## Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)



## Structure and Curriculum of

## Postgraduate Programme (II Year) of Computer Science

M.Sc. (Computer Science)

Approved by

**Board of Studies** 

in States auch Computer Science

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

w.e.f. June, 2024 (In Accordance with NEP-2020)

### **Review Statement**

The **NEP CELL** reviewed the Curriculum of **M.Sc. Computer Science Programme** to be effective from the **Academic Year 2024-25.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 09/08/2023 Place: Latur

> NEP CELL Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)

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#### **CERTIFICATE**

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **in M.Sc. Computer Science** Programme to be effective from the **Academic Year 2024-25.** 

Date: 14/07/2023

Place: Latur

(Dr. Renuka Londhe) Chairperson Board of Studies in M.Sc. Computer Science Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)

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#### From the Desk of the Chairperson...

With the tremendous growth of IoT, Data Science, Artificial Intelligence, and Machine Learning technologies over the past ten years, computers have been influencing the future of humanity. Any student taking B.Sc. (Computer Science) program should be able to understand the philosophy, architecture, and mathematics behind the technologies that advance our modern society. The ever-growing discipline of computer science has strong connections to other disciplines. Many problems in science, engineering, health care, business, and other areas can be solved effectively with computers, but finding a solution requires both computer science expertise and knowledge of the particular domain. Computer science has a wide range of specialties. These include Computer Programming, Software Systems, Graphics, Artificial Intelligence, Mathematical and Statistical Analysis, Data Science, Computational Science, and Software Engineering.

A real genuine attempt has been made while designing the new curriculum of four-year B.Sc. (Computer Science) program under NEP-2020 by Board of Studies in Computer Science of Rajarshi Shahu Mahavidyalaya, Latur (Autonomous) with an aim to develop the core competence in computing and problem solving amongst its graduates. After successful completion of B.Sc. (Computer Science), students can fetch employment directly in companies as programmer, Web Developer, Software Engineer, Network Administrator, Data Scientist, or AI/ML personnel.

The curriculum focuses on building theoretical foundations in Computer Science to enable its students to think critically when challenged with different and new problems. It includes the learner-centric features of NEP-2020 including Multiple Entry and Multiple Exit, Employability, Flexibility to Choose, Multidisciplinary, Research, Advance Courses, etc.

The Computer Science BoS states that the B.Sc. (Computer Science) Honors & M. Sc. (Computer Science) program gives students a strong foundation and exposure to the basics, advanced, and emerging trends of the subject. The program helps students to comprehend the principles of computer science and enhance skills such as programming, networking, and database management. The program also stresses the ethics of creating and using new technologies by making compelling arguments for secure computing, user privacy protection, and green computing. The program trains students for a career in Software industry and inspires them towards further studies and research opportunities.

We sincerely thank all of the experts who provided their insightful comments and recommendations in order to improve the contents; we have made every effort to take each of them into consideration.



(**Dr. Renuka R Londhe**) Board of Studies in Computer Science



## **Department of Computer Science**

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Shiv Chhatrapati Shikshan Sanstha's

#### Rajarshi Shahu Mahavidyalaya, Latur

## (Autonomous)

**Faculty of Science** 

Structure for Postgraduate Degree Programme in M. Sc. Computer Science (In accordance with NEP-2020)

Year	Sem	Majo	or	Lab	RM	OJT/FP	RP	Cum.	Marks	Degree
Level		Mandatory	Elective	Course				Cr		
		Major I	MEC I	LC-I	RMC	NA	NA	20Cr		
		3Cr	3Cr	1Cr	4Cr				<b>m</b> 1	
		Major II		LC-II					Theory:	
	T	3Cr		1Cr					ICr=25M	
	1	Major III		LC-II <mark>I</mark>					Course	
		3Cr		1Cr					1Cr=50M	
				LC-I <mark>V</mark>						PG
				1Cr						Diploma
I		Major IV	MEC II	LC-V	NA	OJT-I	NA	20Cr		(After
6.0		3Cr	3Cr	1Cr		4Cr				03 Year
		Major V		LC-VI		/FPI	×1			B.Sc.
	II	3Cr		1Cr		4Cr				Degree)
		Major VI		LC-VII					OJT/FP:	
		3Cr		1Cr					1Cr=25M	
				LC-VIII						
		Majar	MEC	ICr	DMC	OIT /ED				
	Total	Major 19Cm		LC-8Cr		01Cr	NA	40Cr		
							Veer	D Ca Daa		
	1	Exit Option	n: PG DIPIC		40 Cred		DD I	B.SC. Deg	ree	
		Major VII	MEC III	LU-IX	NA	NA	RP-I	20Cr		
		3Lr Maior VIII	3Cr				4Cr			
				LU-A						
	III	3Cf Major IV								
		Major IX		$10^{-\Lambda}$						
		501				राव	ত স	पता		
				1Cr	1			•	RPI &	PG
	IV	Major X	MEC IV	LC-XIII	NA	NA	RP-II	22Cr	RPII:	Degree
II		3Cr	3Cr	1Cr			6Cr		1Cr=25M	(After
6.5		Major XI		LC-XIV		ald	<			03 Year
		3Cr		1Cr		C	1			UG
		Major XII		LC-XV			-			Degree)
		3Cr	CHEV	1Cr	2121	1 5721	1.5			
				LC-XVI			1000			
				1Cr						
	Total	Major 🛛 🗧	MEC	LC-8Cr	NA	NA	RP	42Cr		
		18Cr	06Cr				10			
			Latu	r (At	Iton	omo	Cr			
Cum. T	ſotal	Major	MEC	LC-	RMC	OJT/FP	RP	40+42		82
of I & II Year 36Cr 12Cr		16Cr	04Cr	04Cr	10Cr	=82 Cr		Credits		
ļ	1									
	Exit Option: Two Years 04 Sem. PG Degree with 82 Credits After 03 Year UG Degree									

Note:

- A) Co-Curricular Courses (CC) includes –
- 1. Health and Wellness
- 2. Yoga education
- 3. Sports and fitness
- 4. Cultural activities
- 5. NSS
- 6. NCC
- 7. Fine Applied Visual Performing Arts
- 8. Study Tour
- 9. Publication of articles in newspaper / magazine.
- B) Field Project concerned with Major



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#### **Abbreviations:**

- 1. MMC : Major Mandatory Course
- 2. MEC : Major Elective Course
- 3. RMC : Research Methodology Course
- 4. OJT : On Job Training(Internship/Apprenticeship)
- 5. FP : Field Project
- 6. RP : Research Project
- 7. Cum. Cr : Cumulative Credit

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Shiv Chhatrapati Shikshan Sanstha's Rajarshi Shahu Mahavidyalaya, Latur (Autonomous) Faculty of Computer Science Department of Computer Science M.Sc. in Computer Science

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
		MMC-VII	Dig <mark>ital</mark> Image	03	45
			Processing		
			LC-IX Based on MMC	01	
			VII		
		MMC-VIII	Machine Learning	03	45
			LC-X Based on MMC	01	
	III		VIII		. –
		MMC-IX	Adv. Python	03	45
			Programming	01	
			LC-XI Based on MMC IX	01	45
Ţ		MEC-III (A)	Io I & Cloud	03	45
			UR Notzwark Cogyrity		
		MEC-III(D)	I C VII Pased on MEC III	01	
		Total	20		
6.0			02	45	
0.0		MMC-X	I C-IX Based on MMC-X	03	45
		MMC-XI	Advanced Java	03	45
		MMC-AI	Programming	03	45
			LC-X Based on MMC-XI	Idi	
		MMC-XII	Big Data Analysis	03	45
			LC-XI Based on MMC-		
	IV		XIII		
		MEC-IV (A)	Software Engineering	03	45
	11	OR	OR		
		MEC-IV (B)	Cyber Security		
	Data	rahi Shal	LC-XII Based on MEC IV	01	
	каја	Code	OJT / Field Project	04	60
		FP-I	(utonomous)		
		20			
	Total Credits (Semester III & IV)				40



Faculty of Science

Prog	Programme Outcomes (POs) for M.Sc. Programme				
P01	Disciplinary Masters Knowledge				
	Comprehensive in-depth relevant scientific knowledge and its				
	execution in the specific area o <mark>f s</mark> tudy.				
P02	Scientific Outlook				
	The qualities such as obse <mark>rvati</mark> on, precision, analysis, logical				
	thinking, clarity of though <mark>t and</mark> expression and systematic approach				
	to work on research proj <mark>ects and</mark> explain scientific phenomena.				
P03	Problem Solving Skills				
	Analytical skills to solve p <mark>roblems, e</mark> valuate situations and act				
	responsibly to communica <mark>te, cooperate</mark> and lead the team.				
P04	Interpersonal Skills and <mark>Ethics</mark>				
	Ability to integrat <mark>e</mark> profess <mark>ional ethics and s</mark> cientific knowledge in				
	life, organization, s <mark>oci</mark> ety and individual to fulfill the needs of				
	mankind in both m <mark>ora</mark> l a <mark>nd material aspects.</mark>				
P05	Self-Directed Lif <mark>e-long Learning</mark>				
	Ability to prepar <mark>e for NET, SET, GATE and other nati</mark> onal and				
	international competitive examinations.				
P06	Professional Competence				
	Ability to apply the knowledge independently for continuous				
	personal and professional development and identify business				
	opportunities and initiate action to achieve it.				
P07	Research and Related Skills				
	Technical know-how about identification of local issues and develop				
	lab to land solutions for the benefit of society at large.				

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## (Autonomous)

Program	nme Specific Outcomes (PSOs) for M.Sc. Computer Science					
PSO No.	Upon completion of this programme the students will be able to					
PSO 1	Transfer the knowledge gained in the different computer science fields					
	such as Soft computing, Information Security, programming languages,					
	advanced database concepts & big data analytics to solve real world					
	problems.					
PSO 2	Design small executable software, useful mobile application by					
	implementing analytical and thinking skills and deliver it in the form of					
	report and presentatio <mark>ns.</mark>					
PSO 3	Acquire jobs in Data Science and Machine Learning areas, Grab job					
	opportunities in teaching / research units.					
<b>PSO 4</b>	Apply skills learnt in the field of Digital Imager Processing, Data mining,					
	Machine learning, Clou <mark>d Computing, N</mark> etworking and Security, Software					
	Quality Assurance in spe <mark>cific areas related t</mark> o health, education, banking etc.					



# Semester - III



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Course Type: MMC-VIICourse Title: Digital Image ProcessingCourse Code: 602COS3101Credits: 03Marks

Marks: 75

Lectures: 45 Hrs.

#### **Learning Objectives:**

- LO1 To familiarize students with digital image fundamentals.
- LO2 To discuss the properties of digital image.
- LO3 To get exposed to simple image enhancement techniques in Spatial and Frequency domain
- LO4 To learn image degradation and restoration techniques.
- LO5 To study the Morphological Image Processing and Image Segmentation.

