Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

'A' Grade NAAC Re-accredited (4th Cycle)

SYLLABUS

for

Master of Science (M.Sc.)

Second Year

Computer Science

(For Affiliated College)

As per NEP 2020

(With effect from June-2024)

2024 - 2025

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE (M.Sc.) PROGRAMME
Credit distribution structure for Two Years/ One Year PG M.Sc. (Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination scheme, Master of Science M.Sc. (Computer Science)
M.Sc. (Level 6.5) Sem-III (Name of Courses for-Major, RM, OJT, RP courses)

Sr. No.	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation (CIE) (CA)	End Semester Evaluation (ESE) (UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-511: Network Programming [T]	4	60	4	-	40	60	3.00
		CS-512: Design and Analysis of Algorithm [T]	4	60	4	-	40	60	3.00
		CS-513: Digital Image Processing [T]	2	30	2	-	20	30	2.00
		CS-514: Lab on Network Programming [P]	2	60	-	4	20	30	2.00
		CS-515: Lab on Digital Image Processing [P]	2	60	-	4	20	30	2.00
2	DSE **(Select Any One)**	CSE-516 (A): Ethical Hacking [T] **OR** CSE-516 (B): Internet of Things [T] **OR** CSE-516 (C): Swayam/NPTEL Course	4	60	4	-	40	60	3.00
3	FP/OJT,RP	CS-517: Research Project	4	120	-	8	40	60	3.00
Total			22	450	14	16	220	330	--

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					Theory	Practical	Continuous Internal Evaluation (CIE) (CA)	End Semester Evaluation (ESE) (UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-521: Advanced Operating System [T]	4	60	4	-	40	60	3.00
		CS-522: Machine Learning with Python [T]	4	60	4	-	40	60	3.00
		CS-523: Lab on Advanced Operating System [P]	2	60	-	4	20	30	2.00
		CS-524: Lab on Machine Learning with Python [P]	2	60	-	4	20	30	2.00
2	DSE (**Select Any One**)	CSE-525 (A): Network Security & Firewall [T] **OR** CSE-525 (B): Natural Language Processing [T] **OR** CSE-525 (C): Swayam/NPTEL Course	4	60	4	-	40	60	3.00
3	FP/OJT, RP	CS-526: Research Project	6	180	-	12	60	90	3.00
Total			22	480	12	20	220	330	--

Semester-III

Course Code: **CS-511** **Network Programming** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

1. To provide theoretical as well as practical knowledge of network programming.
2. To make students capable of developing, implementing, managing and troubleshooting the issues of network programming in their personal as well professional life.

Unit-I: Client-Server Networking **[10L] Max Marks: 20**

The Foundations: Stacks and Libraries, Layers of Application, Talking a protocol, A Network Conversation in its Natural State, The process of encoding and decoding, The Internet protocol (IP), Internet Protocol (IP Addresses), Routing, Fragmentation of packets.

Unit-II: UDP and TCP **[15L] Max Marks: 25**

UDP (User Datagram Protocol), Numbers of particular service on the particular system, Communications connection point (Socket), Unreliability: Backoff, blocking, and timeouts, UDP Socket Connection, The Use of Request IDs Is a Good Idea, From Binding till Interfaces, Fragmentation of UDP, Options for Sockets, Broadcast, When Should We Use UDP?, Transmission Control Protocol (TCP), How transmission control protocol works, When to use transmission control protocol, TCP Sockets Mean?, TCP Client and Server, Each conversation one socket, Address that is in use, From Binding to Interfaces, Deadlock, Half-Open Connections, Closed Connections, TCP Streams as Files.

Unit-III: Network Servers **[15L] Max Marks: 20**

Architecture of the server, Message queues and caches, HTTP clients, Servers that handle HTTP, www (World Wide Web), E-mail construction and parsing, SMTP, POP, IMAP, SSH and Telnet, FTP, RPC

Unit-IV: Domain Name System & Socket Names **[10L] Max Marks: 20**

Sockets and Hostnames, Five Socket Coordinates, IPv6, Modern Address Resolution, Bind Your Server to a Port Using getaddrinfo(),To connect to a service, use getaddrinfo (), Getting a Canonical Hostname with getaddrinfo(), Other getaddrinfo() Flags, PriITive Name Service Routines, In Your Own Code, Use getsockaddrQ, DNS Protocol, Why Shouldn't Use Raw DNS?, Using Python to do a DNS query, Getting Mail Domains Resolved.

