Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

CIRCULAR NO.SU/Sci./College/NEP/39/2023

It is hereby inform to all concerned that, the syllabus prepared by the Ad-hoc Board in Networking & Multimedia and recommended by the Dean, Faculty of Science & Technology the **Academic Council at its meeting held on 30 September 2023 has accepted the Syllabus of M.Sc. Networking & Multimedia Ist to IVth semester as per Norms of National Education Policy – 2020 under the Faculty of Science & Technology run to the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University** as appended herewith.

This shall be effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO. SU/SCI/2023/14734-42
Date:- 05.10.2023

Deputy Registrar,
Academic Section.

Copy forwarded with compliments to :-

1] **The Principal of all concerned affiliated Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation,Dr.BAMU,A'bad.
2] The Section Officer,[M.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
6] The Public Relation Officer, Dr.BAMU,A'bad.
7] The Record Keeper, Dr.BAMU,A'bad.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

NAAC Reaccredited A Grade

FACULTY OF SCIENCE & TECHNOLOGY

2 Years / 1 Year M.Sc. Networking and Multimedia

Course Structure

For University Affiliated Colleges

(Effective from 2023-24)

COURSE STRUCTURE AS PER GUIDELINES OF NEP 2020

Illustrative Credit distribution structure for two/ one year **M.Sc. Networking and Multimedia** Programme with Multiple Entry and Exit options for Discipline Specific Course in Computer Science

A) Eligibility for the course:

i) B.Sc. Computer Science (**OR**) B.Sc. Information Technology (**OR**) B. Sc. Computer Application (Science & Technology) (**OR**) B.E/B. Tech. in Computer Science and Engineering/IT. (**OR**) B.Voc in Networking (**OR**) B.Voc in Multimedia (**OR**) ii) Any Science Graduate with at least one Optional Subject as Computer Science.

B) Credits and Degrees:

i) A candidate who has successfully completed all the core courses, Elective / Specialized courses and, seminars and project prescribed and or optional service courses approved by the University for the program with prescribed CGPA shall be eligible to receive the degree.

ii) One Credit shall mean one teaching period of one hour per week for one semester (of 15 weeks) for theory courses and two practical / laboratory / field / demonstration hours / week for one semester.

iii) Every student will have to complete at least 88 credits to obtain the master's degree of M. Sc. Networking and Multimedia (Post graduate degree)

C) Courses Inclusions:

(i) **Core Course / Mandatory Courses / Discipline Specific Core Courses (DSC):** A core course is a course that a student admitted to M. Sc. Networking and Multimedia program must successfully complete to receive the degree. Normally no theory course shall have more than 4 credits.

(ii) **Discipline Specific Elective Course (DSE):** Means Elective course from the basic subject or specialization. The elective course defined for 4 credits and dedicated for choice of specialization that student want to perceive. The horizontal learning path is to be followed by the student for selection of elective course..

(iii) **Skill Courses (SC):** The service courses will be offered as per the structure of the NEP. This course will be conducted to impart special technology skills to the students. This course is defined for 2 Credits and completely engaged in practical form.

(iv) **On Job Training (OJT)**: The student is required to complete 30 hours on job training in the summer of semester 2 examination.

(iv) Each Course shall include lectures / tutorials / laboratory or field work / Seminar / Practical training / Assignments / midterm and term end examinations/ paper / Report writing or review of literature and any other innovative practice etc., to meet effective teaching and learning needs.

Provision of ONLINE Courses and Credit Transfer

The student(s) is encouraged to undertake equivalence courses from SWAYAM / NPTEL / MICROSOFT PRIME or any other platform. Upon successful completion of such approved course, in order to get the credit transfer to the academic bank of credit as well as exception of equivalent credit course from the list of

academic courses offered by the student, student is required to submit the course completion certificate to the university through college.

D) Multiple entry / Multiple Exits

The course is allowing students for multiple exits as per the guidelines of NEP 2020 and as per the provisions made by the University for the Award of degree. However, these guidelines are updated time to time and the governance related to entry and exit procedure are as per the standard operating procedures of defined by the university.

PROGRAM OBJECTIVES (PO) for M.Sc. Networking and Multimedia

Program objectives for M.Sc. (Master of Science) in Networking and Multimedia course typically aim to provide students with a comprehensive understanding of computer science concepts and practical skills. Following are some broad program objectives earmarked by the department:

1. To equip students with an in-depth understanding of advanced topics in Networking and Multimedia.

2. To foster the ability to critically analyse complex problems in computer networking or a related computing field.

3. To develop strong programming skill to develop solutions for networking problems

4. To enhance logical thinking skills and perception power for development of multimedia related real time problems.

5. To cultivate a sense of ethical responsibility and professionalism among students, emphasizing the importance of adhering to legal and ethical standards in Networking and Multimedia.

6. To teach students how to critically evaluate existing research, publications, and technological advancements.

PROGRAM SPECIFIC OBJECTIVES (PSO) for M.Sc. Networking and Multimedia

Program Specific Objectives (PSOs) are more focused and concrete statements that describe the specific outcomes expected from a Master of Science (M.Sc.) in Networking and Multimedia program. These objectives should align with the broader program objectives mentioned earlier.

PSO1: Generate solutions by understanding underlying computer netwrok environment

PSO2: Communicate computer Networking and multimedia concepts, designs, and solutions effectively and professionally

PSO3: Apply knowledge of computing to produce effective designs and solutions for specific problems

PSO4: Use software development tools, software systems, and modern computing platforms

PSO5: Students will understand the ethical and legal implications of computer science applications and adhere to professional standards in their roles as computer network experts or multimedia professionals.

SEMESTER WISE PROGRAM STRUCTURE

Semester I

Course Type	Course Code	Course Name	Teaching Hrs		Credits Assigned		Total Credits
			TH	PR	TH	PR	
Discipline Specific Courses (Major Mandatory) - DSC	CNM/MJT/500	Data Structure and algorithm	02	-	02	-	14
	CNM/MJT/501	2D Animation	02	-	02	-	
	CNM/MJT/502	Foundation in computer Network	02	-	02	-	
	CNM/MJP/500	Practical Based on Data structure and algorithm	-	04	-	02	
	CNM/MJP/501	Practical Based on 2D Animation	-	04	-	02	
	CNM/MJP/502	Practical Based on Foundation in computer Network	-	04	-	02	
Skill / Advance Course	CNM/MJP/503 -507	Programming-1*	00	04	-	02	
Discipline Specific Electives - DSE	CNM/DSET/520 – 524	Elective-1#	02	-	02	-	02
	CNM/DSEP/520 – 524	Elective-1#	-	04	-	02	02
Research Methodology	CNM/RMT/530	Research Methodology	04	-	04	-	04
		Total	**12**	**20**	**12**	**10**	**22**

Note: *,#Student is advised to select the any one course from the pool of courses, however horizontal selection of courses to be followed at the time of selection of the course.MJT means mandatory theory, MJP means mandatory Practical, DSET **Discipline Specific Electives Theory and** DSEP **Discipline Specific Electives Practical**

Semester II

Course Type	Course Code	Course Name	Teaching Hrs.		Credits Assigned		Total Credits
			TH	PR	TH	PR	
Discipline Specific Courses (Major Mandatory) - DSC	CNM/MJT/550	Multimedia Systems	02	-	02	-	14
	CNM/MJT/551	3D Animation	02	-	02	-	
	CNM/MJT/552	Network Routing and Protocols	02	-	02	-	
	CNM/MJP/550	Practical Based on Multimedia Systems	-	04	-	02	
	CNM/MJP/551	Practical Based on 3D Animation	-	04	-	02	
	CNM/MJP/552	Practical Based on Network Routing and Protocol	-	04	-	02	
Skill / Advance Course	CNM/MJP/553 – 557	Programming-2*	00	04	-	02	
Discipline Specific Electives - DSE	CNM/DSET/570 - 574	Elective-2#	02	-	02	-	02
	CNM/DSEP/570 - 574	Elective-2#	-	04	-	02	02
On-Job Training	CNM/OJT/590	On-Job Training / Field Project	-	08	-	04	04
		Total	**08**	**28**	**08**	**14**	**22**