#### **Course Outcomes:**

- CO1 Know and understand the fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- CO2 Operate on images using the image enhancement and Filtering Methods.
- CO3 Understand the image degradation and restoration.
- CO4 Perform operations on color images
- CO5 Apply the morphological operation and segmentation techniques on images.
- CO6 Perform color image processing Operations.

Unit No.	Title of Unit & Contents	Hrs.				
Ι	Introduction to Image Processing and M Function Programming	10				
	What is digital image processing? Applications of digital image processing,					
	fundamental steps in digital image processing, Components of digital image					
	processing, Elements of visual perception, Light and Electromagnetic					
	Spectrum,					
	image sensing and acquisition devices, a simple image formation model,					
	image sampling and quantization, neignbors of pixels, distance. Representing					
	Digital Images Representation: Coordinate Conventions Images as Matrices					
	Reading Images, Displaying Images, Writing Images, Data Classes, Image					
	Types, Intensity Images, Binary Images, A Note on Terminology, Converting					
	between					
	Dat <mark>a Classes and Image Typ</mark> es, converting between Data Classes, Converting					
	bet <mark>ween Image classes and Types,</mark>					
	Array Indexing: Vector Indexing, Matrix Indexing, Selecting Array					
	Dimensions, Some Important Standard Arrays,					
	Introduction to M Function Programming: M-Files, Operators, Flow Control,					
	Code Optimization, Interactive I/O.					
	Unit Outcomes:					
	U01 Understand the concept and applications of digital image processing.					
	UO2 Understand the concept of M-files, operators, flow control, code					
	optimization, and interactive I/O in M function programming.	4.0				
II	Intensity Transformations and Filtering	12				

Unit No.	Title of Unit & Contents	Hrs.
	<ul> <li>Intensity Transformation Functions: Function imadjust, Logarithmic and Contrast- Stretching Transformations, Histogram Processing and Function Plotting: Generating and Plotting Image Histograms, Histogram Equalization, Histogram Matching (Specification), Spatial Filtering, Linear Spatial Filtering, Nonlinear Spatial Filtering, Image Processing Toolbox standard Spatial Filters, Frequency Domain Processing: The 2-D Discrete Fourier Transform, Computing and Visualizing the 2-D DFT in MATLAB, Filtering in the Frequency Domain, Basic Steps in DFT Filtering. Obtaining Frequency Domain Filters from Spatial Filters, Generating Filters Directly in the Frequency Domain, Sharpening Frequency Domain Filters.</li> <li>Unit Outcome:</li> <li>U01 Understand the concept of spatial filtering, including linear and nonlinear spatial filtering.</li> <li>U02 Understand the 2-D Discrete Fourier Transform and how to compute and visualize it in MATLAB</li> </ul>	
III	Image Restoration and Color Image Processing	10
	A Model of the Image Degradation/Restoration Process, Noise Models, Geometric Transformations and Image Registration: Geometric Spatial Transformations, Applying Spatial Transformations to Images, Image Registration, Color Image Representation in MATLAB: RGB Images, Indexed Images, IPT Functions for Manipulating RGB and Indexed Images, Converting to Other Color Spaces: NTSC Color Space, The YCbCr Color Space, The HSV Color Space, The CMY and CMYK Color Spaces, The HSI Color Space, The Basics of Color Image Processing, color Transformations, Spatial Filtering of Color Images and working directly in RGB vector space. Unit Outcomes: UO1 Learn about different noise models in image processing. UO2 Understand different color spaces-NTSC, YCbCr, HSV, CMY, CMYK, and HSI & how to convert images between these color spaces.	
IV	Morphological Image Processing and Image Segmentation	13
	Erosion and Dilation, Opening and Closing, The Hit or Miss Transformations, Basic Morphological algorithms, Edge Detection, Thresholding, Region based Segmentation, Segmentation using Morphological Watersheds and the use of motion in Segmentation. <b>Unit Outcomes:</b> UO1 Understand the concepts of erosion and dilation in image processing & apply erosion and dilation operations to binary and grayscale images.	
	U02 Identify foreground and background patterns using structuring elements.	

#### Learning Resources:

- R. C. Gonsales R. E. Woods, Digital Image Processing, Second Edition, Pearson Education R.C. Gonsales R. E. Woods, Digital Image Processing using MATLAB, Pearson Education D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Prentice Hall. 1.
- 2.
- 3.



**Department of Computer Science** 

**Course Type** : Lab Course IX **Course Title** : Lab Course (Based on MMC-VII) **Course Code** : 602COS3104

:01

Max. Marks: 50

Hours: 30

#### Learning Objectives:

Credits

- To familiarize students with digital image fundamentals. L01
- L02 To discuss the properties of digital image.
- L03 To get exposed to simple image enhancement techniques in Spatial and Frequency domain
- L04 To learn image degradation and restoration techniques.
- L05 To study the Morphological Image Processing and Image Segmentation.

#### **Course Outcomes:**

- C01 Know and understand the fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- CO2 Operate on images using the image enhancement and Filtering Methods.
- CO3 Understand the image degradation and restoration.
- CO4 Perform operations on color images
- Apply the morphological operation and segmentation techniques on images. C05
- C06 Perform color image processing Operations.

Practical No.	Unit
1	Program <mark>s to demonstrate read, write and display images</mark> in MATLAB.
2	Programs to demonstrate Data classes and image types in MATLAB.
3	Programs to demonstrate Image Operations in MATLAB.
4	Programs to demonstrate Functions in MATLAB.
5	Programs to demonstrate Flow control sin MATLAB
6	Pro <mark>grams to de</mark> monstr <mark>ate Intensity</mark> Transformations in MATLAB.
7	Progr <mark>ams to d</mark> emonstrate Histogram, Histogram Equalization and Histogram
	Matching.
8	Programs to demonstrate Linear Spatial Filtering and Nonlinear Spatial
	Filtering.
9	Programs to demon <mark>stra</mark> te Filtering in Frequency Domain.
10	Programs to demonstrate Geometric Transformation.
11	Programs to demonstrate Image Restoration and Registration.
12	Programs to demonstrate Color Image Processing.
13	Program to demonstrate Morphological Image Processing Operations
14	Program to demonstrate image segmentation techniques.



#### **Department of Computer Science**

Course Type	: MMC VIII	
Course Title	: Machine Learning	
Course Code	:602COS3102	
Credits	:03	Marks: 75

#### **Learning Objectives:**

- LO1 Understand the importance of machine learning, and learn about different types of machine learning systems
- LO2 Learn how to work with the MNIST database and train a binary classifier.
- LO3 Understand and implement different training models like linear regression and logistic regression.
- LO4 Learn about advanced techniques like Support Vector Machines, Decision Trees, and Ensemble Learning, dimensionality reduction and learn how to implement it. reduction.
- LO5 Understand the concept of artificial neural networks and how to train them using TensorFlow.

#### **Course Outcomes:**

After completion of the course, the student will be able to-

- CO1 Understand the challenges faced in machine learning.
- CO2 Gain practical experience by working on an end-to-end machine learning project.
- CO3 Analyze about different types of classification such as multiclass, multilabel, and multioutput classification.
- CO4 Gain knowledge about PCA and how to use it for dimensionality
- CO5 Use TensorFlow for implementing neural networks.
- CO6 Apply the concept of artificial neural networks and how to train them.

Unit No.	Title of Unit & Contents	Hrs.				
Ι	Foundations of Machine Learning: From Theory to Practice					
	What Is Machine Learning? Why Use Machine Learning?					
	Types of Machine Learning Systems - Supervised/Unsupervised Learning,					
	Batch and Online Learning, Instance-Based Versus Model-Based Learning Main					
	Challenges of Machine Learning - Insufficient Quantity of Training Data,					
	Nonrepresentative Training Data , Poor-Quality Data, Irrelevant Features,					
	Overfitting the Training Data, Underfitting the Training Data, Stepping Back					
	End-to-End Machine Learning Project- Working with Real Data, Get the Data,					
	Discover and Visualize the Data to Gain Insights, Prepare the Data for Machine					
	Lea <mark>rning Algorithms, Select and Train a Model, Fine-Tune the Mo</mark> del, Launch,					
	Monitor, and Maintain System.					
	Unit Outcomes: Shahu Mahavid va ava					
	U01 Understand the different types of machine learning systems and					
	instance-based versus model-based learning.					
	UO2 Gain practical experience by working on a real-world machine learning					
	project.					
II	Practical Machine Learning: From Classification to Regression Models					
	Modified National Institute of Standards and Technology database (MNIST),					
	Training a Binary Classifier, Performance Measures, Measuring Accuracy Using					
	Cross-Validation, Confusion Matrix, Precision and Recall, Precision/Recall					

Lectures: 45 Hrs.

Unit No.	Title of Unit & Contents	Hrs.			
	Tradeoff, The ROC Curve, Multiclass Classification, Error Analysis, Multilabel Classification, Multioutput Classification <b>Training Models-</b>				
	<b>Linear Regression-</b> The Normal Equation, Computational Complexity <b>Gradient Descent-</b> Batch Gradient Descent, Stochastic Gradient Descent, Mini- batch Gradient Descent, Polynomial Regression,				
	Learning Curves, <b>Regularized Linear Models</b> - Ridge Regression, Lasso Regression, Elastic Net, Early Stopping.				
	<b>Logistic Regression-</b> Estimating Probabilities, Training and Cost Function, Decision Boundaries,Softmax Regression				
	Unit Outcome:				
	UO1 Understand the MNIST database and how to use it for machine learning. Learn how to train a binary classifier and understand various perform				
	UO2 Learn about gradien <mark>t descent, including batch, stochastic, and mini- batch gradient descent and concept of early stopping.</mark>				
III	Advanced Machine Learning Techniques: From Training Models to				
	Ensemble Learning				
	Support Vector Machines				
	Linear SVM Classification - Soft Margin Classification				
	Caussian RBE Kernel Computational Complexity SVM Regression <b>Under the</b>				
	Hood- Decision Function and Predictions Training Objective Quadratic				
	Programming, The Dual Problem, Kernelized SVM, Online SVMs				
	Decision Trees				
	Training and V <mark>isualizing a Decision Tree, Making Predictions, E</mark> stimating Class				
	Probabilities <mark>, The CART Training Algorithm,</mark>				
	Computational Complexity, Gini Impurity or Entropy?, Regularization				
	Hyperparameters, Regression, Instability, Dimensionality Reduction				
	Ensemble Learning and Random Forests - Voting Classifiers, Bagging and Pasting, Bagging and Pasting in Scilit Learn, Out of Bag Evaluation Pandom				
	Pasting- Bagging and Pasting in Scikit-Learn, Out-of-Bag Evaluation Kandom Patches and Random Subspaces- Random Forests Extra-Trees Feature				
	Importance <b>Boosting</b> - AdaBoost Gradient Boosting <b>Stacking</b>				
	Dimensionality Reduction				
	The Curse of Dimensionality,				
	Main Approaches for Dim <mark>ensio</mark> nality Re <mark>duction - Pr</mark> ojection , Manifold Learning				
	PCA - Preserving the Variance , Principal Components , Projecting Down to d				
	Dimensions, Using Scikit-Learn, Explained Variance Ratio, Choosing the Right				
	Number of Dimensions, PCA for Compression, Incremental PCA , PCA ,				
	<b>Kernel PCA-</b> Selecting a Kernel and Tuning Hyperparameters, LLE, Other				
	Unit Outcomes				
	1101 Learn about the decision function predictions training objective				
	quadratic programming, the dual problem, kernelized SVM, and online SVMs.				
	UO2 Learn how to make predictions and estimate class probabilities using decision trees.				
	UO3 Understand the concept of ensemble learning and random forests.				
	UO4 Learn about selecting a kernel and tuning hyperparameters, LLE, and other dimensionality reduction techniques.				