Unit-V Mobile Ad-Hoc Network **[10L] Max Marks: 15**

Overview of Wireless Ad-Hoc Network- MANET and WSN, Routing in Ad-Hoc Network, Routing Protocols for Ad-Hoc Wireless Network (Proactive, Reactive and Hybrid) Clustering Protocol

References:

1) Brandon Rhodes, John Goerzen, Foundations of Python Network Programming, 3rd Ed., 2014, ISBN: 978-1-4302-5854-4, Apress Berkeley, CA.
2) John Galbraith, Network Programming in Python: The Basic: A Detailed Guide to Python 3 Network Programming and Management, 1st Ed., 2022, ISBN: 978-93-5551- 257-4, BPB publications.
3) Sudip Misra, Isaac Woungang, "Guide to Ad-hoc Network", 2009, ISBN: 9781848003286, Springer.
4) Douglas E. Corner, David Stevens, "Intranetworking with TCP/IP volume III Client

Course Outcomes:

1. At the end of the Course, the student should be able to:
2. Acquire knowledge about client server architecture and its working.
3. Implementing different client server related protocols.
4. Implementing socket related programs.
5. Acquire knowledge about network server and socket programming.

Course Code: **CS-512** **Design and Analysis of Algorithm** *Clock Hours:* ***60***

Total Marks: ***100***

Course Objectives:

1. To Understand and learn Basic concepts of algorithms and analyze the performance of algorithms.
2. Algorithm design techniques for developing algorithms.
3. Searching and traversal algorithms for graphs.

Unit-I: Introduction **[12L] Max Marks: 20**

What Is An Algorithm?, Algorithm Specification, Pseudocode Conventions, Recursive Algorithms, Complexity, Asymptotic Notation, Practical Complexities And Performance Measurement, Removal of recursion ,Tree And Graph Representations, Binary Trees Basics, Heaps And Heap Sort, Sets And Disjoint Set Union And Find.

Unit-II: Divide and Conquer **[12L] Max Marks: 15**

General Method, Binary Search, Finding Maximum and Minimum, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

Unit-III: The Greedy Method **[10L] Max Marks: 20**

General Method, Knapsack Problem, Huffman Code, Minimum-Cost Spanning Trees (Prim's & Kruskal's Algorithm), Single-Source Shortest Paths.

Unit-IV: Dynamic Programming **[10L] Max Marks: 15**

General Method, All-Pair Shortest Path, Matrix Chain Multiplication, Longest Common Sub Sequence, 0/1knapsack, Travelling sales person problem

Unit-V: Basic Search and Traversal Techniques **[08L] Max Marks: 15**

Breadth First Search and Traversal, Depth First Search and Traversal, Spanning Trees.

Unit-VI: Backtracking **[08L] Max Marks: 15**

General Method, Constrains, 8-Queens Problem Graph Coloring.

References:

1. Ellis Horowitz, SatrajSahni, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", 2010, ISBN: 8175152575, Galgothia publications.
2. AnanyLevitin, "Introduction to the design and analysis of Algorithms", 2003, ISBN: 9788178089843, Pearson Education,
3. Parag H. Dave, Himanshu B. Dave, "Design and Analysis of Algorithms", 1st Edition, 2008, ISBN: 8177585959, Pearson Education.

4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to
5. Algorithms”, 3rd Edition, 2010, ISBN: 9788120340077, Prentice Hall of India.
6. Dieter Jungnickel,”Graph,Network and Algorithms”,2nd Edition, 2005, ISBN:3540219056, Springer. Alfred V. Aho, John E.Hopcroft,&Jeffrey D.Ullman, “The Design and Analysis of Computer Algorithms”, 4thEdition, 2009, ISBN: 9788131702055, Pearson Education.

Course Outcomes:

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Design and analyze divide-and-conquer based algorithms.
4. Devise and Synthesize greedy and dynamic-programming based algorithms.
5. Employ graphs to model problems solvable using traversal techniques.
6. Able to model problems using backtracking
7. Able to classify nondeterministic polynomial time algorithms.

Course Code: **CS-513** **Digital Image Processing** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

1. To learn the fundamental concepts of Digital Image Processing.
2. To study basic image processing operations.
3. To understand image analysis algorithms.
4. To expose students to current applications in the field of digital image processing.

Unit-I: Introduction and Image Processing [06L] Max Marks: 15

Fundamental steps in image processing, Human visual system, Sampling & quantization, Digital representing of images, Spatial & gray-level resolution, Image file formats, Basic relationships between pixels, Distance Measures, Basic operations on images-image addition, subtraction, logical operations, scaling, translation, rotation, Image Histogram, Color fundamentals & models.