Note: *,#Student is advised to select the any one course from the pool of courses, however horizontal selection of courses to be followed at the time of selection of the course.MJT means mandatory theory, MJP means mandatory Practical, DSET **Discipline Specific Electives Theory and** DSEP **Discipline Specific Electives Practical**

Semester III

Course Type	Course Code	Course Name	Teaching Hrs.		Credits Assigned		Total Credits
			TH	PR	TH	PR	
Discipline Specific Courses (Major Mandatory) - DSC	CNM/MJT/600	Foundation of Machine Learning	02	-	02	-	14
	CNM/MJT/601	3D Motion Graphics	02	-	02	-	
	CNM/MJT/602	Wireless ad hoc network	02	-	02	-	
	CNM/MJP/600	Practical Based on Foundation of Machine Learning	-	04	-	02	
	CNM/MJP/601	Practical Based on 3D Motion Graphics	-	04	-	02	
	CNM/MJP/602	Practical Based on Wireless ad hoc network	-	04	-	02	
Skill / Advance Course	CNM/MJP/603-607	Programming-3*	00	04	-	02	
PDiscipline Specific Electives - DSE	CNM/DSET/620 – 624	Elective-1#	02	-	02	-	04
	CNM/DSEP/620 – 624	Elective-1#	-	04	-	02	
Research Project	CNM/RP/649	Research Project -1	00	08	04		04
		Total	**08**	**28**	**12**	**10**	**22**

Note: *,#Student is advised to select the any one course from the pool of courses, however horizontal selection of courses to be followed at the time of selection of the course.MJT means mandatory theory, MJP means mandatory Practical, DSET **Discipline Specific Electives Theory and** DSEP **Discipline Specific Electives Practical**

Semester IV

Course Type	Course Code	Course Name	Teaching Hrs		Credits Assigned		Total Credits
			TH	PR	TH	PR	
Discipline Specific Courses (Major Mandatory) - DSC	CNM/MJT/650	Artificial Intelligence	02	-	02	-	12
	CNM/MJT/651	Data Analytics	02	-	02	-	
	CNM/MJT/652	IoT and Cloud : Concept, Case Study and Application	02	-	02	-	
	CNM/MJP/650	Practical Based on Artificial Intelligence	-	04	-	02	
	CNM/MJP/651	Practical Based on Data Analytics	-	04	-	02	
	CNM/MJP/652	Practical Based on IoT and Cloud : Concept, Case Study and Application	-	04	-	02	
Discipline Specific Electives - DSE	CNM/DSET/670 – 674	Elective-2#	02	-	02	-	04
	CNM/DSEP/670 – 674	Elective-2#	-	04	-	02	-
Research Project	CNM/RP/699	Research Project -2	00	12	-	06	06
		Total	**08**	**28**	**08**	**14**	**22**

Note: *,#Student is advised to select the any one course from the pool of courses, however horizontal selection of courses to be followed at the time of selection of the course.MJT means mandatory theory, MJP means mandatory Practical, DSET **Discipline Specific Electives Theory and** DSEP **Discipline Specific Electives Practical**

Skill / Advance Course (Programming Elective Group Basket)

Programming Group	Programming – 1 CNM/MJP/503-507	Programming-2 CNM/MJP/553-557	Programming -3 CNM/MJP/603-607
Java Group	Core Java	Advance Java	Android
Open Group	Python	Advanced Python	Open Web Programming (PHP)

Note: *,#Student is advised to select the any one course from the pool of courses, however horizontal selection of courses to be followed at the time of selection of the course.MJT means mandatory theory, MJP means mandatory Practical, DSET **Discipline Specific Electives Theory and** DSEP **Discipline Specific Electives Practical**

Discipline Specific Electives - DSE (Elective Group Basket)

ElectiveGroup	Elective1 CNM/DSET/520-524 & CNM/DSEP/520-524	Elective2 CNM/DSET/570-574 & CNM/DSEP/570-574	Elective3 CNM/DSET/620-624 & CNM/DSEP/620-624	Elective4 CNM/DSET/670-674 & CNM/DSEP/670-674
Track-I	Computer Graphics	Digital Image Processing	Augmented Reality and Virtual Reality	Video Processing
Track-II	Foundation of Remote Sensing	Geographical Information System	Spatial & Temporal Computing	Hyper Spectral Image Processing
Track-III	Cryptography	Cyber Security	Multimedia Security	Cloud Security

Semester I

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJT/500	Data Structure and algorithm	2	**2hrs/per week**
CNM/MJP/500	Practical Based on Data Structure and algorithm	2	**4hrs/per week**

Course Description:

This course is designed to provide students with a comprehensive introduction to algorithms, their analysis, and their practical implementation. Students will gain a solid understanding of fundamental algorithmic concepts and techniques, and how they apply to various problem domains. The course will cover both theoretical aspects of algorithm design and practical applications through case studies. Students will also be introduced to relevant reference books and resources for further study.

Prerequisites:

- Basic programming skills in a high-level language (e.g., Python, Java, C++)
- Understanding of fundamental data structures (e.g., arrays, linked lists, stacks, queues)

Course Objectives (CO):

- Understand fundamental concepts and terminologies related to algorithm design and analysis.
- Analyse the efficiency of algorithms and make informed choices based on their performance characteristics.
- Apply various algorithmic techniques to solve a wide range of problems.
- Gain hands-on experience in implementing and evaluating algorithms using programming languages.
- Recognize the relevance of algorithms in real-world applications through case studies.
- Develop critical thinking and problem-solving skills required for algorithm design and analysis.

Learning Outcomes (LO):

Upon successful completion of the course, students will be able to:

- Design and implement efficient algorithms to solve computational problems.
- Evaluate the time and space complexity of algorithms using mathematical analysis and empirical studies.
- Select appropriate data structures for specific problem domains.
- Apply algorithmic techniques, such as greedy algorithms and dynamic programming, to tackle complex problems.
- Analyze and compare different algorithms to make informed decisions based on their efficiency and effectiveness.
- Apply algorithms in practical scenarios and understand their impact on various fields of study.

Course Outline:

Unit 1:LINEAR DATA STRUCTURES AND ALGORITHM ANALYSIS

Review of Arrays-Stacks-Queues-linked lists-Linked stacks and Linked queues-Applications- Efficiency ofalgorithms-Asymptotic Notations- Time complexity of an algorithm using O notation- Average- Best- andWorst Case Complexities- Analyzing Recursive Programs.

Unit 2:NON LINEAR DATA STRUCTURES AND HASH TABLE

Introduction- Definition and Basic terminologies of trees and binary trees-Representation of trees and Binarytrees- Binary tree Traversals- Threaded binary trees- Graphs- basic concepts -- representation and traversals.Introduction- Binary Search Trees: Definition- Operations and applications. AVL Trees: Definition- Operationsand applications. B Trees: Definition-Operations and applications. Red – Black Trees- Splay Trees and itsapplications. Hash Tables: Introduction- Hash Tables- Hash Functions and its applications.

Unit 3: DIVIDE & CONQUER METHOD , GREEDY METHOD AND DYNAMIC PROGRAMMING

Divide and Conquer Method: General Method – binary search – finding maximum and minimum – merge sortand quick sort – Stassen's Matrix multiplication. Greedy Method: General method – knapsack problem – minimum cost spanning tree algorithms – single source shortest path algorithm – scheduling, optimal storageon tapes, optimal merge patterns.

Reference Books:

1. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
2. "Algorithms" by Robert Sedgewick and Kevin Wayne.
3. "The Algorithm Design Manual" by Steven S. Skiena.
4. "Algorithm Design: Foundations, Analysis, and Internet Examples" by Michael T. Goodrich and Roberto Tamassia.
5. "Algorithms Unlocked" by Thomas H. Cormen.