Unit No.		Title of Unit & Contents	Hrs.				
IV	Neural N	letworks and Deep Learning					
	Up and R	Running with TensorFlow					
	Installati	on, Creating First Graph and Running It in a Session,					
	Managing	ging Graphs, Lifecycle of a Node Value, Linear Regression with					
	TensorFl	ow, Implementing Gradient Descent- Manually Computing the					
	Gradients	s, Using autodiff, Using an Optimizer					
	Feeding	Data to the Training Algorithm, Saving and Restoring Models,					
	Visualizi	ng the Graph and Training Curves Using TensorBoard, Name Scopes,					
	Modulari	ity, Sharing Variables					
	Introduc	ction to Artificial Neural Networks					
	From B	Biological to Artificial Neurons- Biological Neurons, Logical					
	Computa	itions with Neuron <mark>s, The</mark> Perceptron, Multi-Layer Perceptron and					
	Васкргор	pagation,					
	Training	an MLP with TensorFlow's High-Level API,					
	Training a DNN Using Plain TensorFlow- Construction Phase,						
	Execution	n Phase, Using the Neural Network,					
	Number	of Neurons per Hidden Layer, Activation Functions					
		ional Neural Networks, Recurrent Neural Networks					
	Unit Out						
	UI01 In	nstall TensorFlow and how to manage graphs and understand the					
	li	fecycle of a node value.					
	11						
	U02 U	Inderstan <mark>d the t</mark> ra <mark>nsition from biological to a</mark> rtificial neurons. Train a					
	n	nulti-laye <mark>r perceptron (MLP) with TensorFlo</mark> w' <mark>s high-le</mark> vel API.					
	U03 T	'rain a d <mark>eep neural network (DNN) using pla</mark> in TensorFlow, including					
	u	nders <mark>tanding the construction and execution phases.</mark>					
	U04 U	Inderstand CNN & RNN					

#### **Learning Resources:**

- Hands-On Machine Learning with Scikit-Learn & TensorFlow, O'Reilly publication
   Introduction to Machine Learning with Python, by Andreas C. Müller & Sarah Guido, O'Reilly publication

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3.



Course Type: Lab Course XCourse Title: Lab Course (Based on MMC-VIII)Course Code: 602COS3105Credits: 01Max. Marks: 50

Hours: 30

#### Learning Objectives:

- LO1 Understand the importance of machine learning, and learn about different types of machine learning systems
- LO2 Learn how to work with the MNIST database and train a binary classifier.
- LO3 Understand and implement different training models like linear regression and logistic regression.
- LO4 Learn about advanced techniques like Support Vector Machines, Decision Trees, and Ensemble Learning, dimensionality reduction and learn how to implement it. reduction.
- LO5 Understand the concept of artificial neural networks and how to train them using TensorFlow.

#### **Course Outcomes:**

- CO1 Understand the challenges faced in machine learning.
- CO2 Gain practical experience by working on an end-to-end machine learning project.
- CO3 Analyze about different types of classification such as multiclass, multilabel, and multioutput classification.
- CO4 Gain knowledge about PCA and how to use it for dimensionality
- CO5 Use TensorFlow for implementing neural networks.
- CO6 Apply the concept of artificial neural networks and how to train them.

Practical No.	Unit	
1	Install TensorFlow and create first computation graph	
2	Imple <mark>ment a s</mark> imple li <mark>near re</mark> gression model using a small dataset	
3	Implem <mark>ent a</mark> binary classifier using the MNIST database	
4	Measure the accurac <mark>y of b</mark> inary classifier using cross-validation.	
5	Create a confusion matrix for your binary classifier to understand its	
	performance in more detail.	
6	Implement a multiclass classification model using the MNIST database.	
7	Measure the accuracy of a binary classifier using cross-validation.	
8	Create a confusion matrix for binary classifier to understand its performance in	
	more detail.	
9	Implement a multiclass classification model using the MNIST database.	
10	Implement a linear regression model and compute the normal equation.	
11	Implement gradient descent (batch, stochastic, and mini-batch) for optimizing	
	linear regression model.	
12	Implement a regularized linear model such as Ridge Regression or Lasso	
	Regression.	
13	Implement a Support Vector Machine (SVM) for classification tasks.	

14	Train and visualize a decision tree using a suitable dataset.
15	Implement ensemble learning techniques such as bagging, pasting, and boosting.
16	Implement Principal Component Analysis (PCA) for dimensionality reduction on a high-dimensional dataset.





Course Type: MMC IXCourse Title: Advanced Python ProgrammingCourse Code: 602C0S3103Credits: 03Marks: 75

Lectures: 45 Hrs.

#### **Learning Objectives:**

- LO1 Understand advanced data structures such as sets, dictionaries, heaps, and graphs. Learn about algorithm design and analysis, including recursion, sorting, searching, and dynamic programming.
- LO2 Understand the power of pattern searching using regex in Python.
- LO3 Learn how to set up the development environment. Understand Flask and Django, including templates and forms.
- LO4 Set up the Python environment for data science, understand data manipulation with Pandas, importing and exporting data, and data cleaning and preparation.

#### **Course Outcomes:**

- CO1 Analyze time and space complexity of operations on sets, dictionaries, heaps, and graphs. Apply graph algorithms (e.g., traversal, shortest path, connectivity) to real-world problems.
- CO2 Use regular expressions for powerful pattern matching and searching, validate and parse data (e.g., passwords, emails, URLs) using regular expressions.
- CO3 Handle exceptions effectively to prevent code breaks.
- CO4 Set up a development environment for web development using Python.
- CO5 Set up a Python environment for data science using tools like Anaconda and Jupyter notebooks.

Unit No.	Title of Unit & Contents		
Ι	Mastering Advanced Data Structures in Python		
	Advanced da <mark>ta stru</mark> ctures: <mark>sets, d</mark> ictionaries, heaps,		
	and graphs, Algorithm design and analysis: recursion, sorting, searching, and		
	dynamic programming, T <mark>ime a</mark> nd		
	space complexity analysis		
	Unit Outcomes:		
	UO1 Understand the properties of sets & implement common set		
	operations.		
	UO2 Describe the concept of a heap and its applications implement a min-		
	heap or max-heap.		
II	Mastering Regular Expressions, Exception Handling, and Database		
	Connections in Python		
	Powerful pattern matching and searching, Power of pattern searching using		
	regex in Python, Real time parsing of networking or system data using regex,		
	Password, email, URL validation using regular expression, Pattern finding		
	programs using regular expression, Exception Handling: Avoiding code break		
	using exception handling, Safe guarding file operation using exception		
	handling, Handling and helping developer with error code, Programming		
	using Exception handling. Database Connection: SQL Database connection		

Unit No.	Title of Unit & Contents	Hrs.
	using Python, Creating and searching tables, Reading and storing config	
	information on database, Programming using database connections.	
	Unit Outcomes:	
	UO 1. Avoiding Code Breaks using Exception Handling.	
	UO 2. Handling and Helping Developers with Error Codes	
	UO 3. Establishing Database Connections	
III	Building Web Applications with Python	
	Introduction to Web Development in Python-	
	Setting Up the Development Environment,	
	Introduction to Flask and Django, Templates and Forms, Working with	
	Databases, User Authentication, Deploying Python Web Applications, Testing	
	Unit Outcomes	
	UO1 Define web development and its components (nont-end, back-end).	
IV	Eveloping Data Science using Python	
	<b>Introduction to Data Science</b> - Understanding the role of data science in	
	today's world. Overview of the data science process. <b>Python for Data</b>	
	Science- Why Python for data science?	
	Setting up the Python environment for data science (Anaconda, Jupyter	
	notebooks),	
	Data Manipulation with Pandas- Introduction to Pandas	
	Data structures in Failuas (Series, DataFraile), importing and exporting data,	
	Data Analysis with Pandas- Descriptive statistics Grouping and	
	aggregation. Handling missing data. Merging, joining, and reshaning data	
	<b>Data Visualization with Matplotlib and Seaborn-</b> Introduction to	
	Matplotlib and Seaborn, Creating plots (bar plots, histograms, scatter plots,	
	etc.), Customizing plots	
	Unit Outcomes:	
	UO1 Learn why Python is used for data science and how to set up the	
	Pyt <mark>hon envir</mark> onmen <mark>t for data science.</mark>	
	UO2 Learn how to create and customize various types of plots (bar plots,	
	histo <mark>grams</mark> , scatter <mark>plots,</mark> etc.).	

#### **Learning Resources:**

- 1. "Data Structures and Algorithms in Python" by Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser
- 2. "Core Python Programming" by Dr. R. Nageshwar Rao
- 3. "Fluent Python" by Luciano Ramalho, O'Reilly Media
- 4. "Python Cookbook" by Brian Jones, David Beazley, OReilly Media



Course Type: Lab Course XICourse Title: Lab Course (Based on MMC IX)Course Code: 602COS3106Credits: 01Max. Marks: 50

Hours: 30

#### **Learning Objectives:**

- LO1 Understand advanced data structures such as sets, dictionaries, heaps, and graphs. Learn about algorithm design and analysis, including recursion, sorting, searching, and dynamic programming.
- LO2 Understand the power of pattern searching using regex in Python.
- LO3 Learn how to set up the development environment. Understand Flask and Django, including templates and forms.
- LO4 Set up the Python environment for data science, understand data manipulation with Pandas, importing and exporting data, and data cleaning and preparation.

#### **Course Outcomes:**

- CO1 Analyze time and space complexity of operations on sets, dictionaries, heaps, and graphs. Apply graph algorithms (e.g., traversal, shortest path, connectivity) to real-world problems.
- CO2 Use regular expressions for powerful pattern matching and searching, validate and parse data (e.g., passwords, emails, URLs) using regular expressions.
- CO3 Handle exceptions effectively to prevent code breaks.
- CO4 Set up a development environment for web development using Python.
- CO5 Set up a Python environment for data science using tools like Anaconda and Jupyter notebooks.