Unit-II: Image Enhancement and Restoration [10L] Max Marks: 15

Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency domain, Holomorphic filtering, Restoration: Noise models, Restoration using Inverse filtering, Minimum Mean Square Error (Wiener) filtering

Unit-III: Image Segmentation and Morphological Operations [06L] Max Marks: 10

Image Segmentation: Point Detections, Line detection, Edge Detection: Prewitt and Sobel and Canny Thresholding – Global, Adaptive, Otsu's Method, Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.

Unit-IV: Feature extraction and Object Recognition [08L] Max Marks: 10

Feature extraction: Shape and size, texture: LBP, GLCM, color, Applications: Biometric Authentication, Character Recognition, Medical application of Image processing.

References:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition 2010, Pearson Education
2. Sandipan Dey , "Hands-on Image Processing with Python",Packt Publishing
3. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002
4. S Sridhar, "Digital Image Processing", Oxford University Press.
5. Alexander M., Abid K., "OpenCV-Python Tutorials", 2017

Course Outcomes:

1. Developed a theoretical foundation of digital image processing concepts
2. Exposed students to Python image processing library
3. Implemented image processing techniques for object recognition application

Course Code: **CS-514** **Lab on Network Programming** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

- To impart the students with hands of Experience on Socket programming

Laboratory Assignments:

1. Write an echo program with client and iterative server using TCP.
2. Write an echo program with client and iterative server using UDP.
3. Write an echo program with client and concurrent server using TCP.
4. Write an echo program with client and concurrent server using UDP.
5. Write a client and server program for chatting.
6. Write a program to retrieve date and time using TCP.
7. Write a program to retrieve date and time using UDP.
8. Write a client and server program to implement file transfer**.**

Course Outcomes:

After completion of this course students shall be able to:

1. Develop knowledge to implement client server applications.
2. Establish a Connection using TCP/IP Protocol.

C*ourse Code:* **CS-515** **Lab on Digital Image Processing** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

1. To learn and understand the digital image processing
2. To learn and understand various image transform used in digital image processing
3. To learn and understand various image enhancement technique used in digital image processing
4. To learn and understand various image restoration technique and methods used in digital image processing
5. To learn and understand various image compression and Segmentation used in digital image processing

Laboratory Assignments:

1. Write a Python script to perform basic operations on images.
2. Write a Python script to perform conversion between color spaces.
3. Write a Python script to perform histogram equalization.
4. Write a Python script to perform image filtering in spatial domain.
5. Write a Python script to perform image filtering in frequency domain.
6. Write a Python script to perform image restoration.
7. Write a Python script to perform edge detection using various operators.
8. Write a Python script to perform global, adaptive, Otsu's thresholding.
9. Write a Python script to apply morphological operations on an image.
10. Write a Python script to extract texture and color features of an image.
11. Write a Python code to perform character recognition

Course Outcomes:

1. Describe digital image representation, manipulation and Illustrate the use of histograms.
2. Applying various Geometric transformations on image and Illustrate Two- dimensional Fourier transform.
3. Use and Compare, various Linear filtering methods.
4. Applying various Ideal filters in the frequency domain and Understand the concept of edge detection.
5. Compose various Morphological operations on binary images and Generate their transformed images.

Course Code: **CSE-516(A)** **Ethical Hacking** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. Understand the concept of ethical hacking and its importance in securing information systems.
2. Identify and navigate the legal and ethical considerations associated with ethical hacking.
3. Differentiate between ethical hackers, hacktivists, and malicious hackers.
4. Understand common wireless security protocols.
5. Identify and exploit information disclosed during the enumeration phase.
6. Implement remediation strategies and effective patch management.

Unit-I: Introduction to Ethical Hacking **[12L] Max Marks: 20**

Definition and Scope , What is Ethical Hacking?, Importance and Scope of Ethical Hacking, Key Concepts: White Hat vs. Black Hat Hacking Legal and Ethical Considerations: Laws and Regulations, Code of Ethics for Ethical Hackers, Professional Standards and Responsibilities, Types of Hackers: Ethical Hackers , Hacktivists, Malicious Hackers.

Unit-II: Networking Fundamentals **[12L] Max Marks: 20**

OSI Model, TCP/IP Protocol Suite, Networking Devices (Routers, Switches, Firewalls), Network Security Concepts: Confidentiality, Integrity, Availability (CIA), Encryption and Decryption, Virtual Private Networks (VPNs) Wireless Network Security: WEP, WPA, WPA2, WPA3, Wireless Security Protocols, Securing Wireless Networks.

Unit-III: Information Gathering and Footprinting **[12L] Max Marks: 20**

What is footprinting? Purpose and objectives of foot printing, Footprinting and Reconnaissance, Passive vs. Active Reconnaissance, Information Gathering Techniques, Tools for Footprinting, Google Hacking, Google Dorks, Advanced Google Search Techniques, Using Google for Information Gathering.