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJT/501	2D Animation	2	**2hrs/per week**
CNM/MJP/501	Practical Based on 2D Animation	2	**4hrs/per week**

Course Description:

This course is designed to instill an understanding of animation principles and produce quality 2D Digital animations implementing these principles and exploring various technique. They will learn the production process of animation including writing a treatment, storyboarding, timing through animatics and final rendered animations.

Prerequisites:

- Basic programming skills in a high-level language (e.g., Python, Java, C++)

Course Objectives (CO):

- Trace the origins and early history of the art of animation
- Explore how the eye and brain process moving images
- Compare the difference between past animation techniques and current animation
- Technologies
- Understand the dierences between various types of animation

Learning Outcomes (LO):

- Identify and apply the 12 Animation Principles
- Have an understanding of timing and motion through key-frames, holds and in-betweens
- Demonstrate skills in the use of industry standard tools.

Course Outline:

Unit 1: Principle of Animation- I

Apply process of animation, creation from script to story board through layout and key posing to in between, clean-up,lip syncing, and editing. Understand animate user interface and use of basic tools overview.

Unit 2: Character and Background Development

The Relationship between shape and character design.focus on building our design from simple shapes. How shape affect our design, use of pen tool and other basic shape in animate to design character for animate purpose.

Unit 3:Digital Animation

Create a new composition ,then create element and basic text. Import bit map and vector images ,edit the properties of an element, add key frames to a composition to animate an element, adding and animating element effects, such as drop shadows, using the pin tool to create animation.

Recommended Reference Book

- Adob Animate Classroom in a book(2021 release) By Russell chum
- Adob Animate 20222 for Creative Professionals : Implement Professional Techniques And Create Vivid Animated And Interactive Content With Animate ,Book by Joseph Labrecque

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJT/502	Foundation in computer Network	2	**2hrs/per week**
CNM/MJP/502	Practical Based on Foundation in computer Network	2	**4hrs/per week**

Course Description:

An introduction to the design and analysis of computer communication networks. Topics include layered network architectures, addressing, naming, forwarding, routing, communication reliability, the client-server model, web and email protocols.

Prerequisites:

Have knowledge of computer organization and basics of operating system.

Course Objectives (CO):

- Become familiar with layered communication architectures (OSI and TCP/IP).
- Understand the client/server model and key application layer protocols.
- Learn sockets programming and how to implement client/server programs.
- Understand the concepts of reliable data transfer and how TCP implements these concepts.
- Know the principles of congestion control and trade-offs in fairness and efficiency.
-

Learning Outcomes (LO):

By the end of this course, students will be able to:

- Describe the general principles of data communication.
- Describe how computer networks are organized with the concept of layered approach.
- Describe how signals are used to transfer data between nodes.
- Implement a simple LAN with hubs, bridges and switches.
- Students acquire practical experience by programming of real Internet protocol .

Course Outline:

Unit 1: Fundamentals on Graph Theory, Network flow problems,Network representations, Complexity Analysis, Developing Polynomial time algorithms, Search Algorithms, FlowDecomposition algorithms.

Shortest Paths: Label Setting Algorithms – Dijkstra's Algorithm, Dial's implementation, Heap Implementation, Radix Heap Implementation

Unit 2: Shortest Paths : Label Correcting Algorithms – Generic Label Correcting algorithms, Special implementations of the modified label correcting algorithm- detecting negative cycles, All pairs shortest path problem .

Maximum Flows : Generic Augmenting path algorithm, Labeling algorithm and MaxFlow Min – cut theorem Capacity Scaling Algorithm, Distance labels and layered networks, Generic pre flow push algorithm, FIFO pre flow push algorithm

Unit 3:

Minimum Cost flows : Optimality conditions, Cycle cancelingalgorithm and the integrity property, Successive shortest path algorithm, Primal – dual algorithm, Out – of Kilter Algorithm, Capacity scaling algorithm, Cost scaling algorithm

Minimum Spanning Trees – Kruskal's algorithm, Prim's Algorithm ,Sollin's Algorithm, Convex Cost Flows – Pseudo Polynomial time algorithm, polynomial time algorithm Generalized Flows – Augmented forest structures determining potentials and flows for an augmented forest structure, generalized network simplex algorithm

Recommended Reference Books:

1. Ravindra K. Ahuja, Thomas L. Magnanti, James B.Orlin, Network Flows – "Theory, Algorithms and Applications", Prentice Hall
2. Mokhtar S. Bazaraa, John J. Jarvis, Hanif D. Sherali, "Linear Programming And Network Flows", John Wiley & Sons, 4th Edition,
3. Gunther Ruhe, Kluwer, "Algorithmic Aspects Of Flows In Networks", Academic Publishers Group
4. Michael W. Lucas, "Network Flow Analysis", , No Starch Press
5. Alexander Engau, Vdm Verlag Dr. Muller, "Semi-Simultaneous Flows In Multiple Networks", Aktiengesellschaft & Co. Kg
6. Wai-kai Che, John Wiley, "Theory Of Nets: Flows In Network"s,
7. Ulrich Derigs, "Programming In Networks And Graphs: On The Combinatorial Background And Near Equivalence Of Network Flow And Matching Algorithms",
8. Ford L. R. Jr. , Robert G. Bland, Fulkerson D. R, "Flows In Networks", Princeton University Press.
9. Alexander Hall, Vdm Verlag Dr. Mueller E. K, "Scheduling And Flow Related Problems In Networks"
10. Pioro M, Routing, "Flow And Capacity Design In Communication And Computer Networks", Elsevier India Private Limited

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/RMT/530	**Research Methodology**	4	**4hrs/per week**

Course Description:

This course is designed to provide students with a comprehensive understanding of computational and statistical methods used in research methodology. Students will learn various techniques and tools to analyse, interpret, and present research data in computer science. The course will also include case studies to illustrate the application of these methods in real-world scenarios. Students will gain practical skills in designing experiments, collecting and analysing data, and drawing meaningful conclusions. Reference books will be provided to supplement the course materials and enhance the students' knowledge.

Prerequisites:

- Basic understanding of computer science concepts
- Familiarity with programming languages (e.g., Python, R, or MATLAB)
- Knowledge of introductory statistics

Course Objectives (CO):

- To introduce students to the fundamental principles of research methodology in computer science.
- To provide students with a comprehensive understanding of computational and statistical methods used in computer science research.
- To equip students with the skills to collect, pre-process, analyse, and interpret data for research purposes.
- To enable students to apply appropriate statistical techniques for hypothesis testing and inference.
- To familiarize students with machine learning algorithms and their applications in computer science research.
- To develop students' ability to design and analyse experiments in the context of computer science research.
- To enhance students' critical thinking and problem-solving skills through case studies and practical assignments.

Learning Outcomes (LO):

By the end of the course, students will be able to:

- Formulate research questions and select appropriate research methodologies.
- Collect, pre-process, and analyse data using computational and statistical techniques.
- Apply hypothesis testing and statistical inference to draw meaningful conclusions from data.
- Build and evaluate regression and machine learning models for predictive analysis.
- Design and analyse controlled experiments to investigate research hypotheses.
- Demonstrate an understanding of real-world applications of computational and statistical methods in computer science research.
- Critically evaluate research studies and identify strengths and limitations in their methodology.

