which are used against cybercrimes and cyber criminals.
MC520.4	Explain the basics of computer forensics.
MC520.5	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
MC520.1	-	3	-	-	-	-	-	-	-	-	-	-
MC520.2	-	-	-	3	3	-	-	-	-	-	-	-
MC520.3	-	2	-	-	-	-	-	-	-	-	-	-
MC520.4	2	-	-	2	-	-	-	-	-	-	-	-
MC520.5	-	-	-	3	3	-	-	-	-	-	-	-

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	1	-	-	1	-
MC520.4	1	-	-	-	1
MC520.5	-	-	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		
	1.9	Best practices with social media marketing tools		
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.		

	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

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	Block Chain Technology	3	-	2	4	9	3	-	1	4
		Examination Scheme								
MC521		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***	
MC521.1	Explain the basics of Block chain
MC521.2	Analyze various block chain Technology
MC521.3	Demonstrate the working of Bitcoin and Ethereum
MC521.4	Explain the basic of Multichain technology
MC521.5	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	PO 10	PO 11	PO 12
MC521.1	3	-	-	-	-	-	-	-	-	-	-	-
MC521.2	-	2	-	1	-	-	-	-	-	-	-	-
MC521.3	-	-	2	-	3	-	1	-	-	-	-	-
MC521.4	2	1	-	-	-	-	-	-	-	-	-	-
MC521.5	3	-	-	-	-	-	1	-	-	-	-	-

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MC521.1	-	-	-	-	-	-	-
MC521.2	-	-	-	-	-	-	-
MC521.3	-	-	-	-	-	-	3
MC521.4	-	-	-	-	-	-	-
MC521.5	-	-	-	-	-	-	-

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** 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.	**1,2**	**7**
2	**Blockchain Technology** 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	**1,2**	**9**
3	**Bitcoin and Ethereum** 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.	**1,2**	**10**
4	**Introduction to Multichain** 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.	**1,2**	**9**
5	**IoT in Blockchain** 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)	**1,2**	**7**
6	**Self-Study Topics** Use Cases Of Blockchain Technology: ● Blockchain in Supply Chain ● Blockchain in Manufacturing ● Blockchain in Automobiles		

	• Blockchain in Healthcare • Blockchain in Cyber security • Blockchain in Financial Industry Use Cases of blockchain IoT connected decives: • 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	Data Warehousing and Mining	3	-	2	4	9	3	-	1	4
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
MC522		Theory		75		75		150		300
		Laboratory		50		--		50		100

Pre-requisite Course Codes, if any.	DBMS, Mathematics
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
MC522.1	Identify the scope and essentiality of Data Warehousing and Mining.
MC522.2	Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
MC522.3	Build Data ware house for real time problems
MC522.4	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	PO 10	PO 11	PO 12
MC522.1	-	2	-	-	-	-	-	-	-	-	-	-
MC522.2	2	-	2	-	-	-	-	-	-	-	-	-
MC522.3	-	-	-	2	-	-	-	-	-	2	-	-
MC522.4	-	-	-	2	2	-	2	-	-	2	-	-

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

	PEO1	PEO2	PEO3	PSO1	PSO2
MC522.1	2	-	-	2	-
MC522.2	2	-	-	2	-
MC522.3	2	-	-	-	2
MC522.4	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** 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	**3, 4**	**8**
2	**Data Warehouse and OLAP Technology for Data Mining** 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	**1, 2**	**8**
3	**Introduction to Data Mining** 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	**1,2**	**8**
4	**Association Rules** 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	**2**	**6**
5	**Classification** 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	**2**	**6**
6	**Clustering** 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	**2**	**6**

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

Text Books

[1] Jiawei Han, Micheline Kamber, Morgan Kaufmann "*Data Mining-Concepts and Techniques*" Second Edition Elsevier 2006

[2] Ning Tan, Vipin Kumar, Michael Steinbanch "*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	Computer Graphics	3	-	2	4	9	3	-	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
MC523		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): ***At the End of the course students will be able to***	
MC523.1	Apply output primitive algorithms on a given scenario
MC523.2	Apply 2D geometric transformation functions and clipping algorithms.
MC523.3	Apply basics of 3D concepts and Fractals.
MC523.4	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
MC523.1	2	1	-	-	2	-	-	-	-	-	-	-
MC523.2	2	2	-	-	3	-	-	-	-	-	-	-
MC523.3	-	3	-	2	-	-	-	-	-	-	-	-
MC523.4	-	-	2	-	3	-	-	-	-	-	-	-

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

	PEO1	PEO2	PEO3	PSO1	PSO2
MC523.1	-	-	-	-	2
MC523.2	-	-	-	-	2
MC523.3	-	-	-	-	-
MC523.4	-	-	-	-	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** Introduction to Computer Graphics, Elements of Computer Graphics, Graphics display systems.	**1,2**	**2**
2	**Output primitives & its Algorithms** 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	**1,2**	**10**
3	**2D Geometric Transformations & Clipping** 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	**1,2**	**11**
4	**Basic 3D Concepts & Fractals** 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, Sirpenski Triangle	**1,2**	**8**
5	**Introduction to Image Processing and image enhancement** 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	**3**	**11**
6	**Self-Study Topics** Color and shading models, Ray tracing		
		Total	**42**

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	Ethical Hacking	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 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***	
MC524.1	Explain the basics of ethical hacking.
MC524.2	Analyze various types of attacks in ethical hacking.
MC524.3	Explain hijacking techniques and its countermeasures.
MC524.4	Analyze network and Web attacks and its countermeasures
MC524.5	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
MC524.1	3	-	-	-	-	-	-	-	-	-	-	-
MC524.2	-	2	-	2	3	-	1	-	-	-	-	-
MC524.3	2	-	-	2	2	-	1	-	-	-	-	-
MC524.4	1	-	-	2	2	-	1	-	-	-	-	-
MC524.5	1	-	-	1	2	-	1	-	-	-	-	-

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

	PEO1	PEO2	PEO3	PSO1	PSO2
MC524.1	-	-	-	-	-
MC524.2	-	-	-	-	2
MC524.3	-	-	-	-	1
MC524.4	-	-	-	-	1
MC524.5	-	-	-	-	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** 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	1,3	8
2	**Various types of attacks** 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	1,3	9
3	**Hijacking and Hacking** Session Hijacking introduction, Session hijacking techniques and countermeasures, Different types of web server attacks, Web server attack methodology, Web server countermeasures	1,3	8
4	**Wireless and SQL injection attack** Working of viruses , Virus analysis, Malware analysis procedure, Computer worms, Countermeasures, SQL Injection attacks and detection tools, Firewall : Introduction and Configuration	1,3	9
5	**Mobile and Network attack** Hacking Mobile Platforms, Wireless Encryption , Wireless hacking methodology, IDS and honeypot evasion techniques, Evasion tools, Countermeasures	1,3	8
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								
		Component		ISE		MSE		ESE		Total
MC601		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): ***At the End of the course students will be able to***	
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 ✓

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.

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								
		Component	ISE		MSE		ESE			Total
MC602		Theory	50		50		100			200
		Laboratory	-		--		-			-

Pre-requisite Course Codes, if any.	-
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
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	-

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BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create
			✓		

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**

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	SVXX / STXX	SEVA/SATVA V/VI	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 Dean Industry Relation