Unit-IV: Introduction to Network Scanning **[12L] Max Marks: 20**

Definition and Purpose - Understanding Network Scanning in Ethical Hacking ,Importance of Network Scanning in Security Assessments, Types of Network Scans: Overview of Port Scanning ,Service Scanning and Version Detection, tools for network scanning:NMAP, WIRESHARK, Types of Scans and Techniques: Basic Scanning Techniques, service detection.

Unit-V: Role of Kali Linux in ethical hacking **[12L] Max Marks: 20**

Overview of Kali Linux, Overview of Kali Linux, Tools and Applications in kali, Tools and Applications, Command Line Interface (CLI) in Kali, Command Line Interface (CLI) in Kali, Essential Tools for Ethical Hacking, Securing Kali Linux, Basic Security Measures

References:

1. Manoj Sharma “Ethical hacking and Network analysis with wireshark”, BPB publication ISBN 978-93-55517-722.
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing”, SYNGRESS Publication. ISBN 978-0-12-411644-3
3. "Network Security Essentials" by William Stallings.
4. "Nmap Network Scanning" by Gordon Fyodor Lyon.
5. "Hacking: The Art of Exploitation" by Jon Erickson.

Course Outcomes:

1. Explain the legal and ethical considerations associated with ethical hacking.
2. Differentiate between types of hackers and their motivations.
3. Conduct effective information gathering and foot printing using various techniques and tools.
4. Employ Google hacking and advanced search techniques for reconnaissance.

Course Code: **CSE-516 (B)** **Internet of Things** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. To understand roles of sensors in IoT
2. To learn different protocols used for IoT design
3. To be familiar with data handling and analytics tools in IoT
4. Appreciate the role of big data, cloud computing and data analytics in a typical IoT system.
5. Understand the role of IoT in various domains of Industry.

Unit-I: Introduction to Internet of Things **[10L] Max Marks: 20**

Introduction to IoT- Defining IoT, Characteristics of IoT, Conceptual Framework of IoT, Physical Design of IoT ,Logical Design of IoT , Functional blocks of IoT, IoT Enabling Technologies, Convergence of IT and OT, IOT challenges. Introduction IoT and M2M, Difference between IoT and M2M

Unit-II: IoT Architecture **[08L] Max Marks: 16**

Introduction, State of the art, Reference Model and architecture, IoT reference Model, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Unit-III: IoT Enabling Technologies **[10L] Max Marks: 20**

Introduction, Sensors characteristics, Sensor Classification, Types of sensors,IoT Enabling Technologies — Wireless Sensor Networks , Cloud Computing ,Big Data Analytics, Communication Protocols,Embedded Systems 08

Unit-IV: IoT Protocols **[10L] Max Marks: 20**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFIDProtocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

Unit-V: Application of IoT **[08L] Max Marks: 14**

Home Automation, Smart Parking, Water Management, Agriculture, Citizen Safety, Waste Management, Intelligent Transport System, Smart Cities, Health and Lifestyle.

References

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

Course Outcomes:

On completion of the course, student will be able to

1. Understand the various concepts, terminologies and architecture of IoT systems.
2. Use sensors and actuators for design of IoT.
3. Understand and apply various protocols for design of IoT systems
4. Use various techniques of data storage and analytics in IoT
5. Understand various applications of IoT
6. Understand APIs to connect IoT related technologies

Course Code: **CSE-516 (C)** **Swayam/NPTEL Course** *Clock Hours:* ***60***
Total Marks: ***100***

Students can enroll for NPTEL course, complete its assignments and appear for certificate examination as and when conducted by NPTEL. The guidelines for this course will be provided by the faculty.

Course Code: **CS-517** **Research Project** *Clock Hours:* ***120***
Total Marks: ***100***

Course Objective:

A project is an in-depth study of an issue or topic in computational sciences, information technology or computing. It may be in the form of a small-scale research study, a case study, hardware/software implementation of research paper or innovative software solution.
In this course it is expected that the student will complete the topic selection, research gap finding, literature survey/review, study of methodologies/techniques to solve the problem.

Guidelines for the Research Project

1) Each student shall have to carry out the Research Project work. A project may be carried out in any outside organization or in the same college/institute or in the sub system of an organization.

2) The project work should be carried out individually. No group work is allowed in the Project work. The project title should not be repeated.

3) The topic of the project should be decided in consultation with the Internal Guide (teacher) of the institute/college. The project should be necessarily innovative and problem solving or implementation of method/s/techniques through the hardware/software of a latest research paper/s from a reputed (UGC Care) journal.