Course Outline:

Unit 1: Introduction to Research Methodology - Overview of research methodology in computer science, Research design and problem formulation, Literature review and identifying research gaps, Ethical considerations in research

Unit 2: Data Collection and Pre-processing - Data collection techniques: surveys, interviews, observations, etc. Data pre-processing and cleaning, Handling missing data and outliers, Exploratory data analysis, Case study: Visualizing and summarizing real-world datasets

Unit 3: Statistical Analysis - Descriptive statistics: measures of central tendency, dispersion, etc., Hypothesis testing and statistical significance, Parametric and non-parametric tests, Analysis of variance (ANOVA) and regression analysis, Case study: Applying statistical inference techniques to analyse experimental data

Unit 4: Computational Analysis - Introduction to machine learning algorithms, Supervised and unsupervised learning techniques, feature selection and dimensionality reduction, Evaluation metrics for Computational Methods and Techniques, Case study: Building a computational model for classification or clustering

Unit 5: Presenting Research Findings - Effective data visualization techniques, Scientific writing and report preparation, Presenting research findings in conferences and journals, Peer review process and publication ethics.

Assessment Methods:

- Assignments and quizzes to assess understanding of concepts and techniques
- Course project report and presentation evaluation
- Participation in class discussions and group activities

Recommended Reference Books:

1. "Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar
2. "Designing and Conducting Mixed Methods Research" by John W. Creswell and Vicki L. Plano Clark
3. "Statistical Methods for Computer Science" by Walter D. Wallis
4. "Pattern Recognition and Machine Learning" by Christopher M. Bishop
5. "Data Science for Business" by Foster Provost and Tom Fawcett
6. "The Elements of Statistical Learning: Data Mining, Inference, and Prediction" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman
7. "Visualization Analysis and Design" by Tamara Munzner

Semester – II

CourseType(**Mandatory**)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/MJT/550	**Multimedia System**	2	**2hrs/per week**
CNM/MJP/550	Practical Based on **Multimedia System**	2	**4hrs/per week**

Course Description:

Multimedia data has become an indispensable part of our daily life and modern research projects. It's also one of the critical links in the ongoing unification of computing and communications. In this course, students will be introduced to principles and current technologies of multimedia systems, multimedia standards, and gain hands-on experience in this area. Issues in effectively representing, processing, and retrieving multimedia data such as sound and music, graphics, image and video will be addressed.

Prerequisites:

No prerequisite required.

Course Objectives (CO):

- To learn the basics and Fundamentals of Multimedia.
- To introduce Multimedia components and Tools.
- To understand how Multimedia can be incorporated

Learning Outcomes (LO):

At the end of this course, the students will be able to,

- Define what Multimedia is and how that works.
- Understand multimedia components using various tools and techniques.
- Analyze and interpret Multimedia data.
- Discuss about different types of media format and their properties.
- Justify the right way of manipulating multimedia systems.

Course Outline:

Unit1:

Multi Media Fundamentals: Multimedia, Multimedia Objects, Multimedia in business andwork, Multimedia hardware, Memory & Storage devices, Communication devices. MultimediaTools: Presentation tools, object generation which includes video sound; image capturing,Authoring tools , card and page based authoring tools.

Unit2:

Sound/Audio Perception of sound, hearing sensitivity, frequency range, sound- wavelength, the speed of sound. Measuring the sound, musical sounds, noise signal, dynamic range,pitch, harmonics-equalization-reverberation time, Sound isolation and room acoustics-treatments-studio layout–room dimensions. The Basic set-up of recording systems ; theproduction chain and responsibilities. Microphones types-phantom power, noise, choosing theright mike ; Mixing console ; Input devices ; Output devices; Audio Publishing.

Unit 3:

Graphics/Image :Image file formats and how and where it is used, Video Conferencing,Web Streaming, Video Streaming, Internet Telephony -VirtualReality-Artificial intelligence.Multimedia Authoring: Steps to multimedia authoring , Parameters of authoring systems'evaluation , Fundamentals of content authoring tools Fundamentals of authoring for sharing ,Assessment , Design and development processes of Multimedia project and documentation.Multimedia project : Multimedia project evaluation process , Factors that affect multimediaproject management , Steps of multimedia project development , Assessment .

Reference Books :

1."Multimedia Fundamentals: Vol 1 - Media Coding and ContentProcessing", Ralf Steinmetz, Klara Narstedt, Pearson Education, 2004.

2.https://engineering.futureuniversity.com/BOOKS%20FOR%20IT/DCAP303_MULTIMEDIA_SYSTEMS.pdf

3.Rajneesh Aggarwal & B. B Tiwari, " Multimedia Systems", Excel Publication, New Delhi , 2007.

4. Li & Drew, " Fundamentals of Multimedia" , Pearson Education, 2009.

5. https://users.dimi.uniud.it/~antonio.dangelo/MMS/materials/Fundamentals_of_Multimedia.pdf

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJT/551	**3D Animation**	2	**2hrs/per week**
CNM/MJP/551	Practical Based on **3D Animation**	2	**4hrs/per week**

Course Description:

The course provides students the fundamental skills to animate effectively with simple objects and characters necessary for work in 3D Animation. Students will develop their skills using key-frame animation and the graph editor. Students will also learn techniques for researching & using reference. Students can also apply skills learned in this class in other areas including game art.

Prerequisites:

Basics of 2D animation

Course Objectives (CO):

3D is everywhere -video games ,movie and television special effects ,mobile devices ,etc. Many Aspring artists and animators have grown up with 3D and computers, and naturally gravitate to this field as their area of interest. Bringing a blend of studio and classroom experience to offer you thorough coverage of the 3D animation industry, this must-have book shows you what it takes to create compelling and realistic 3D imagery.

Learning Outcomes (LO):

Upon successful completion of this course ,students will be expected to:

- Serves as the first step to understanding the language of 3D and computer graphics(CG)
- Covers 3D Animation basics : pre-production, modelling, animation, rendering, and post-production
- Dissects core 3D concepts including design, film, video, and games
- Exmaines what artistic and technical skills are needed to succeed in the industry
- Offers helpful real-world scenarios and informative interviews with key educators and studio and industry professionals.

Course Outline:

Unit 1:

Introduction, 3D Animation overview , Defining 3D Animation ,Exploring the 3D Animation industry , Entertainment, scientific rationale , The history of 3D Animation. Getting to know the production pipeline, understanding the production pipeline's components , Working in 3D Animation Pre-production: Idea/story,Script/Screenplay ,storyboard,Animistic/Pre-visualization, Design

Unit 2:

Working in 3D Animation production -Layout, Modeling,Texturing, Rigging/setup, Animation, 3D Visual Effects, Lightning/Rendering, Working in 3D Animation Postproduction- Compositing ,2D Visual Effects/Motion Graphics, Color Correction, Final Output

Unit 3:

Using production Tools, Folder Management and Naming Conventions, Understanding Digital Imaging and video, Understanding Digital Imaging -Pixels, Raster Graphics vs. Vector Graphics, Anti-Aliasing Basic Graphic- File Formats, Channels, Color Depth or Bit Depth, Color Calibration, Understanding Digital Video, Resolution, Device Aspect Ration, and Pixel Aspect Ratio, Interlaced and Progressive scanning.

Recommended Reference Books:

3D Animation Essential - Andy Beane ,Wiley Publication

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJT/552	**Network Routing and Protocol**	2	**2hrs/per week**
CNM/MJP/552	Practical Based on **Network Routing and Protocol**	2	**4hrs/per week**

Course Description:

To introduce students to more advanced IP routing concepts.introduce students to a broad range TCP/IP topics including: IP addressing, protocols, ports, sockets, communications, packet fragmentation and sequencing, subnetting, and packet sniffers.

Prerequisites:

- Basic programming understanding

Course Objectives (CO):

- Explore different types of routing algorithms adopted in an Internet based applications.
- Apply various routing protocols and standards used to optimize the routing in large networks.
- Analyze the issues related to routing in an IP traffic engineering of complex networks.

Learning Outcomes (LO):

By the end of the course, students will be able to:

- Able to use protocols and design algorithm / techniques to optimize the routing in large networks.
- Able control traffic and applying services in complex networks.
- Troubleshoot & Resolve IP Routing problems.
- Implement Access Control Lists.