Practical No.	Unit	
1	Imple <mark>ment a he</mark> ap data structure and perform heap sort.	
2	Create <mark>a diction</mark> ary an <mark>d perf</mark> orm operations like add, remove, and search.	
3	Implement a graph data structure and perform depth-first and breadth-first search.	
4	Write a Python program to validate email addresses using regular expressions.	
5	Write a Python program to handle exceptions during file operations.	
6	Connect to a SQL database using Python and perform CRUD operations.	
7	Set up a development environment and create a simple Flask application.	
8	Create a web application with user authentication using Django.	
9	Deploy a Python web application on a cloud platform.	
10	Set up the Python environment for data science and perform basic operations using Jupyter notebooks.	
11	Import a dataset using Pandas and perform data cleaning and preparation.	
12	Perform data analysis on a dataset using Pandas and generate descriptive statistics.	
13	Visualize a dataset using Matplotlib and Seaborn.	
14	Handle missing data in a dataset and perform data reshaping using Pandas.	



<b>Course Type</b>	: MEC III (A)		
<b>Course Title</b>	: IoT and Cloud Integration		
Course Code	:602COS3201		
Credits	:03	Marks: 75	Lectures: 45 Hrs.

#### Learning Objectives:

- Learn how to securely connect IoT devices to cloud platforms. L01
- L02 Implement data ingestion, storage, and processing pipelines in the cloud.
- L03 Develop IoT applications for real-time monitoring, analytics, and control

L04 Gain proficiency in using cloud services for IoT deployment, scalability, and management. **Course Outcomes:** 

- After completion of the course, the student will be able to-C01 Comprehend the architecture and components of IoT systems, including devices,
- gateways, cloud services, and applications.
- CO2 Implement IoT communication protocols and techniques for device-to-cloud and deviceto-device communication
- CO3 Select and utilize cloud services provided by major cloud platforms (AWS, Azure, Google Cloud) for IoT applications.
- CO4 Develop IoT applications for cloud platforms, including real-time monitoring, visualization, and control functionalities.

Unit No.	Title of Unit & Contents	Hrs.
Ι	Introduction to IoT and Cloud Integration	9
	Overview of IoT and cloud computing, Importance of integrating IoT with cloud	
	platforms, Use cases and applications of IoT and cloud integration, IoT Device	
	Protocol <mark>s and Comm</mark> unicati <mark>on</mark>	
	Introduction to IoT communication protocols (MQTT, CoAP, HTTP), Device-to-	
	cloud and d <mark>evice-to-</mark> device communication C 800 C C	
	Hands-on: Se <mark>tting u</mark> p IoT d <mark>evice c</mark> ommunication protocols	
	Unit Outcomes:	
	U01 Understand the basic concepts of IoT and cloud computing, identify the	
	key components and architecture of an IoT system.	
	U02 Understand the significance of integrating IoT with cloud platforms,	
	identify the challenges and solutions in IoT-cloud integration.	
II	Cloud Services for IoT & Data management	11
	Ove <mark>rview of major cloud platforms (AWS, Azure, Google Cloud)</mark>	
	IoT services provided by cloud platforms, Selecting the right cloud services for	
	IoT projects, IoT Data Management in the Cloud, Data ingestion from IoT	
	devices to the cloud, Real-time data processing and analytics, Hands-on:	
	Implementing data ingestion and processing pipelines using cloud services	
	Unit Outcomes:	
	U01 Develop the ability to choose the right cloud platform based on specific	
	IoT requirements.	
	UO2 Develop the ability to implement real-time data processing and	
	analytics for IoT data.	
III	Security and Privacy in IoT and Cloud	11

Unit No	Title of Unit & Contents	Hrc			
Unit NO.	The of onit & contents	1115.			
	IoT security challenges and best practices, Securing data transmission and storage in the cloud, Identity management and access control, IoT Application Development in the Cloud, Developing IoT applications for cloud platforms, Real-time monitoring and visualization, Hands-on: Building a dashboard for IoT data visualization				
	Unit Outcomes:				
	UO1 Understand the security challenges in IoT and learn about the best				
	UO2 Gain practical experience in building a dashboard for IoT data				
IV	Edge Computing, Hybrid Architectures and Case Studies	14			
	Introduction to edge computing, implementing edge computing in IoT solutions, Hands-on: Deploying edge computing solutions in IoT projects, Real- world examples of IoT and cloud integration Case studies from different industries (e.g., smart cities, healthcare, manufacturing)				
	Unit Outcomes:				
	UO1 Learn about the process of implementing edge computing in IoT solutions.				
	UO2 Analyze case studies of IoT and cloud integration from various industries.				

#### **Learning Resources:**

- 1. "Integration of IoT with Cloud Computing for Smart Applications" by Rohit Anand, Sapna Juneja, Abhinav Juneja, Vishal Jain, Ramani Kannan
- 2. "Cloud IoT: Concepts, Paradigms, and Applications" by Deepak Kumar Saxena (Editor), Jitendra Kumar Verma (Editor), Vicente Gonzalez-Prida Diaz (Editor), Vira Shendryk (Editor)
- 3. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz
- 4. "IoT Solutions in Microsoft's Azure IoT Suite: Data Acquisition and Analysis in the Real World" by Scott Klein, Mark Dunkel
- 5. "Architecting the Industrial Internet of Things" by Peter Thorne, Mithulan Nandagopal, Sameer Paradkar
- 6. "Practical Internet of Things Security" by Brian Russell, Drew Van Duren
- 7. "IoT Projects with Raspberry Pi Zero" by Marco Schwartz





#### **Department of Computer Science**

Course Type: Lab Course XIICourse Title: Lab Course (Based on MEC-III (A))Course Code: 602COS3203Credits: 01Max. Marks: 50

Hours: 30

#### Learning Objectives:

LO1 Learn how to securely connect IoT devices to cloud platforms.

LO2 Implement data ingestion, storage, and processing pipelines in the cloud.

LO3 Develop IoT applications for real-time monitoring, analytics, and control

LO4 Gain proficiency in using cloud services for IoT deployment, scalability, and management.

#### **Course Outcomes:**

- CO1 Comprehend the architecture and components of IoT systems, including devices, gateways, cloud services, and applications.
- CO2 Implement IoT communication protocols and techniques for device-to-cloud and deviceto-device communication
- CO3 Select and utilize cloud services provided by major cloud platforms (AWS, Azure, Google Cloud) for IoT applications.
- CO4 Develop IoT applications for cloud platforms, including real-time monitoring, visualization, and control functionalities.

Practical No.	Unit			
1	Resea <mark>rch and analyze real-world IoT applications in variou</mark> s industries.			
	Prepare presentations on the benefits and challenges of integrating IoT with			
	cloud platforms.			
2	Se <mark>t up IoT devic</mark> es (e.g <mark>., Raspberry Pi, A</mark> rduino) and configure communication			
	proto <mark>cols such a</mark> s MQT <mark>T, CoAP</mark> , and HTTP.			
3	Establi <mark>sh devi</mark> ce-to-clo <mark>ud an</mark> d device-to-device communication channels using			
	simulat <mark>ed or</mark> real devices.			
4	Develop simple IoT applications to exchange data between devices and cloud			
	platforms.			
5	Create an account on any one major cloud platforms (AWS, Azure, Google			
	Cloud) and explore IoT services provided by each platform.			
6	Implement real-time monitoring and visualization of IoT data using cloud			
	services (e.g., AWS IoT Analytics, Azure Stream Analytics).			
7	Build a dashboard application to visualize sensor data and control IoT devices			
	remotely.			
8	Set up edge computing devices (e.g., edge servers, gateways) and deploy edge			
	computin <mark>g solutions in IoT projects.</mark>			
9	Analyze case studies of IoT and cloud integration in various industries and			
	discuss the benefits of edge computing in each scenario.			
10	Present findings and recommendations based on real-world examples of			
	successful IoT and cloud integration projects.			



Credits	:03	Marks: 75	Lectures: 45 Hrs
Course Code	:602COS3203		
<b>Course Title</b>	: Network Security (B)		
Course Type	: MEC III		

#### Learning Objectives:

- Understand the fundamentals of network security, including threats, vulnerabilities, and L01 attack vectors.
- L02 Learn techniques for securing network infrastructure, including firewalls, VPNs, and intrusion detection/prevention systems (IDS/IPS)
- L03 Gain proficiency in implementing cryptographic protocols and secure communication channels
- L04 Develop skills in network monitoring, incident detection, and response
- L05 Learn best practices for securing wireless networks, IoT devices, and cloud-based services
- L06 Understand legal and ethical considerations in network security

#### **Course Outcomes:**

- C01 Understand the fundamental concepts and terminology used in network security, Identify common threats and attack vectors in network security.
- CO2 Understand the principles of defense-in-depth and risk management in network security.
- CO3 Learn about network traffic analysis, intrusion detection techniques, and incident response planning.
- CO4 Gain an overview of cloud computing, learn how to secure cloud-based services and data, and understand identity and access management in the cloud.

Unit No.	Title of Unit & Contents	
Ι	Introduction to Network Security & Infrastructure	8
	Overview of network security concepts and terminology	
	Common threats and attack vectors	
	Principles of defense-in-depth and risk management	
	Network Infrastructure Security - Securing network devices (routers,	
	switches, firewalls), Virtual Private Networks (VPNs) for secure remote	
	access, Intrusion Detection and Prevention Systems (IDS/IPS)	
	Unit Outcomes:	
	UO1 Identify the components of a secure network and their functions.	
	UO2 Implement Virtual Private Networks (VPNs) for secure remote access.	
II	Cryptography and Secure Communication	12
	Introduction to cryptographic algorithms and protocols, Secure	
	communication channels (SSL/TLS, SSH), Public Key Infrastructure (PKI) and	
	algital certificates	
	Network Monitoring and Incident Response- Network traffic analysis and	
	packet sniffing, Intrusion detection techniques and tools, Incident response	
	planning and procedures	
	Unit Outcome:	