4) The student should clearly mention the need of project, database(s), files required for the project, software used for the project, reasons for selection of that software, inputs required, etc.

5) The student must write a draft 20-25 pages report based on the actual work undertaken to carry out the above steps in the Research Project and get it certified by the concerned teacher that the Project work has been satisfactorily initiated and it is ongoing. The student will submit the draft report in a Practical/Project file to the concern Head of the Department of the college.

Course Outcomes:

On completion of this course, students will have the knowledge, skills and understanding to enable them to:
- Apply critical thinking skills.
- Apply foundational research skills to address a research question.
- Demonstrate planning, time and change management skills.

Semester-IV

Course Code: **CS-521** **Advanced Operating System** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. To learn Advanced Operating Systems Concepts
2. To understand the programming interface to the Unix/Linux system
3. To provide an understanding of the system calls of Operating Systems
4. To teach the different memory management techniques.

Unit-I: Overview of UNIX Operating System **[10L] Max Marks: 20**

Architecture of UNIX/LINUX Operating System, Introduction to Kernel, Introduction to shell programming and UNIX commands.

Unit-II: File Subsystem **[20L] Max Marks: 30**

Nodes, structure of regular file, Conversion of a path name to an Inode, Super block, Inode assignment to a new file, System calls for File system: Algorithms for: Open – Read – Write – Adjusting the position of file I/O lseek –Close, File creation. Changing directory, root, owner, mode, stat and fstat, Pipes – Dup, Mounting and unmounting

Unit-III: Processes **[10L] Max Marks: 10**

Concept of a process: states, operations with examples from UNIX (fork, exec), Process scheduling, inter-process communication (shared memory and message passing), UNIX signals.

Unit-IV: Signal Handling **[10L] Max Marks: 20**

Introduction, Signal Concepts, Signal function, kill and raise functions, alarm and pause functions, abort function, sleep function

Unit-V: Memory Management **[10L] Max Marks: 20**

With and without swapping, paging and segmentation, demand paging, virtual memory, page replacement algorithms, working set model, implementations from operating systems such as UNIX.

References:

1. Maurice J. Bach, “The Design of the Unix Operating System”,ISBN : 9780132017992, Prentice Hall.
2. Abraham Silberschatz, Peter B. Galvin, Greg Gagne (2009), Operating System Concepts, 8th Ed., John Wiley, *ISBN* 0-471-69466-5.
3. AS Tanenbaum, AS Woodhull (2006), Operating Systems Design and Implementation, 3rd Ed., Prentice Hall, *ISBN*-10: 0131429388
4. Richard Stevens; Advanced Programming in the UNIX Environment; Addison-Wesley

Course Outcomes:

Upon completion of the subject, students will be able to:

1. Understand different types of operating systems.
2. Gain extensive knowledge on principles and modules of the operating systems.
3. Understand key mechanisms in the design of operating systems modules.
4. Understand process management, thread management, memory management, file management and deadlock handling.
5. Compare performance of different processor scheduling algorithms.
6. produce algorithmic solutions to process synchronization problems
7. Understand the issues related to protection and security.

Course Code: **CS-522** **Machine Learning with Python** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

The objectives of the course are:

1. Make use of Data sets in implementing the machine learning algorithms
2. Course gives fair idea about all important techniques of Machine Learning such as Classification, Regression and Clustering.
3. Implement various ML algorithms for Classification clustering, regression using a programming language of your choice preferably Python.
4. Implement the machine learning concepts and algorithms in any suitable language of choice.

Unit-I: Introduction to Machine Learning **[10L] Max Marks: 15**

Introduction to ML, Fundamentals of ML, Python Libraries suitable for ML: Numpy, Pandas, Scikit-learn, Matplotlib, openCV etc., Types of Learning, Hypothesis Space and Inductive bias, Applications of Machine Learning.

Unit-II: Supervised Learning in ML **[15L] Max Marks: 25**

Regression: Introduction, Types of regression (Linear, Lasso, Ridge, Non-Linear), Evaluating SL model for regression (MSE, RMSE, MAE, R2). Classification: Introduction, Types of Classification (Logistics regression, SVM with various kernels, Decision Tree, Random Forest, K-Nearest Neighbor), Training and Testing, Evaluating SL model for Classification (Accuracy, Precision, Recall, F1 Score, Confusion Matrix). Probability and Naïve Bayes classifier. Application of SL, Advantage of SL, Disadvantage of SL.

Unit-III: Unsupervised Learning in ML **[10L] Max Marks: 20**

Introduction to Unsupervised Learning, Clustering: - K-Means Clustering, Density-Based Clustering, Gaussian Mixture Model, FCM Clustering, Agglomerative clustering. Association Rule Learning (Apriori Algorithm), Application of UL, Advantage of UL, Disadvantage of UL.