Course Outline:

Unit 1: IP Traffic Engineering

Traffic, Stochasticity, Delay and Utilization, Applications View, An Architectural Framework, Traffic Engineering, IGP Metric, Determining IGP Link Weights via Duality of MCNF Problems, Illustration of Link Weight Determination Through Duality, Link Weight Determination, Large Networks, IP Traffic Engineering of PoP-to-Datacenter Networks.

Unit 2:IP Packet Filtering and Classification

Importance of Packet Classification, Packet Classification Problem, Packet Classification Algorithms, Naive Solutions, Two-Dimensional Solutions, Approaches for d Dimensions, Extending Two-Dimensional Solutions, Divide and Conquer Approaches, Tuple Space Approaches, Decision Tree Approaches, Hardware based Solutions

Unit 3:Routing in Reservation-Oriented Networks

Hierarchical Call Routing, The Road to Dynamic Routing, Dynamic Non-Hierarchical Routing(DNHR)Dynamically Controlled led Routing, Dynamic Alternate Routing, Real-Time Network Routing, Classification of Dynamic Call Routing Schemes, Maximum Allowable Residual Capacity Routing, Dynamic Routing and its Relation to Other Routing, Network Control for Traffic Engineering, Analysis of Dynamic Routing, Performance for Heterogeneous Services

Recommended Reference books

1. Network Routing: Algorithms, Principles and Architectures, Deep Medhi, Karthik Ramasamy,Second Edition, Morgan Kaufmann publications, 2018, ISBN: 978-0-12-800737-2.
2. IP Routing, Ravi Malhotra, First Edition, Oreilly Publication, 2002, ISBN: 81-7366-337-8
3. Designing Large-Scale LANs, Kevin Dooley, First Edition, Oreilly Publication, 2002, ISBN: 81-7366-337-2.
4. Technical and Research Papers on Traffic Engineering and Routing.

Semester III

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJT/600	**Foundation of Machine Learning**	2	**2hrs/per week**
CNM/MJP/600	Practical Based on **Foundation of Machine Learning**	2	**4hrs/per week**

Course Description:

Thecourseisconcernedintroducingmachinelearningtechniqueslikeregression,classification clustering etc. Use of various techniques for developing real-time application andanalyzingits performance

Prerequisites: There are no perquisites required for attending this course.

Course Objectives(CO):

- Applysuitablemachinelearningtechniquesfordatahandlingandtogainknowledgefromit.
- Designandimplementsupervisedandunsupervisedmachinelearningalgorithmsforre al-worldapplications, while understanding the strengths and weaknesses.

Learning Outcomes (LO):

Students should be able to:

- Mathematical modelling of real time problem.
- Demonstrateknowledgeoflearningalgorithmsthroughimplementationforsustainabl esolutionsofapplications
- Analyze research based problems using Machine learning techniques

Course Outline:

Unit 1: Introduction: Overview of Probability Theory, Model Selection, Introduction to Machine learning.Linear Regression – Basis Function models, Bias Variance Decomposition, Bayesian linear Regression;Stochastic gradient Descent, Discriminant Functions, Bayesian Logistic regression. Examples on linearregression, logistic regression

Unit 2:Supervised Learning

Kernel Methods: Dual representations, Construction of a kernel, Radial Basis Function Networks,Gaussian Process, Tree Based methods. Sparse Kernel Machines: Maximum margin classifiers (SVM),RVM. Examples on spam, mixer and k nearest neighbour

Unsupervised Learning

Mixture Models: K-means Clustering, Mixtures of Gaussians, Maximum likelihood, EM for Gaussianmixtures, The EM Algorithm in General, Principal Component Analysis, Probabilistic PCA. Exampleson Market booklet analysis

Unit 3:Random Forests

Introduction, Definition of Random Forests, Details of Random ,Out of Bag Samples , VariableImportance, Proximity Plots, Random Forests and Over-fitting, Analysis of Random Forests, Varianceand the De-Correlation Effect, Bias, Adaptive Nearest Neighbors.

Recommended Reference Books:

1. Pattern Recognition and Machine Learning, Christopher M Bishop, 2nd Edition, February 2006,Springer, ISBN-13: 978-0387-31073-2.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman,2nd Edition, 2008, Springer, ISBN 978-0-387-84858-7
3. Data Mining – Concepts and Techniques, Jiawei Han and Micheline Kamber, MorganKaufmann, 3rdEdition, 2006,Elsevier, ISBN 1-55860-901-6
4. Practical data science with R, Zumel, N., & Mount, J, 2014, Manning PublicationsISBN 9781617291562

Course Type(**Mandatory**)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/MJT/601	**3D Motion Graphics**	2	**2hrs/per week**
CNM/MJP/601	Practical Based on **3D Motion Graphics**	2	**4hrs/per week**

Course Description:

Introduction to Motion Graphics, Animation, and Compositing is a basic video compositing course aimed at students from various degrees including Motion Graphics, Emphasis on keyframe animation, basic motion design, audio integration, effects, 3D space and composition

Prerequisites:

- Basic knowledge of programming concepts
- Familiarity with Python programming language (recommended)
- Understanding of fundamental statistical concepts
- Basic knowledge of databases and SQL

Course Objectives (CO):

- Create motion graphics presentations using industry-standard tools
- Communicate messages through motion graphics design
- Perform keyframing of basic transform tools and effects properties
- Demonstrate ability to perform basic masking techniques

Learning Outcomes (LO):

By the end of the course, students will be able to:

- Create animated movies from still and video assets
- Apply knowledge of 3D principles to create multiplanar environments
- Become capable of producing strong, effective motion graphics and animations

Course Outline:

Unit 1: Overview of the course and reintroduction into Motion Graphics and 3D animation. Review basic keyframe based object and camera animation. Discuss building narrative with motion and review3D modeling, lighting, and workflows.

Unit 2: Understanding 2D Splines& shape, Extrude & Bevel 2D object to 3D, Understanding Loft & terrain, Modeling simple 4 objects with splines, Understanding morph, scatter, conform, connect compound objects, blobmesh, Boolean ,Proboolean &procutter compound object

Unit 3:

Modeling with Polygons, using the graphite, working with XRefs, Building simple scenes, Building complex scenes with XRefs, using assets tracking, deforming surfaces & using the mesh modifiers, modeling with patches & NURBS. Creating Keyframes, Auto Keyframes, Move & Scale Keyframe on the timeline, Animating with constraints & simple controllers, animation Modifiers & complex controllers, function curves in the track view, motion mixer etc.

Reference Books:

1. 3D Motion Graphics for 2D Artists by Bill Byrne,2012,Publisher(s): Routledge ISBN: 9781136040177 "

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJT/602	**Wireless ad hoc network**	2	**2hrs/per week**
CNM/MJP/602	Practical Based on **Wireless ad hoc network**	2	**4hrs/per week**

Course Description:

This course covers major aspects of ad hoc networks, from design through performance issues to application requirements. discuss characteristics features and applications of adhoc networks, Modulation techniques and voice coding..

Prerequisites:

- Basic knowledge of computer networks and protocols
- Familiarity with programming concepts

Course Objectives (CO):

- Enumerate the concept of wireless ad-hoc networks and issues in different layers of protocols in network.
- Articulate routing protocols of ad-hoc networks.
- Prioritize table-driven, on-demand and hybrid protocols and identify appropriate attributes for routing.

Learning Outcomes (LO):

By the end of this course, students will be able to:

- Infer performance of various unicast and multicast routing protocols.
- Evaluate on security attacks and secure routing.
- Investigate the measurements of protocol performance in wireless ad-hoc networks

Course Outline:

Unit 1: Cellular and Adhoc Wireless Networks, Applications of Adhoc wireless networks, Issues in Adhoc wireless networks,Hidden and exposed terminal problems, Error prone shared broadcast channel, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms. Routing Protocols for Ad-hoc Wireless Networks: Table Driven Routing Protocols.