U01       Understand and explain key cryptographic algorithms and protitive role of Public Key Infrastructure (PKI) and digital certific network security.         U02       Perform network traffic analysis and packet sniffing. Understa apply intrusion detection techniques and tools.         III       Wireless Network, Cloud Security         Securing Wi-Fi networks (WPA2, WPA3)         Wireless intrusion detection/prevention systems (WIDS/WIPS)         Best practices for securing IoT devices         Cloud Security-         Overview of cloud computing and deployment m         Securing cloud-based services and data, Identity and access managen the cloud.         U01       Understand the role of Wireless Intrusion Detection and Prev         Systems (WIDS/WIPS) in network security. Implement the sidetect and prevent unauthorized access to wireless networks.	tocols, ates in nd and <b>10</b>
<ul> <li>the role of Public Key Infrastructure (PKI) and digital certific network security.</li> <li>UO2 Perform network traffic analysis and packet sniffing. Understa apply intrusion detection techniques and tools.</li> <li>III Wireless Network, Cloud Security</li> <li>Securing Wi-Fi networks (WPA2, WPA3)</li> <li>Wireless intrusion detection/prevention systems (WIDS/WIPS)</li> <li>Best practices for securing IoT devices</li> <li>Cloud Security- Overview of cloud computing and deployment m Securing cloud-based services and data, Identity and access managen the cloud.</li> <li>Unit Outcomes:</li> <li>UO1 Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the sa detect and prevent unauthorized access to wireless networks.</li> </ul>	ates in nd and 10
network security.         UO2       Perform network traffic analysis and packet sniffing. Understa apply intrusion detection techniques and tools.         III       Wireless Network, Cloud Security         Securing Wi-Fi networks (WPA2, WPA3)         Wireless intrusion detection/prevention systems (WIDS/WIPS)         Best practices for securing IoT devices         Cloud Security- Overview of cloud computing and deployment methods         Securing cloud-based services and data, Identity and access managen the cloud.         Unit Outcomes:         UO1       Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the sa detect and prevent unauthorized access to wireless networks.	nd and 10
UO2Perform network traffic analysis and packet sniffing. Understa apply intrusion detection techniques and tools.IIIWireless Network, Cloud SecuritySecuring Wi-Fi networks (WPA2, WPA3) Wireless intrusion detection/prevention systems (WIDS/WIPS) Best practices for securing IoT devices Cloud Security- Overview of cloud computing and deployment in Securing cloud-based services and data, Identity and access managen the cloud.Unit Outcomes: U01 Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the sa detect and prevent unauthorized access to wireless networks.	nd and 10
apply intrusion detection techniques and tools.         III       Wireless Network, Cloud Security         Securing Wi-Fi networks (WPA2, WPA3)         Wireless intrusion detection/prevention systems (WIDS/WIPS)         Best practices for securing IoT devices         Cloud Security- Overview of cloud computing and deployment m         Securing cloud-based services and data, Identity and access managen         the cloud.         Unit Outcomes:         UO1       Understand the role of Wireless Intrusion Detection and Prev         Systems (WIDS/WIPS) in network security. Implement the sa         detect and prevent unauthorized access to wireless networks.         UO2       Implement security measures for cloud based services and data	10
III         Wireless Network, Cloud Security           Securing Wi-Fi networks (WPA2, WPA3)         Wireless intrusion detection/prevention systems (WIDS/WIPS)           Best practices for securing IoT devices         Cloud Security- Overview of cloud computing and deployment m           Securing cloud-based services and data, Identity and access managen the cloud.         Unit Outcomes:           U01         Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the state detect and prevent unauthorized access to wireless networks.	10
Securing Wi-Fi networks (WPA2, WPA3) Wireless intrusion detection/prevention systems (WIDS/WIPS) Best practices for securing IoT devices <b>Cloud Security-</b> Overview of cloud computing and deployment m Securing cloud-based services and data, Identity and access managen the cloud. <b>Unit Outcomes:</b> UO1 Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the sa detect and prevent unauthorized access to wireless networks.	odels
<ul> <li>Wireless intrusion detection/prevention systems (WIDS/WIPS)</li> <li>Best practices for securing IoT devices</li> <li>Cloud Security- Overview of cloud computing and deployment m Securing cloud-based services and data, Identity and access managen the cloud.</li> <li>Unit Outcomes:</li> <li>U01 Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the sa detect and prevent unauthorized access to wireless networks.</li> <li>U02 Implement security measures for cloud based services and data</li> </ul>	udels
Best practices for securing IoT devices         Cloud Security- Overview of cloud computing and deployment m         Securing cloud-based services and data, Identity and access managen         the cloud.         Unit Outcomes:         UO1       Understand the role of Wireless Intrusion Detection and Prev         Systems (WIDS/WIPS) in network security. Implement the sa         detect and prevent unauthorized access to wireless networks.         UO2	udels
Cloud Security- Overview of cloud computing and deployment r.         Securing cloud-based services and data, Identity and access management the cloud.         Unit Outcomes:         U01       Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the state detect and prevent unauthorized access to wireless networks.         U02       Implement security measures for cloud based services and data	Indels
Securing cloud-based services and data, Identity and access managen the cloud. Unit Outcomes: UO1 Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the sa detect and prevent unauthorized access to wireless networks. UO2 Implement security measures for cloud based services and data	ioucis,
the cloud.         Unit Outcomes:         UO1       Understand the role of Wireless Intrusion Detection and Prev         Systems (WIDS/WIPS) in network security. Implement the sa         detect and prevent unauthorized access to wireless networks.         UO2       Implement security measures for cloud based services and dot	ient in
Unit Outcomes:         U01       Understand the role of Wireless Intrusion Detection and Prev         Systems (WIDS/WIPS) in network security. Implement the state detect and prevent unauthorized access to wireless networks.         U02       Implement security measures for cloud based services and detect and prevent unauthorized access to wireless networks.	
UO1 Understand the role of Wireless Intrusion Detection and Prev Systems (WIDS/WIPS) in network security. Implement the security access to wireless networks.	
Systems (WIDS/WIPS) in network security. Implement the security access to wireless networks.	ention
detect and prevent unauthorized access to wireless networks.	ame to
UO2 Implement cocurity measures for cloud based corriges and det	
1002 Implement security measures for cloud-based services and da	
IV Security Policies and Procedures, Case Studies	15
Developing network security policies and guidelines, Employee traini	ng and
awareness programs, Security auditing and compliance.	
Case Studies and Practical Applications	,
Analysis of real-world network security breaches and incidents, Ha	nds-on
labs and simulations to reinforce concepts, Group projects on designi	ng and
Implementing secure network architectures.	
Unit outcomes:	_
widelines	/
guidelines.	among
002 Recognize the significance of cybersecurity awareness	annong n the
employees. Promote a security-conscious culture with	n uie
UI gallization.	
UO4 Collaborate with nears to design secure network architectures	
UO5 Apply principles of defense in death segmentation and	20025
controls	access

#### Learning Resources:

- 1. "Network Security Essentials: Applications and Standards" by William Stallings (Sith Edition, Pearson Publication).
- 2. "Computer Networking: A Top-Down Approach" by James F. Kurose and Keith W. Ross
- 3. "Principles of Computer Security: CompTIA Security+ and Beyond" by Wm. Arthur Conklin, Gregory White, Dwayne Williams, Chuck Cothren, and Roger L. Davis.
- 4. "Applied Cryptography: Protocols, Algorithms, and Source Code in C" by Bruce Schneier
- 5. "Security Engineering: A Guide to Building Dependable Distributed Systems" by Ross J. Anderson



#### **Department of Computer Science**

Course Type: Lab Course XIICourse Title: Lab Course (Based on Elective-III B)Course Code: 602C0S3203Credits: 01Max. Marks: 50

Hours: 30

#### **Learning Objectives:**

- LO1 Understand the fundamentals of network security, including threats, vulnerabilities, and attack vectors.
- LO2 Learn techniques for securing network infrastructure, including firewalls, VPNs, and intrusion detection/prevention systems (IDS/IPS)
- LO3 Gain proficiency in implementing cryptographic protocols and secure communication channels
- LO4 Develop skills in network monitoring, incident detection, and response
- LO5 Learn best practices for securing wireless networks, IoT devices, and cloud-based services
- LO6 Understand legal and ethical considerations in network security

#### **Course Outcomes:**

- CO1 Understand the fundamental concepts and terminology used in network security, Identify common threats and attack vectors in network security.
- CO2 Understand the principles of defense-in-depth and risk management in network security.
- CO3 Learn about network traffic analysis, intrusion detection techniques, and incident response planning.
- CO4 Gain an overview of cloud computing, learn how to secure cloud-based services and data, and understand identity and access management in the cloud.

Practical No.	Unit
1	Conduct a threat modeling exercise to identify potential threats to a network
	infrastr <mark>ucture</mark> .
2	Configure access control lists (ACLs) on routers and switches to restrict
	unauthorized access.
3	Set up firewall rules to filter incoming and outgoing traffic based on security
	policies.
4	Configure SSL/TLS encryption for web servers to secure communication over
	HTTPS.
	Set up SSH for secure remote access to network devices.
5	Use network monitoring tools like Wireshark to capture and analyze network
	traffic. Shahu Mahayo yalaya
	Configure network sensors to monitor for suspicious activities and anomalies
6	Configure Wi-Fi access points with WPA2 or WPA3 encryption and strong
	passphrase policies.
7	Deploy WIDS/WIPS solutions to monitor wireless networks for unauthorized
	access and attacks.
8	Implement multi-factor authentication (MFA) for cloud user accounts.

9	Configure access controls and permissions to restrict unauthorized access to
	cloud resources.
10	Analyze real-world case studies of network security breaches and incidents to
	identify lessons learned.



# Semester - IV



।। आरोह तमसो ज्योतिः।।



Course Type	: MMC-X		
<b>Course Title</b>	: Pattern Recognition		
Course Code	:602COS4101		
Credits	:03	Marks: 75	Lectures: 45 Hrs.

#### Learning Objectives:

- LO1 Understand and apply foundational concepts of pattern recognition, including statistical methods and decision theory.
- LO2 Utilize dimensionality reduction, clustering, and evaluation metrics for effective data analysis and model validation.
- LO3 Explore supervised learning techniques, including neural networks, SVMs, and ensemble methods for pattern recognition tasks.
- LO4 Analyze and implement unsupervised, semi-supervised, and advanced pattern recognition techniques in real-world applications.

#### **Course Outcomes:**

- CO1 Develop the ability to design and evaluate models for foundational and advanced pattern recognition tasks.
- CO2 Implement supervised, unsupervised, and semi-supervised algorithms to solve classification, clustering, and generative modeling problems.
- CO3 Demonstrate practical expertise in applying pattern recognition techniques to domains like image processing, healthcare, and finance.
- CO4 Critically analyze advanced topics such as transfer learning, meta-learning, and adversarial approaches in pattern recognition.