Unit-IV: Reinforcement Learning in ML **[10L] Max Marks: 10**

Introduction to Reinforcement Learning, Types of Reinforcement, Elements of Reinforcement Learning, Applications of Reinforcement Learning

Unit-V: Neural Network **[15L] Max Marks: 20**

Introduction to Neural network, Perceptron, Multilayer Network, Back Propagation, Introduction to Deep Neural network: ANN, CNN, RNN, Application of Neural Network.

References:

1. Tom Mitchell(1997), Machine Learning, First EditionMcGraw-Hill.
2. Ethem Alpaydin (2009). Introduction to Machine Learning Edition 2. The MIT Press.
3. Dipanjan Sarkar, Raghav Bali, and Tushar Sharma, " Practical Machine Learning with Python" A Problem-Solver's Guide to Building Real-World Intelligent Systems, ISBN-13 (pbk): 978-1-4842-3206-4, Apress.

Course Outcomes:

After completion of this course students shall be able to-

1. Understand the implementation procedures for the machine learning algorithms.
2. Design Python programs for various Learning algorithms.
3. Apply appropriate data sets to the Machine Learning algorithms.
4. Identify and apply Machine Learning algorithms to solve real world problems.
5. Acquire in-depth knowledge of various facets of Machine Learning methods/techniques and algorithms.

Course Code: **CS-523** **Lab on Advanced Operating System** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

1. To learn Advanced Operating Systems Concepts
2. To understand the programming interface to the Unix/Linux system
3. To provide an understanding of the system calls of Operating Systems
4. To get knowledge of the design and implementation of Operating Systems.

Laboratory Assignments:

1. Use of Unix/Linux – User Commands
    a. Editors - Shell programming
    b. Factorial of given number
    c. Fibonacci Series
    d. Prime Number
    e. Palindrome or not

2. Write programs using the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir

3. Write programs using the I/O System calls of UNIX operating system (open, read, write, etc.).

4. Develop application using Inter-Process Communication (using shared memory, pipes or message queues).

5. Write a C program that catches the ctrl-c (SIGINT) signal for the first time and display the appropriate message and exits on pressing ctrl-c again.

6. Implement Memory management schemes like paging and segmentation.

Course Outcomes:

After completion of this course students shall be able to-

1. Exposure to different OS

2. Awareness of concepts of multiprogramming, multithreading and multitasking

3. Demonstration of memory management algorithms

4. Demonstration of file-handling concepts by implementing suitable algorithms.

5. Awareness of computational issues, resources in distributed environment.

Course Code: **CS-524** **Lab on Machine Learning with Python** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

1. To acquire programming skills in core Machine Learning in Python.
2. Make use of Data sets in implementing the machine learning algorithms
3. Implement various ML algorithms for Classification clustering, regression using a programming language of your choice preferably Python
4. Implement the machine learning concepts and algorithms in any suitable language of choice.

Laboratory Assignments:

1. Write a Program to Implement Linear Regression Algorithm.
2. Write a Program to Implement Non- Linear RegressionAlgorithm.
3. Write a program to implement Decision tree using Python.
4. Write a Program to Implement Random Forest Algorithm.
5. Write a program to implement k-Nearest Neighbor algorithm to classify the iris dataset. Print both correct and wrong predictions.
6. Implement simple KNN using Euclidean distance in python.
7. Implement the program of SVM.
8. Write a program to implement the naïve Bayesian classifierfor a sample training dataset stored as a .CSV file. Compute theaccuracy of the classifier.
9. Implementing Agglomerative Clustering in python.
10. Implementing K-Means Clustering in python
11. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

Course Outcomes:

1. Envisage practical application of Machine Learning to Business and Research Computational problems.
2. Apply appropriate data sets to the Machine Learning algorithms.
3. Identify and apply Machine Learning algorithms to solve real world problems.
4. Acquire in-depth knowledge of various facets of Machine Learning methods/techniques and algorithms.

Course Code: **CSE-525 (A)** **Network Security & Firewall** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. Understand Concept of Security needed in Communication of data through computers and networks along with Various Possible Attacks
2. Understand Various Encryption mechanisms for secure transmission of data and
3. Understand authentication requirements and study various authentication mechanisms.
4. Understand what a firewall does.