Unit 2: On-Demand Routing Protocols, Hybrid Routing Protocols. Multicast Routing in Ad-hoc Wireless Networks: Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols. Tree-Based Multicast Routing Protocols: BEMRP, MZRP, MCEDAR, ABAM, WBM, PLBM

Unit 3: Mesh based Multicast Routing protocols: ODMRP, DCMP, FGMP, MSMP, CAMP. Transport Layer and Security Protocols for Ad-hoc Networks: Feedback based TCP, TCP bus, Adhoc TCP and Split TCP. Security in Ad-hoc Wireless Networks, Network Security Attacks: Network layer attacks, Transport layer attacks, Application layer attacks, Key Management: Approaches in adhoc networks, Secure Routing Ad-hoc Wireless Networks: SAR, SEAD, ARAN, AODV.

Recommended Reference Books:

1. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011.
2. Onyemelukwe Soke, On-Demand Routing and Security in Mobile Ad-Hoc Networks, LAP Lambert Academic Publishing, 2013.
3. Chai K Toh, Adhoc Mobile Wireless Networks: Protocols and Systems, Pearson Publications, 2015.
4. Subir Kumar Sarkar, T.G. Basavaraju and Puttamadappa, Ad Hoc Mobile Wireless Networks: Principles, Protocols, and Applications, Second Edition, CRC Press, 2016.
5. Magnus Frodigh, Per Johansson and Peter Larsson, Wireless ad hoc networking—The art of networking without a network.
6. Mohammed Ilyas, The Handbook of Adhoc Wireless Networks.

Semester IV

Course Type(**Mandatory**)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/MJT/650	**Artificial Intelligence**	2	**2hrs/per week**
CNM/MJP/650	Practical Based on Artificial Intelligence	2	**4hrs/per week**

Course Description:

This course is designed to provide students with a comprehensive introduction to practical applications of Artificial Intelligence (AI) in various industries. The course will cover fundamental concepts, techniques, and case studies that demonstrate how AI is being used to solve real-world problems. Students will gain hands-on experience through practical exercises and explore the ethical implications and future trends of AI.

Prerequisites:

- Basic programming knowledge (Python preferred)
- Understanding of linear algebra and calculus
- Familiarity with statistics and probability theory

Course Objectives (CO):

- Gain a practical understanding of the core concepts and techniques in Artificial Intelligence.
- Develop the skills to implement and train machine learning models for various tasks.
- Explore advanced topics in deep learning, natural language processing, computer vision, and reinforcement learning.
- Apply AI techniques to real-world problems through case studies.
- Understand the ethical considerations and challenges associated with AI implementation.

Learning Outcomes (LO):

By the end of the course, students will be able to:

- Implement and evaluate machine learning models using popular libraries and frameworks.
- Build and train neural networks for various AI tasks.
- Apply NLP techniques to analyse and process textual data.
- Utilize computer vision algorithms for image analysis and object recognition.
- Understand the principles of reinforcement learning and develop RL-based agents.
- Analyse and interpret AI case studies in different domains.
- Demonstrate an awareness of ethical considerations in AI and the impact of AI on society.

Course Outline:

Unit 1: Introduction to Artificial Intelligence - Introduction, history and foundation of AI, Searching: Why Search?, Graph Searching, A Generic Searching Algorithm, Costs, Finding Paths, Blind Search Strategies, Depth-First Search, Breadth-First Search, Heuristic Search: Best-First Search, Heuristic Depth- First Search, A* Search, Iterative Deepening, Direction of Search, Bidirectional Search, Constraint Satisfaction Problems, Generate-and-Test Algorithms, Backtracking Algorithms, Hill Climbing, Beam Search

Unit 2:Introduction to knowledge representation, Reasoning, Learning and Agents:

Need for proper representation, The Propositional Calculus, Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. The Predicate Calculus, Weak Slot-and-Filler Structures: semantic nets, frames, Strong slot-and-Filler Structures: Conceptual dependency, Scripts, Object Oriented Programming, Search Spaces, Monotonic and Non-monotonic reasoning, bays net, Demster Shafer Theory, Basics of PROLOG: Representation, Structure, Backtracking. Expert System: Case study of Expert System in PROLOG

What is Learning?, How can we learn? Rote Learning, Learning by Taking Advice Learning by Problem Solving, learning by Parameter Adjustment, Learning by Macro Operators, Learning by Chunking, Inductive Learning, Version Spaces, Decision Trees, Explanation Based Learning, Discovery, Analogy. PEAS Representation for an Agent, Agent Environments, Concept of Rational Agent, Structure of Intelligent agents, Types of Agents.

Unit3:FuzzySets, Fuzzy Systems:Need for Numeric and Linguistic Processing, Fuzzy Uncertainty and the Linguistic Variable ,Fuzzy Set, Membership functions, Geometry of Fuzzy Sets, Simple Operations on Fuzzy Sets, Fuzzy Rules for Approximate Reasoning, Rule Composition and Deffuzification, Fuzzy Engineering. Neural Networks and Deep Learning - Introduction to neural networks, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs).

in Governance

Recommended Reference Books:

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
2. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
3. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper
4. "Computer Vision: Algorithms and Applications" by Richard Szeliski
5. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto
6. "Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy" by Cathy O'Neil
7. "Superintelligence: Paths, Dangers, Strategies" by Nick Bostrom
8. "The Hundred-Page Machine Learning Book" by Andriy Burkov
9. "Prediction Machines: The Simple Economics of Artificial Intelligence" by Ajay Agrawal, Joshua Gans, and Avi Goldfarb
10. "Machine Learning Yearning" by Andrew Ng (available online for free)

CourseType(**Mandatory**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJT/651	**Data Analytics**	2	**2hrs/per week**
CNM/MJP/651	Practical Based on Data Analytics	2	**4hrs/per week**

Course Description:

This course is designed to provide participants with practical knowledge and skills in data analytics, enabling them to effectively analyse and derive insights from real-world data. The course combines theoretical concepts, hands-on exercises, case studies, and reference books to create a comprehensive learning experience. Participants will gain a solid foundation in data analytics techniques, learn to work with various data analysis tools, and apply their knowledge through practical case studies.

Prerequisites:

- Basic knowledge of statistics and probability
- Familiarity with programming concepts (preferably Python or R)
- Understanding of database concepts and SQL
- Some exposure to data analysis or data-driven decision-making

Course Objectives (CO):

- To provide students with a comprehensive understanding of data analytics concepts, techniques, and tools.
- To develop practical skills for data collection, pre-processing, and exploratory analysis.
- To introduce students to various data mining techniques and their applications in solving real-world problems.
- To equip students with the knowledge and skills required for predictive modelling and machine learning in data analytics.
- To explore big data analytics concepts and scalable data processing frameworks.
- To enhance students' ability to apply data analytics techniques to real-world case studies and projects.
- To promote ethical considerations and responsible use of data in the context of data analytics.

Learning Outcomes (LO):

By the end of this course, students will be able to:

- Understand the fundamental concepts and principles of data analytics.
- Collect, preprocess, and analyze data using various techniques and tools.
- Apply exploratory data analysis techniques to gain insights and visualize data effectively.
- Utilize different data mining techniques for pattern discovery, clustering, and classification.
- Build predictive models using appropriate algorithms and evaluate their performance.
- Apply machine learning algorithms to solve data analytics problems.
- Understand the challenges and opportunities associated with big data analytics.
- Develop the ability to critically analyze and solve real-world data analytics problems.
- Demonstrate ethical considerations and responsible use of data in the context of data analytics.

Course Outline

Unit 1: Introduction to Data Analytics - Understanding the importance of data analytics, Overview of data analytics lifecycle, Introduction to data analysis tools and technologies. Data Preparation and Cleaning - Data collection and pre-processing techniques, Handling missing data and outliers, Data transformation and feature engineering. Exploratory Data Analysis (EDA) - Descriptive statistics and data visualization, Univariate and multivariate analysis techniques, Exploring relationships and patterns in data.