Unit No.	Title of Unit & Contents	Hrs.	
Ι	Foundations of Pattern Recognition	10	
	Introduction to Pattern Recognition, Statistical Pattern Recognition, Bayesian Decision Theory, Maximum Likelihood Estimation, Parametric and Non- Parametric Methods, Feature Extraction and Selection, Dimensionality Reduction (PCA, LLE, t-SNE), Clustering Algorithms (k-means, hierarchical), Evaluation Metrics (Accuracy, Precision, Recall, F1), Case Studies: Handwritten Digit Recognition, Face Recognition		
	<ul> <li>Unit Outcomes:</li> <li>U01 Explain the fundamentals of pattern recognition and its significance in computational systems.</li> <li>U02 Apply &amp; implement statistical methods, feature extraction and dimensionality reduction techniques for pattern classification.</li> </ul>		
II	Supervised Learning for Pattern Recognition		
	Linear Discriminant Analysis (LDA), Support Vector Machines (SVMs), Neural Networks for Pattern Recognition, Convolutional, Neural Networks (CNNs), Recurrent Neural Networks (RNNs) for Sequential Patterns, Transfer Learning and Fine-tuning, Regularization Techniques (Dropout, L1, L2), Optimization Algorithms (SGD, Adam, RMSProp), Ensemble Methods (Bagging, Boosting), Pattern Recognition Applications: Object Detection, Image Classification,		

Jnit No.	Title of Unit & Contents	Hrs
	Advanced Topics: Generative Adversarial Networks (GANs),	
	Case Studies: Speech Recognition, Natural Language Processing	
	Unit Outcome:	
	U01 Apply advanced pattern recognition techniques, and transfer	
	learning, to solve complex real-world problems.	
	UO2 Evaluate the performance of models using regularization,	
	optimization algorithms, and ensemble methods, while exploring	
	applications like object detection, image classification, and emerging	
	topics like GANs.	
III	Unsupervised and Semi-Supervised Pattern Recognition	10
	K-Means Clustering and Variants, Hierarchical Clustering and Dendrograms,	
	Expectation-Maximization (EM) Algorithm, Mixture Models and Gaussian	
	Mixture Models, Semi-Supervised Learning: Label Propagation, Self-Training,	
	Medele VAEs CANS	
	Pattern Pacagnition Applications: Image Segmentation Anomaly Detection	
	Advanced Tonics: Granh-Based Methods Spectral Clustering	
	Case Studies: Customer Segmentation Gene Expression Analysis	
	Unit Outcomes:	
	101 Implement clustering techniques, mixture models, and unsupervised	
	feature learning methods for exploratory data analysis and pattern	
	discovery.	
	UO2 Analyze advanced unsupervised learning approaches, including deep	
	generative models and graph-based methods, with applications in	
	image seg <mark>mentation, anomaly detection, and case studi</mark> es.	
IV	Advanced Topics and Applications	13
	Time-Series Pattern Recognition, Spatial Pattern Recognition: Image and	
	Video Analy <mark>sis, Pattern Recognition in Multimedia: Audio, Tex</mark> t, and Video,	
	Biologically-Inspired Pattern Recognition: Neural Networks and Deep	
	Learning,	
	Pattern Recognition in Healthcare: Disease Diagnosis, Medical Imaging,	
	Pattern Re <mark>cognition i</mark> n Finance: Predictive Modeling, Risk Analysis	
	Advanced Topics: Transfer Learning, Meta-Learning, Adversarial Attacks,	
	Project Presentations and Case Studies	
	Unit Outcomes:	
	U01 Apply pattern recognition techniques to diverse domains, including	
	time-series, multimedia, healthcare, and finance, for real-world	
	problem-solving.	
	UO2 Evaluate advanced approaches like transfer learning, meta-learning,	
	and advancerial matheda through presides and again studies agrees	
	and adversarial methods through projects and case studies across	
	various applications.	

- 2. Neural Networks for Pattern Recognition- Christopher M. Bishop
- 3. The Elements of Statistical Learning Hastie, Tibshirani, and Friedman
- 4. Deep Learning Ian Goodfellow, Yoshua Bengio, and Aaron Courville
- 5. Unsupervised Learning Algorithms Abhishek Kumar Pandey
- 6. Pattern Recognition S. Theodoridis and K. Koutroumbas, 4th Edition, Academic Press, 2009



Course Type	: MMC-X		
<b>Course Title</b>	: Big Data Analysis		
Course Code	:		
Credits	:03	Marks: 75	Lectures: 45 Hrs.

#### **Learning Objectives:**

- LO1 This course provides an overview of approaches facilitating data analytics on huge datasets.
- LO2 To Implement clustering, regression, association rules, and decision trees for data analysis and prediction.
- LO3 To assess realistic application of big data analytics technologies for different usage scenarios and start with their own experiments.

#### **Course Outcomes:**

- CO1 Understand the concept and challenge of bigdata and why existing technology is in adequate to analyze the bigdata.
- CO2 Collect, manage, store, query, and analyze various form of big data.
- CO3 Gain hands-on experience on large-scale analytics tools to solve some big data problems.
- CO4 Understand the impact of big data for business decisions and strategy.

Unit No.	Title of Unit & Contents	Hrs.
Ι	Introduction to Big Data Analytics & Data Analytics Lifecycle	
	Big Data Overview, Data Structures, Analyst Perspective on Data Repositories, State of the Practice in Analytics, Bl Versus Data Science, Current Analytical Architecture, Drivers of Big Data, Emerging Big Data Ecosystem and a New Approach to Analytics, Key Roles for the New Big Data Ecosystem. Data Analytics Lifecycle Overview Key Roles for a Successful Analytics, Project Background and Overview of Data Analytics Lifecycle Phase 1: Discovery: Learning the Business Domain, Resources, Framing the Problem, Identifying Key Stakeholders, Interviewing the Analytics Sponsor, Developing Initial Hypotheses, identifying Potential Data Sources. Phase2: Data Preparation: Preparing the Analytic Sandbox, Performing ETLT, Learning About the Data, Data Conditioning, Survey and Visualize, Common Tools for the Data Preparation Phase. Phase 3: Model Planning: Data Exploration and Variable Selection, Model Selection, Common Tools for the Model Planning Phase. Phase4: Model Building Common Tools for the Mode/Building Phase. Phase5: Communicate Results. Phase 6: Operationalize. Unit Outcomes: UO1 Understand the concept of big data and its impact on various domains. UO2 Understand the roles and responsibilities of data engineers, data	
TT	scientists, and analysts.	
11	Review of Basic Data Analytic Methods Using R	

Unit No.	Title of Unit & Contents	Hrs.
	Introduction to R: Graphical User Interfaces, Data Import and Export, Attribute and Data Types, Descriptive Statistics, Exploratory Data Analysis, Visualization Before Analysis, Dirty Data, visualizing a Single Variable, Examining Multiple Variables, Data Exploration Versus Presentation Statistical Methods for Evaluation: Hypothesis Testing, Difference of Means, Wilcoxon Rank- SumTest, Type I and Type II Errors, Power and Sample Size, ANOVA	
	Unit Outcome:U01Understand the basics of R programming language.U02Gain proficiency in statistical techniques for evaluating hypotheses and making informed decisions	
III	Advanced Analytical Theory and Methods: Clustering & Decision Trees	
	Overview of Clustering, K-means, Use Cases, Overview of the Method, Determining the Number of Clusters, Diagnostics, Contents, Reasons to Choose and Cautions. Decision Trees: Overview of a Decision Tree, Decision tree Algorithms, Decision Trees in R, Naïve Bayes, Naïve Bayes in R <b>Unit Outcomes:</b> UO1 Understand the fundamentals of clustering.	
	U02 Dive into decision trees as a powerful tool for decision-making.	
IV	Advanced Analytical Theory and Methods: Association Rules and Regression	
	Overview of Association, Evaluation of Candidate rules, Applications of Association Rules, An Example: Transaction in a Grocery Store, Validations & testing. Linear Regression: Use cases, model description, and diagnostics. Logistic Regression: Use cases, model description, and diagnostics. Reasons to choose & cautions.	
	Unit Outcomes:	
	<ul> <li>U01 Explore linear regression as a predictive modeling technique:</li> <li>U02 Understand the trade-offs and considerations when choosing between linear regression and logistic regression. Recognize the strengths and limitations of each model type.</li> </ul>	

#### **Learning Resources:**

1. Data Science & Big Data Analytics, Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services. By WILEY Publication

शिक्षण संस्था

2. Big Data, Black Book: Covers Hadoop2, Map Reduce, Hive, YARN, Pig, Rand Data Visualization Paperback–2016



#### **Department of Computer Science**

Course Type: Lab Course XIIICourse Title: Lab Course (Based on MMC-X)Course Code:Credits: 01

Max. Marks: 50

Hours: 30

#### Learning Objectives:

- LO1 This course provides an overview of approaches facilitating data analytics on huge datasets.
- LO2 To Implement clustering, regression, association rules, and decision trees for data analysis and prediction.
- LO3 To assess realistic application of big data analytics technologies for different usage scenarios and start with their own experiments.

#### **Course Outcomes:**

- CO1 Understand the concept and challenge of bigdata and why existing technology is in adequate to analyze the bigdata.
- CO2 Collect, manage, store, query, and analyze various form of big data.
- CO3 Gain hands-on experience on large-scale analytics tools to solve some big data problems.
- CO4 Understand the impact of big data for business decisions and strategy.

Practical No.	Unit			
1	Introduction to R Software and Programming			
2	Imp <mark>orting and Exporting datasets in R Software</mark>			
3	Study of Different att <mark>ributes, datatypes and storage</mark> data types in R			
4	St <mark>udy of Descr</mark> iptive s <mark>tatistics and</mark> Exploratory data analysis in R			
5	Study of Visualization of single variables in R			
6	Study o <mark>f Exam</mark> ining m <mark>ultiple</mark> variables in R			
7	Study of Data exploration vs. Data Presentation in R			
8	Study of Statistical methods for evaluation in R			
	a. Hypothesis Testing b. Difference of means			
9	Study of Statistical methods for evaluation in R–			
	a. Wilcox on Rank-sumtest			
	b. Type I and Type II errors			
	c. Power and sample size			
10	Implementation of K-mean clusters in R			
11	Implementation of Decision Trees in R.			
12	Implementation of Linear Regression in R			
13	Implementation of association rules in R			



Course Type: MMC-XICourse Title: Pattern RecognitionCourse Code: 602COS4102Credits: 03Marks: 75

#### **Learning Objectives:**

- LO1 Understand and apply foundational concepts of pattern recognition, including statistical methods and decision theory.
- LO2 Utilize dimensionality reduction, clustering, and evaluation metrics for effective data analysis and model validation.
- LO3 Explore supervised learning techniques, including neural networks, SVMs, and ensemble methods for pattern recognition tasks.
- LO4 Analyze and implement unsupervised, semi-supervised, and advanced pattern recognition techniques in real-world applications.

#### **Course Outcomes:**

After completion of the course, the student will be able to-

- CO1 Develop the ability to design and evaluate models for foundational and advanced pattern recognition tasks.
- CO2 Implement supervised, unsupervised, and semi-supervised algorithms to solve classification, clustering, and generative modeling problems.
- CO3 Demonstrate practical expertise in applying pattern recognition techniques to domains like image processing, healthcare, and finance.
- CO4 Critically analyze advanced topics such as transfer learning, meta-learning, and adversarial approaches in pattern recognition.