Unit-I: Introduction **[12L] Max Marks: 16**

Need for Security, Security Attacks, Services and Mechanisms, Network Security, Model

Unit-II: Symmetric Ciphers **[12L] Max Marks: 22**

Substitution &Transposition Techniques, Block Cipher, DES, Triple DES, Stream Ciphers, RC4

Unit-III: Public Key Cryptography **[12L] Max Marks: 22**

Need and Principles of Public Key Cryptosystems, RSA Algorithm, Key Distribution and Management, Diffie-Hellman Key Exchange, Digital Signatures

Unit-IV: Authentication **[12L] Max Marks: 20**

Authentication Requirements, Message Authentication Codes, Hashes, MD5 & SHA, User Authentication: Password, Certificate based & Biometric Authentication, Kerberos

Unit-V: Firewall **[12L] Max Marks: 20**

Introduction, Key Components of firewall, Types of Firewall, Key Benefits of firewall, VPN, IP Security, Transport Layer Security (TLS)

References:

1. Author(s): Matthew Strebe, "Network Security Foundations", ISBN: 9780782143744,0782143741
2. Author(s): Chris Hare, Karanjit Siyan, "Internet Firewalls and Network Security ",Second Ediotion, ISBN: 9781562056322,1-56205-632-8
3. Author(s): William R. Cheswick, Steven M. Bellovin, Aviel D. Rubin ," Firewalls and Internet Security: Repelling the Wily Hacker", ISBN: 780201634662,020163466X

4. https://nptel.ac.in/cours es/106105031/ “Cryptography and Network Security by Debdeep Mukhopadhyay, IIT Kharagpur”
5. https://www.edx.org /course/networksecurity-2 “An eDx Course on Network Security”

Course Outcomes:

1. Develop Concept of Security needed in Communication of data through computers and networks along with Various Possible Attacks
2. Understand Various Encryption mechanisms for secure transmission of data and management of key required for required for encryption
3. Understand authentication requirements and study various authentication mechanisms
4. Understand network security concepts and study different Web security mechanisms

Course Code: **CSE-525 (B)** **Natural Language Processing** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. The main goal of this course is to familiarize students with the topic of language computing and the various applications it has in both classical and modern settings.
2. Understanding of numerous NLP tasks and NLP abstractions, such as morphological analysis, POS tagging, syntactic parsing idea, and semantic analysis, is another goal of the course.
3. The course teaches several methods and techniques for completing NLP assignments.
4. The course also covers the ideas of computational linguistics' modeling of language grammar.

Unit-I: Introduction **[08L] Max Marks: 12**

Introduction to NLP, brief history, NLP applications: Speech to Text(STT), Text to Speech(TTS), Story Understanding, NL Generation, QA system, Machine Translation, Text Summarization, Text classification, Sentiment Analysis, Grammar/Spell Checkers etc., challenges/Open Problems, NLP abstraction levels, NL tasks: Segmentation, Chunking, tagging, NER, Web 2.0 Applications : Sentiment Analysis; Text Entailment; Cross Lingual Information Retrieval (CLIR).

Unit-II: Text Processing Challenges **[12L] Max Marks: 16**

Text Processing Challenges, Overview of Language Scripts and their representation on Machines using Character Sets, Language, Corpus and Application Dependence issues, Segmentation: word level (Tokenization), Sentence level. Regular Expression and Automata Morphology, Types, Survey of English and Indian Languages Morphology, Morphological parsing FSA and FST, Porter stemmer, Rule based, and Paradigm based Morphology, Human Morphological Processing

Unit-III: Word Classes and Part-of-Speech tagging (POS) **[12L] Max Marks: 18**

Word Classes and Part-of-Speech tagging (POS), survey of POS tagsets, Rule based approaches (ENGTOWL), stochastic approaches (Probabilistic, N-gram and HMM), TBL morphology, unknown word handling, Maximum Entropy and Conditional Random Field, evaluation metrics: Precision/Recall/F-measure, error analysis.

Unit-IV: Overview of Parsing and Grammar Formalisms **[15L] Max Marks: 22**

Overview of parsing and Grammar Formalisms: Constituency and dependency parsing, Grammar notations CFG, LFG, PCFG, LTAG, Feature-Unification, overview of English CFG,

Indian Language Parsing in Paninian Karaka Theory, CFG parsing using Earley's and CYK algorithms, Probabilistic parsing

Unit-V: Theories and approaches for Semantic Analysis [15L] Max Marks: 22

Theories and approaches for Semantic Analysis, Meaning Representation, word similarity, Lexical Semantics, word senses and relationships, WordNet (English and IndoWordnet), Word Sense Disambiguation: Lesk Algorithm, Walker's algorithm, Coreferences Resolution: Anaphora, Cataphora.