Unit 2: Statistical Analysis - Hypothesis testing and confidence intervals, Parametric and non-parametric tests, Regression analysis and correlation. Predictive Analytics - Introduction to predictive modelling, Regression and classification algorithms, Model evaluation and selection. Time Series Analysis - Understanding time series data, Trend analysis and seasonality, Forecasting techniques. Clustering and Dimensionality Reduction - Unsupervised learning algorithms, K-means clustering and hierarchical clustering, Principal Component Analysis (PCA)

Unit 3: Case Studies a) Text Mining and Sentiment Analysis - Basics of text mining, Text pre-processing and feature extraction, Sentiment analysis techniques, b) Network Analysis - Introduction to network theory, Social network analysis, Network visualization and metrics, c) Analysing real-world datasets and scenarios (data can be downloaded from https://www.kaggle.com/datasets), d) Applying data analytics techniques to solve problems on the Kaggle Data set (https://www.kaggle.com/datasets), e) Discussion and interpretation of case study results

Reference Book

1. "Data Analytics for Beginners" by John Smith
2. "Data Science for Business" by Foster Provost and Tom Fawcett
3. "Python for Data Analysis" by Wes McKinney
4. "Statistics for Data Science" by James Miller
5. "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel
6. "Forecasting: Principles and Practice" by Rob J. Hyndman and George Athanasopoulos
7. "Pattern Recognition and Machine Learning" by Christopher M. Bishop

8. "Text Mining: Applications and Theory" by Michael W. Berry and Jacob Kogan

9. "Network Science" by Albert-László Barabási

Course Type(**Mandatory**)			
Course Code	**Course Title**	**Credits**	**ContactHours**
CNM/MJT/652	**IoT and Cloud : Concepts, Case Studies and Applications**	2	**2hrs/per week**
CNM/MJP/652	Practical Based on IoT and Cloud : Concepts, Case Studies and Applications	2	**4hrs/per week**

Course Overview:

The IoT and Cloud course provides a comprehensive understanding of the Internet of Things (IoT) and its integration with cloud computing. Students will learn the fundamental concepts, architectures, protocols, and technologies behind IoT and explore how cloud computing enables scalable, secure, and efficient IoT deployments. The course will also include real-world case studies and reference books to provide practical insights and hands-on experience.

Prerequisites:

- Basic knowledge of computer networks and protocols
- Understanding of programming concepts and languages
- Familiarity with basic cloud computing principles
- Some background in data management and analytics

Course Objectives (CO):

- Introduce students to the fundamental concepts and principles of IoT and Cloud Computing.
- Provide an understanding of the technologies, protocols, and infrastructure used in IoT and Cloud environments.
- Explore the integration of IoT devices with cloud platforms and analyze real-world case studies.
- Address the security challenges and best practices for IoT and Cloud deployments.
- Foster critical thinking and problem-solving skills through hands-on exercises and case study analysis.
- Highlight emerging trends and future directions in IoT and Cloud Computing.

Learning Outcomes (LO):

By the end of the course, students will be able to:

- Explain the key concepts, principles, and architectures of IoT and Cloud Computing.
- Identify and evaluate various IoT technologies, protocols, and cloud service models.
- Design and implement IoT and Cloud integration solutions for specific applications.
- Analyze case studies of real-world IoT and Cloud deployments and draw insights from them.
- Apply security measures and best practices to mitigate risks in IoT and Cloud environments.
- Demonstrate proficiency in using cloud-based platforms and tools for IoT applications.
- Recognize emerging trends and future directions in the field of IoT and Cloud Computing.

Course Outline:

Unit 1: Introduction to IoT and Cloud Computing - Definition and significance of IoT and cloud computing, Evolution and growth of IoT and cloud technologies, IoT and cloud convergence. IoT Architecture and Technologies - IoT ecosystem and components, Sensor networks and connectivity protocols, Edge computing in IoT, Data acquisition and processing. Cloud Computing Fundamentals - Cloud service models (IaaS, PaaS, SaaS), Cloud deployment models (public, private, hybrid), Virtualization and containerization, Cloud security and privacy considerations.

Unit 2: IoT Data Management and Analytics - Data storage and retrieval in the cloud, Real-time data processing and analytics, Machine learning and AI for IoT, Data visualization and dashboards. Cloud-based IoT Platforms

and Services - IoT platform architectures and features, Device management and provisioning, Cloud-based IoT application development, Integration with cloud APIs and services

Unit 3: Security and Privacy in IoT and Cloud - Threats and vulnerabilities in IoT systems, Authentication and access control, Data encryption and secure communication, Privacy concerns and regulatory frameworks. Emerging Trends and Future Directions - Edge AI and Fog Computing, 5G and IoT, Introduction to Blockchain in IoT, Edge-to-cloud integration.

Case Studies and Industry Applications – a) Smart homes and buildings, b) Industrial IoT and Industry 4.0, c) Healthcare and wearable devices d) Smart cities and infrastructure.

Reference Books:

"Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz

"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro

"Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood

"Internet of Things for Architects: Architecting IoT Solutions by Implementing Sensors, Communication Infrastructure, Edge Computing, Analytics, and Security" by Perry Lea

"Internet of Things (A Hands-on-Approach)" by Arshdeep Bahga and Vijay Madisetti

Course Contents for Skill / Advance Course (Programming Elective Group Basket)

Programming Group	**Programming - 1** CNM/MJP/503-507	**Programming-2** CNM/MJP/553-557	**Programming -3** CNM/MJP/603-607
Java Group	Core Java	Advance Java	Android
Open Group	Python	Advanced Python	Open Web Programming (PHP)

Note: *,#Student is advised to select the any one course from the pool of courses, however horizontal selection of courses to be followed at the time of selection of the course.

Programming Group: Java Group

CourseType(**Skill / Advance Course**)			
Course Code	**Course Title**	**Credits**	**ContactHours**
CNM/MJP/503	**Core Java**	2	**4hrs/per week**

Course Description:

This course is designed to provide a comprehensive understanding of Core Java programming concepts and best practices. It covers essential topics from basic syntax and control flow to object-oriented programming, exception handling, and file I/O. The course incorporates case studies to reinforce learning and includes a list of recommended reference books for further exploration.

Prerequisite:

No prior programming experience is required for this course. However, a basic understanding of computer systems and general familiarity with using computers is recommended.

Course Objectives (CO):

- Understand the fundamental concepts and principles of the Java programming language.
- Gain proficiency in writing, compiling, and executing Java programs.
- Develop object-oriented programming skills and design reusable code.
- Familiarize yourself with the Java Collections Framework and its various data structures.
- Acquire knowledge of GUI programming using Swing.

- Explore multithreading and concurrent programming concepts.

Learning Outcome (LO):

By the end of this course, students will be able to:

- Write Java programs to solve simple to complex programming problems.
- Understand and apply object-oriented programming concepts effectively.
- Utilize the Java Collections Framework to manage and manipulate data efficiently.
- Develop interactive graphical user interfaces using Swing.
- Implement multithreading and concurrent programming techniques.
- Analyze and solve programming challenges using Java.

Course Outline:

Unit 1: Introduction to Java - History and features of Java, Java development environment setup, Basic syntax, data types, and variables, Operators and expressions, Control flow statements (if-else, loops), Object-Oriented Programming (OOP) Basics - Classes and objects, Encapsulation, Inheritance, and Polymorphism, Method overloading and overriding, Constructors and static members, Access modifiers

Unit 2: Advanced OOP Concepts - Abstract classes and interfaces, Packages and access control, Exception handling, Enumerations, Inner classes, Java Collections Framework - Introduction to collections, ArrayList, LinkedList, and Vector, HashSet, LinkedHashSet, and TreeSet, HashMap, LinkedHashMap, and TreeMap, Iterators and foreach loop, File Handling and I/O - File class and file operations, Character streams and byte streams, Reading and writing files, Serialization and deserialization, Working with directories, Multithreading - Understanding threads, Creating and running threads, Synchronization and thread safety, Thread communication and coordination, Thread pools and executors

Unit 3: GUI Programming with Applet and Swing – Life Cycle of Applets & Swings components, Creating UI components – Applet & Swings (buttons, labels, text fields, etc.), Event-driven programming, Layout managers, Creating Dialogs and message boxes, Swing Layouts. Revisiting to Databases and SQL - Understanding databases and database management systems, Introduction to SQL (Structured Query Language), Performing basic database operations using SQL. Database Integration with Java (JDBC) - Overview of JDBC (Java Database Connectivity), Connecting to databases using JDBC, Executing SQL queries and retrieving results in Java, Advanced JDBC Concepts -Prepared statements and parameterized queries, Batch processing and transaction management, Handling result sets and metadata

Case Studies and Project Work - Case studies covering real-world scenarios, implementing case study solutions using Core Java. Following Case studies are required to be addressed by the students during their laboratory work.