Practical No.	Unit
1	Implement a simple pattern recognition system and understand its components.
2	Implement different types of pattern recognition systems such as supervised,
	unsupervised, and se <mark>mi-su</mark> pervis <mark>ed learning.</mark>
3	Design a pattern rec <mark>ognit</mark> ion system based on given principles.
4	Implement a training and learning process in a pattern recognition system.
5	Extract features from a given dataset and use them in a pattern recognition
	system.
6	Implement parametric estimation in a supervised learning context.
7	Implement non-parametric approaches like Parzen window and KNN
	estimation.
8	Implement a clustering algorithm and understand its role in unsupervised
	learning.
9	Implement a pattern recognition system using grammar-based approaches.
10	Implement a pattern recognition system using Hidden Markov Model.
11	Implement Principal Component Analysis in a pattern recognition context.
12	Implement non-metric methods for pattern classification.

Lectures: 45 Hrs.



#### **Department of Computer Science**

Course Type: Lab Course XIVCourse Title: Lab Course (Based on MMC-XI)Course Code: 602C0S4105Credits: 01Max. Marks: 50Hours: 30

#### Learning Objectives:

- LO1 Learning basic of Java programming, and OOP's concepts.
- LO2 Understand Threads, Packages, and handling runtime errors.
- LO3 Inculcate knowledge of developing GUI applications using Swing, & AWT components.
- LO4 Learning event handling paradigm, interaction with back-end databases.
- LO5 Learn to Create Web Applications using Java.

#### **Course Outcomes:**

After completion of the course, the student will be able to-

- CO1 Write, compile and execute simple Java programs.
- CO2 Write programs using OOP's concepts.
- CO3 Design graphical application, work with events,
- CO4 Interact with database with JDBC , Develop web-based applications.

Dractical No	Init
Practical No.	Unit
1	Write a jav <mark>a program to check weather a given number is</mark> prime or not?
2	Write a j <mark>ava program that demonstrates the fundamental</mark> concepts of oops.
3	Write <mark>a java program that demonstrates various types of co</mark> nstructors.
4	Write a java program for demonstrating inner class.
5	Demonstrate the concept of Interface with the help of suitable java program.
6	Write a java program that demonstrates the creation and use of user define
	package.
7	Write a java program that discusses exception handling with the help of any
	standard exception available in java.
8	Write a j <mark>av</mark> a progra <mark>m to im</mark> plement user defined exception handling.
9	Write a java progra <mark>m th</mark> at implem <mark>ents the mu</mark> lti-threading concepts.
10	Write a java program that demonstrates the use of AWT components.
11	Explain collection framework with help of suitable java program.
12	Implement java program that generates and handles anyone type of event.
13	Write a java program that demonstrates the concepts of JDBC.

# ajarshi Shahu Mahavidyalaya



#### **Department of Computer Science**

Course Type: MMC-XIICourse Title: Advanced Java ProgrammingCourse Code: 602COS4103Credits: 03

Marks: 75

Lectures: 45 Hrs.

#### Learning Objectives:

- LO1 Learning basic of Java programming, and OOP's concepts.
- LO2 Understand Threads, Packages, and handling runtime errors.
- LO3 Inculcate knowledge of developing GUI applications using Swing, & AWT components.
- LO4 Learning event handling paradigm, interaction with back-end databases.
- LO5 Learn to Create Web Applications using Java.

#### **Course Outcomes:**

- CO1 Write, compile and execute simple Java programs.
- CO2 Write programs using OOP's concepts.
- CO3 Design graphical application, work with events,
- CO4 Interact with database with JDBC , Develop web-based applications.

Unit No.	Title of Unit & Contents	Hrs.	
Ι	Introduction and Object-Oriented Programming		
	Programming language Types and Paradigms, Computer Programming		
	Hierarchy, How Computer Architecture Affects a Language? Why Java?		
	Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry,		
	Features of Java Language, JVM-The heart of Java, Java's Magic Byte code.		
	Installing Java, Java Program Development, Java Source File Structure,		
	Compilation, Executions.		
	Object Oriented Programming Class Fundamentals, Object & Object reference,		
	Object Life time & Garbage Collection, Creating and Operating Objects,		
	Vosted Inner Class & Anonymous Classes Abstract Class & Interfaces		
	Defining Methods Argument Passing Mechanism Method Overloading		
	Becursion Dealing with Static Members, Finalize() Method Native Method		
	Unit Outcomes:		
	U01 Recognize the responsibilities and tasks of a Java programmer in the		
	industry.		
	UO2 Understand static members (variables, methods) and their usage.		
	Recognize the purpose of the finalize() method and native methods.		
II	Extending Classes Inheritance and Packages		
	Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting		
	Data members and Methods, Role of Constructors in inheritance, Overriding		
	Super Class Methods, Use of "super", Package, Organizing Classes and		
	Interfaces in Packages, Package as Access Protection, Defining Package,		
	CLASSPATH Setting for Packages, Naming Convention for Packages.		
	Unit Outcome:		
	UO1 Understand the concept of inheritance in object-oriented		
	programming (OOP).		

Unit No.	Title of Unit & Contents	Hrs.
	U01 Organizing Classes and Interfaces in Packages, Package as Access Protection etc.	
III	Exception Handling, Thread and GUI Programming	
	Exception Handling	
	The Idea behind Exception, Exceptions & Errors, Types of Exception, Control Flow in Exceptions, JVM reaction to Exceptions, Use of try, catch, finally, throw, throws in Exception Handling, In-built and User Defined Exceptions, Checked and Un-Checked Exceptions. Thread: Understanding Threads, Needs of Multi-Threaded Programming,	
	Thread Life-Cycle, Thread Priorities, Synchronizing Threads, Inter Communication of Threads, Critical Factor in Thread –Dead Locks. GUI Programming:	
	Basics of Components, Using Containers, Layout Managers, AWT Components, adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects Collection Types Sets Sequence Man Understanding Hashing Use of	
	ArrayList & Vector.	
	Unit Outcomes:	
	U01 Understand the fundamentals of exception handling.	
	UO2 Understanding threads, need of multi-threaded Programming, thread	
	Life-Cycle: Learn about thread states, thread Priorities &	
	Synchronizing Threads	
IV	Event Handling, JDBC and Servlets	
	Event Handling Event-Driven Programming in Java, Event-Handling Process, Event-Handling Mechanism, The Delegation Model of Event Handling, Event Classes, Event	
	Sources, Event Listeners, Adapter Classes as Helper Classes in Event Handling.	
	Database Programming USIng JDBC	
	IDBC Connecting to non-conventional Databases	
	Java Server Technologies Servlet	
	Web Application Basics, Architecture and challenges of Web Application.	
	Introduction to servlet, Servlet life cycle Developing and Deploving Servlets.	
	Exploring Deployment, Descriptor (web.xml), Handling Request and	
	Response.	
	Unit Outcomes:	
	U01 Understand event-driven programming in Java.	
	UO2 Learn about Java Database Connectivity (JDBC)	
	U03 Explore web application development using servlets	

- Learning Resources:

   1.
   Core Java Volume I Cay H. Hortsman and G. Cornell
- Core Java Volume II: Advanced Features Cay H. Hortsman and G. Cornell 2.
- 3. The Complete Reference Java Seventh Edition, Herbert Schildt



#### **Department of Computer Science**

Course Type: MEC-IV (A)Course Title: Software EngineeringCourse Code: 602C0S4201Credits: 03Marks: 75Lectures: 45 Hrs.

#### **Learning Objectives:**

- LO1 To impart the knowledge on the Software Engineering Principles, Applications and Process models.
- LO2 To help the students to learn the Requirement Engineering Process.
- LO3 To create awareness on the basic activities of software project management.
- LO4 To provide the idea of decomposing the given problem into Analysis, Design, implementation, Testing and Maintenance phases.
- LO5 To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

#### **Course Outcomes:**

- CO1 Demonstrate an understanding of the key facts, concepts, principles and theories of software engineering.
- CO2 Analyze the effective software engineering process, based on knowledge of widely used development lifecycle models.
- CO3 Choose appropriate process model depending on the user requirements.
- CO4 Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
- CO5 Apply the knowledge, techniques, and skills in the development of a software product.

Unit No.	Title of Unit & Contents	Hrs.
Ι	Introduction and Software Metrics	
	Software, Software Characteristics, Software Components, SoftwareApplications, Software: A Crisis on The Horizon, The Software Process, Software Process Models: The Linear Sequential Model, The Prototyping Model, Evolutionary Software Process Models: The Incremental Model, The Spiral Model, Software Project Management: People, The Problem, The Process Measures, Metrics, Indicators, Software Measurement: Size -Oriented Metrics, Function-Oriented Metrics.Unit Outcomes: U01U01Identify the key components of software. Describe the interaction of various components to create functional software systems.U02Explain the software development life cycle (SDLC) and its stages	
II	Software Project Planning and Risk Management	
	Project Planning Objectives, Software Scope, Resources, Software Project Estimation, Empirical Estimation Models: The Structure of Estimation Models, COCOMO Model, The Software Equation, Software Risks, Risk Identification: Product Size, Business Impact, Customer Characteristics, Process Definition, Development Environment, Technology to Be Built, Staff Size and Experience,	

Unit No.	Title of Unit & Contents	Hrs.
	RMMM Plan, Software Scheduling: Timeline Chart, Tracking the Schedule, The	
	Init Outcome	-
	Unit Outcome:	
	aims to solve.	
	UO2 Explore techniques for estimating project size, effort, cost, and time,	
	apply estimation models to predict project parameters.	
	UO3 Recognize the significance of accurate estimation for resource	
	planning and budgeting.	
III	Software Quality Assurance and Configuration Management	
	Quality Concepts: Quality, Qua <mark>lity C</mark> ontrol, Quality Assurance, Cost of Quality,	
	Formal Technical Reviews: The Review Meeting, Review Reporting and	
	Record Keeping, Review Guidelines, SQA Plan, The Iso 9000 Quality	
	Standards, Software Con <mark>figuratio</mark> n Management: Baseline, Software	
	Configuration Items, The De <mark>sign Proces</mark> s.	
	Unit Outcomes:	
	U01 Recognize the cost of quality, which includes prevention costs,	
	appraisal costs, intern <mark>al failure costs, an</mark> d external failure costs.	
	UO2 Develop an SQA plan that outline quality assurance activities. Set clear	
	goals for quality improvement.	
IV	Types and Levels of Testing	
	White box testing, Black box testing, Levels of testing, Unit testing, Integration	
	testing, Testing web application, Acceptance testing, GUI testing, Regression	
	testing, Manual testing, Automated testing.	-
	Unit Outcomes:	
	U01 Understand the internal workings and code structure of a software	
	application. Evaluate software functionalities without knowledge of	
	internal code details.	
	UU2 Explore different testing levels.	
	UU3 Understand web-specific testing challenges. Validate user interfaces,	
	functionality, and security. Lonsider cross-browser compatibility and	
	performance.	<u> </u>