References:

1. Indurkhya, N., & Damerau, F. J. (Eds.). (2010). Handbook of Natural Language Processing, 2nd Edition. New York: CRC Press Taylor and Francis Group, Boca Raton London, New York. ISBN-10: 1420085921, ISBN-13: 978-1420085921
2. 2. Martin, J. H., & Jurafsky, D.(2013), Speech and Language Processing, Pearson Education India; 2 edition, ISBN-10: 9332518416, ISBN-13: 978-9332518414
3. Manning, Christopher and Heinrich, Schutze(1999), Foundations of Statistical Natural Language Processing", MIT Press, ISBN-10: 0262133601, ISBN-13: 978-0262133609.
4. Akshar Bharati, Chaitanya, V., Kulkarni, A., & Sangal, R. (July 1997). Machine translation in Stages (Vol. 10 no. 3). Mumbai: NCST, Mumbai.
5. Bharati, A., Chaitanya, V., & Sangal, R. (1995). Natural Language Processing: A Paninian Perspective, New Delhi: Prentice Hall of India, ISBN 10: 8120309219, ISBN 13: 9788120309210.
6. Steven Bird, Edward Loper (2016),Natural Language Processing With Python, Ed. 2, O'Reilly Media,ISBN 1491913428, 9781491913420

Auxiliary Resources:

a. Web Links

1. https://see.stanford.edu/Course/CS224N
2. https://web.stanford.edu/~jurafsky/NLPCourseraSlides.html

b. Video Links

1. http://www.nptelvideos.in/2012/11/natural-language-processing.html
2. https://www.youtube.com/playlist?list=PL6397E4B26D00A269

Course Outcomes:

On successful completion of course learner should:

1. Have a broad understanding of the field of natural language processing.
2. Have a sense of the capabilities and limitations of current natural language technologies,
3. Be able to model linguistic phenomena with formal grammars.

4. Be able to Design, implement and test algorithms for NLP problems
5. Understand the mathematical and linguistic foundations underlying approaches to the various areas in NLP
6. Be able to apply NLP techniques to design real world NLP applications such as machine translation, text categorization, text summarization, information extraction etc.

Course Code: **CSE-525 (C)** **Swayam/NPTEL Course** *Clock Hours:* ***60***

Students can enroll for NPTEL course, complete its assignments and appear for certificate examination as and when conducted by NPTEL. The guidelines for this course will be provided by the faculty.

Course Code: **CS-526** **Research Project** *Clock Hours:* ***180***
Total Marks: ***150***

Course Objective:

A project is an in-depth study of an issue or topic in computational sciences, information technology or computing. It may be in the form of a small-scale research study, a case study, hardware/software implementation of research paper or innovative software solution.

In this course it is expected that the student will complete the Research Project initiated in the previous semester (CS-517) by identifying the suitable methodologies/techniques, Analyze data and synthesize research findings, to solve the problem. The student will report research findings in written and verbal forms.

Guidelines for the Research Project

1) The students should continue the work initiated in the previous semester (CS-517) by identifying the suitable methodologies/techniques, Analyze data and synthesize research findings, to solve the problem.

2) The student should clearly mention the need of project, database(s), files required for the project, software used for the project, reasons for selection of that software, inputs required, outputs produced etc.

3) The student has to prepare a report based on the actual work undertaken at the specific selected enterprise/ organization or sub system and get it certified by the concerned teacher that the Project report has been satisfactorily completed and submit TWO typed copies (with Spiral Binding) of the same to the Head / Director of the institute /Principal of the college.

4) One copy of the report submitted by the student shall be maintained/kept with respective recognized Research Laboratory of the College/ Institute.

5) No student will be permitted to appear for Viva-Voce examinations, unless and until the project report is submitted within the stipulated time.

Presentation of your project report

Template:

The contents of the Dissertation shall be arranged in the following order:

- Cover Page
- Inside Title Page
- Certificate signed by the Supervisor and HOD
- Declaration signed by the Candidate
- Acknowledgements
- Abstract
- Table of Contents
- List of Figures
- List of Tables
- Abbreviations/ Notations/ Nomenclature (if any)
- Text of the Report

- Chapter 1: Introduction
- Chapter 2: Literature Review
- Chapter 3: Methodology

- Chapter 4: Results and Discussions
- Chapter 5: Conclusion and Recommendations

- References
- Appendices
- Non-paper materials (if any)

Course Outcomes:

On completion of this course, students will have the knowledge, skills and understanding to enable them to:

- Apply critical thinking skills.
- Apply foundational research skills to address a research question.
- Demonstrate planning, time and change management skills.
- Analyze data and synthesize research findings.
- Report research findings in written and verbal forms.
- Use research findings to advance education theory and practice.
- Undertake research independently.

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