#### **Learning Resources:**

- 1. Software Engineering A Practitioner's Approach Fourth Edition, Roger S. Pressman, Ph.D.
- 2. Software testing Principles & Practices, Naresh Chauhan, Oxford University Press

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**Department of Computer Science** 

**Course Type** : Lab Course XVI **Course Title** : Lab Course (Based on MEC IV) **Course Code** : 602C0S3203 Credits :01 Max. Marks: 50

Hours: 30

#### Learning Objectives:

- L01 To impart the knowledge on the Software Engineering Principles, Applications and Process models.
- L02 To help the students to learn the Requirement Engineering Process.
- L03 To create awareness on the basic activities of software project management.
- L04 To provide the idea of decomposing the given problem into Analysis, Design, implementation, Testing and Maintenance phases.
- L05 To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

#### **Course Outcomes:**

- Demonstrate an understanding of the key facts, concepts, principles and theories of C01 software engineering.
- CO2 Analyze the effective software engineering process, based on knowledge of widely used development lifecycle models.
- CO3 Choose appropriate process model depending on the user requirements.
- CO4 Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
- Apply the knowledge, techniques, and skills in the development of a software product. C05

Practical No.	Unit
1	Inve <mark>stigation of</mark> Softwa <mark>re Characteristics and Components</mark> in an Open-Source
	Text Editor
2	Compar <mark>ative</mark> Analysis of Linear Sequential, Prototyping, Incremental, and Spiral
	Models in Software Development
	Procedure:
3	Simulating Software Project Management: Roles, Risks, Processes, and Metrics
4	Evaluation and Comparison of Size-Oriented and Function-Oriented Metrics in
	an Open-Source Software Project
5	Comparative Analysis of Empirical Estimation Models in Software Project
	Planning.
6	Risk Identification and Management in Software Projects: A Case Study
	Approach.
7	Effective Software Scheduling and Timeline Management Using Gantt Charts
8	Defining Software Project Scope and Efficient Resource Allocation.
9	Analyzing Software Quality Assurance and Cost of Quality in Open-Source
	Projects
10	Implementation and Analysis of Formal Technical Reviews in Software Projects

11	Implementing Software Configuration Management Practices in Open-Source
	Projects
12	Developing and Implementing an SQA Plan Based on ISO 9000 Quality Standards
13	Comparative Analysis of White Box and Black Box Testing Techniques
14	Implementing Unit and Integration Testing for a Software Application
15	Manual and Automated Testing of a Web Application"
	Procedure
16	Conducting Regression and GUI Testing for Software Quality Assurance

Note: Perform above Practical Using Selenium





#### **Department of Computer Science**

Credits	:03	Marks: 75	Lectures: 45 Hrs.
Course Code	:602COS4201		
<b>Course Title</b>	: Cyber Security		
Course Type	: MEC-IV (B)		

#### **Learning Objectives:**

- LO1 Understand the fundamentals of cybersecurity and its importance in the digital age.
- LO2 Learn about the different types of cyber threats and common attack vectors.
- LO3 Gain hands-on experience with cybersecurity tools and technologies.
- LO4 Understand the basics of network security and learn how to secure wireless networks.
- LO5 Develop cybersecurity awareness and learn how to create effective training programs.
- LO6 Analyze real-world cybersecurity incidents and breaches.

#### **Course Outcomes:**

- CO1 Apply the principles of cybersecurity to secure computer systems and networks.
- CO2 Gain practical skills in using cybersecurity tools and technologies.
- CO3 Implement network security measures and secure wireless networks, endpoint security measures and data protection strategies.
- CO4 Develop and implement cybersecurity training programs to analyze real-world cybersecurity incidents and breaches and propose security measures.
- CO5 Design and implement security measures for simulated environments.

Unit No.	Title of Unit & Contents	Hrs.
Ι	Introduction to Cybersecurity & Cyber Threats	
	Overview of cybersecurity fundamentals- Importance of cybersecurity in the digital age. Cybersecurity roles and responsibilities	
	<b>Cyber Threat Landscape-</b> Types of cyber threats (malware, phishing,	
	ransomware, etc.), Common attack vectors (social engineering, exploitation of vulnerabilities), Case studies of high-profile cyber-attacks.	
	Unit Outcomes:	
	UO1 Learn about different types of cyber threats such as malware,	
	<ul> <li>phishing, ransomware, etc., and understand common attack vectors like social engineering and exploitation of vulnerabilities.</li> <li>UO2 Analyze high-profile cyber-attacks to understand their impact and the methods used by attackers.</li> </ul>	
II	Security Principles and Best Practices & Tools & Technologies	
	CIA Triad: Confidentiality, Integrity, Availability, Principles of least privilege and defense-in-depth, best practices for securing computer systems and networks	
	<b>Cybersecurity Tools and Technologies-</b> Introduction to cybersecurity tools	
	(antivirus, firewalls, intrusion detection systems), Hands-on labs: Using security tools to analyze and protect systems	
	Unit Outcome:	

Unit No.	Title of Unit & Contents	Hrs.
	U01 Understand the importance of keeping data accessibility, correctness	
	of data, and prompt data access.	
	protect computer systems.	
	U03 Understand how antivirus tools detect and prevent malware.	
	UO4 Explore tools that monitor network activity.	
III	Network, Endpoint Security and data protection and encryption	
	Basics of network security (firewalls, VPNs, secure protocols) Securing wireless networks (WPA2, WPA3), Network segmentation and	
	<b>Endpoint Security-</b> Securing endpoints (computers, laptops, mobile	
	devices), Antivirus software and endpoint protection solutions, Mobile device management (MDM) and BY <mark>OD poli</mark> cies	
	Data Protection and Encryption	
	<b>Importance of data protection and encryption-</b> Encryption algorithms and protocols (AES, RSA, SSL/TL <mark>S), Data loss</mark> prevention (DLP) strategies.	
	Unit Outcomes: UO1 Understand the role of firewalls, VPNs, and secure protocols in safeguarding network communication.	
	UO2 Learn about WPA2 and WPA3 as security protocols for Wi-Fi networks.	
	UO3 Recognize the criticality of data protection and explore various encryption algorithms.	
	UO4 Understand the significance of Mobile Device Management (MDM)	
IV	Ethical and Legal Issues in Cybersecurity Case Studies	
1.	Ethical considerations in cybersecurity practice	
	Legal and regulatory frameworks (GDPR, HIPAA, etc.)	
	Cybersecurity compliance and risk management	
	Cybersecurity Awareness and Training	
	Developing cybersecurity training programs	
	Phishing awareness and social engineering training	
	Case Studies and Practical Applications	
	Analysis of real-world cybersecurity incidents and breaches	
	Hands-on projects: Designing and implementing security measures for	
	U01 Explore the balance between security measures and individual	
	privacy rights. UO2 Use Data Protection Regulation (GDPR) for protecting personal data	
	of EU citizens.	
	UO3 Analyze real-world cybersecurity incidents and breaches.	
	UO4 Simulate environments to test security measures. Gain experience in securing systems, networks, and data.	

#### Learning Resources:

- 1.
- "Cybersecurity Essentials" by Charles J. Brooks. "Cybersecurity: A Practical Guide to the Law of Cyber Risk" by David F. Burg, Lowell D. 2. Sauer, and Daniel B. Garrie
- "Network Security Essentials: Applications and Standards" by William Stallings 3.

- 4. "Cybersecurity: Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare" by Thomas A. Johnson
- 5. "Hands-On Cybersecurity for Finance: Identify, Detect, and Respond to Financial Risks" by Emmanuel Tsukerman and Konstantin Ustinovich
- 6. "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" by Dafydd Stuttard and Marcus Pinto





#### **Department of Computer Science**

Course Type: Lab Course XVICourse Title: Lab Course (Based on MEC IV (B))Course Code: 602C0S3203Credits: 01Max. Marks: 50

Learning Objectives:

- LO1 Understand the fundamentals of cybersecurity and its importance in the digital age.
- LO2 Learn about the different types of cyber threats and common attack vectors.
- LO3 Gain hands-on experience with cybersecurity tools and technologies.
- LO4 Understand the basics of network security and learn how to secure wireless networks.
- LO5 Develop cybersecurity awareness and learn how to create effective training programs.
- LO6 Analyze real-world cybersecurity incidents and breaches.

#### **Course Outcomes:**

After completion of the course, the student will be able to-

- CO1 Apply the principles of cybersecurity to secure computer systems and networks.
- CO2 Gain practical skills in using cybersecurity tools and technologies.
- CO3 Implement network security measures and secure wireless networks, endpoint security measures and data protection strategies.
- CO4 Develop and implement cybersecurity training programs to analyze real-world cybersecurity incidents and breaches and propose security measures.
- CO5 Design and implement security measures for simulated environments.

Practical	Unit
No.	
1	Set u <mark>p a virtual lab</mark> enviro <mark>nment using tools like VirtualBox o</mark> r VMware. Explore
	basic ne <mark>twork config</mark> uratio <mark>ns, create isol</mark> ated networks, and simulate cyber threats.
	Virtualizat <mark>ion softwa</mark> re (Vir <mark>tualBox, VMware), operating system</mark> images (Kali Linux,
	Windows).
2	Implement th <mark>e CI</mark> A Triad p <mark>rincip</mark> les (Confidentiality, Integrity, Availability) for a
	small network. Configure <mark>firew</mark> all rules, user access controls, and regular backups.
	Firewall software (pfSen <mark>se, ipt</mark> ables), u <mark>ser manage</mark> ment tools (Active Directory,
	LDAP).
3	Deploy an open-source intrusion detection system (IDS) such as Snort or Suricata.
	Monitor network traffic and detect suspicious activities.
4	Set <mark>up a VPN (Virtual Private Network) using OpenVPN. Configure</mark> client-server
	communication securely over the internet.
5	Ins <mark>tall and configure an antivirus</mark> software (e.g., ClamAV) on a test machine. Run
	scans and analyze results.
6	Develop a phishing awareness training program for employees. Create simulated
	phishing emails and measure user responses. (GoPhish, KnowBe4).
7	Investigate a well-known cybersecurity incident (e.g., Equifax data breach). Analyze
	the attack vectors, impact, and mitigation strategies. (Wireshark, log analysis tools).

Hours: 30

8	Encrypt a sensitive file using AES (Advanced Encryption Standard) or RSA (Rivest-
	Shamir–Adleman). Understand key management and decryption. (OpenSSL, GPG
	(GNU Privacy Guard))
9	Design a secure network architecture for a small business. Include firewalls, VPNs,
	and intrusion prevention systems. Network diagram tools (draw.io, Lucidchart).