> Case Study a) Building a Contact Management System - Analyzing requirements, Designing the database schema, Implementing the system using Core Java, databases, and Swing, b) Creating an Inventory Management Application - Understanding the business case, Designing the database structure Developing the application with Core Java, databases, and Swing
>
> Capstone Project: Final Capstone project work incorporating multiple concepts learned by the student during the course work with Code optimization and best practices.

Reference Books:

"Head First Java" by Kathy Sierra and Bert Bates

"Core Java, Volume I -- Fundamentals" by Cay S. Horstmann

"Effective Java" by Joshua Bloch

"Java: The Complete Reference" by Herbert Schildt

"Thinking in Java" by Bruce Eckel

Course Type(**Skill / Advance Course**			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/MJP/553	**Advance Java**	2	**4hrs/per week**

Course Description:

This course provides practical and advanced training in Java programming with a focus on building web applications using Servlets, Struts, and Hibernate frameworks. Students will gain hands-on experience in developing robust and scalable Java-based web applications by utilizing these powerful frameworks. The course emphasizes best practices, design patterns, and industry-standard techniques to create efficient and maintainable web applications.

Prerequisite:

- Solid understanding of core Java programming concepts
- Familiarity with web development basics (HTML, CSS, and JavaScript)
- Knowledge of relational databases and SQL

Course Objectives (CO):

- Develop a deep understanding of advanced Java web development concepts
- Gain proficiency in using Servlets, Struts, and Hibernate frameworks
- Learn to design and build scalable and maintainable web applications
- Acquire hands-on experience in implementing MVC architecture
- Develop skills in database integration and ORM techniques

Learning Outcomes (LO):

By the end of this course, students will be able to:

- Design and develop advanced Java-based web applications
- Effectively use Servlets, Struts, and Hibernate frameworks in web development projects
- Apply industry-standard design patterns and best practices
- Implement secure authentication and session management
- Create efficient database-driven web applications
- Demonstrate proficiency in integrating and utilizing multiple frameworks

Course Outline:

Unit 1: Introduction to Advanced Java Web Development - Overview of Java Servlets, Struts, and Hibernate, Comparison of different web frameworks, Understanding the MVC (Model-View-Controller) architecture. Servlets: Building Dynamic Web Applications - Servlet life cycle and request handling, Handling form data and request parameters, Session management and authentication, Servlet filters and listeners, Error handling and exception management

Unit 2: Struts Framework: Structured Web Application Development - Introduction to Struts framework and its components, Configuring Struts and defining action mappings, working with forms and validation, Managing database operations using Struts, Implementing security and authentication in Struts. Hibernate: Object-Relational Mapping (ORM) - Introduction to Hibernate and ORM concepts, Configuring Hibernate with different database systems, Mapping Java objects to database tables, Performing CRUD operations using Hibernate, Querying data using Hibernate Query Language (HQL)

Unit 3: Integration of Servlets, Struts, and Hibernate - Leveraging the power of Servlets, Struts, and Hibernate together, building a complete end-to-end web application, Implementing layered architecture and separation of concerns, Handling transactions and database operations. Case Studies a) Building an e-commerce platform using Servlets, Struts, and Hibernate, b) Developing a social networking application with advanced Java web technologies, c) Creating a banking system with secure authentication and transaction handling, d) Implementing a content management system (CMS) using Java web frameworks

Reference Books:

"Head First Servlets and JSP" by Bryan Basham, Kathy Sierra, and Bert Bates

"Struts 2 in Action" by Don Brown, Chad Davis, Scott Stanlick, and Ted Husted

"Hibernate in Action" by Christian Bauer and Gavin King

"Pro Spring MVC: With Web Flow" by Marten Deinum, Koen Serneels, and Colin Yates

"Java Persistence with Hibernate" by Christian Bauer and Gavin King

Course Type(**Skill / Advance Course**			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/MJP/603	**Android Programming**	2	**4hrs/per week**

Course Description:

This course is designed to provide a comprehensive understanding of Android programming, starting from the basics and progressing towards more advanced concepts. Students will learn the fundamentals of Android app development, including user interfaces, data storage, networking, and multimedia integration. The course will also incorporate case studies and practical examples to demonstrate real-world applications of Android programming. Students will gain hands-on experience by developing their own Android apps and exploring reference books to deepen their knowledge.

Prerequisite:

- Basic knowledge of Java programming language
- Familiarity with object-oriented programming concepts

Course Objectives (CO):

- Understand the fundamental concepts and architecture of the Android platform.
- Gain proficiency in developing Android applications using Java.
- Acquire knowledge of various Android components and their functionalities.
- Learn to design user-friendly and visually appealing Android interfaces.
- Develop skills in handling data storage, network communication, and multimedia integration in Android applications.
- Apply best practices and coding standards for developing high-quality Android apps.
- Gain hands-on experience by working on real-world case studies.

Learning Outcome (LO):

By the end of the course, students will be able to:

- Design and develop functional Android applications from scratch.
- Implement key Android features such as activities, services, and content providers.
- Create intuitive user interfaces using XML layouts and UI components.
- Perform network communication and data persistence in Android apps.
- Integrate multimedia elements and utilize device sensors.
- Employ advanced Android techniques such as notifications, maps, and external API integration.
- Apply the knowledge gained from case studies to build complex Android applications.

Course Outline:

Unit 1: Introduction to Android Development - Overview of Android ecosystem, setting up development environment (Android Studio, SDK, emulators), Understanding the Android project structure, Introduction to Android components (activities, fragments, services). User Interface Development - Layouts and views, User input and event handling, working with menus and dialogues, Creating responsive and adaptive interfaces, Material Design principles and guidelines

Unit 2: Data Storage and Persistence - Using SQLite database, Content Providers and data sharing Shared Preferences for app preferences, Working with files and external storage, Introduction to cloud storage and synchronization (Firebase). Networking and Web Services - Making HTTP requests (HTTP libraries, RESTful APIs), Parsing JSON and XML data, Working with web sockets, Authentication and authorization mechanisms, Caching and offline capabilities

Unit 3: Multimedia Integration - Working with images, audio, and video, integrating camera and gallery functionalities, playing media files and streaming, Implementing notifications and push notifications, Location-based services and maps integration, Testing and debugging Android applications. Case Studies and Project Development - Exploring case studies of popular Android applications (Data Collected), Analysing and dissecting their architecture and key features (Social Media Applications), Implementing key components of case study apps, Applying best practices and optimization techniques,

Recommended Reference Books:

"Android Programming: The Big Nerd Ranch Guide" by Bill Phillips, Chris Stewart, and Kristin Marsicano

"Head First Android Development" by Dawn Griffiths and David Griffiths

"Android Studio 4.0 Development Essentials - Kotlin Edition" by Neil Smyth

"Android App Development for Dummies" by Michael Burton

"Professional Android 4 Application Development" by Reto Meier

Programming Group: Open Group

Course Type(**Skill / Advance Course**			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/MJP/504	**Python Programming**	2	**4hrs/per week**

Course Description:

This course is designed to provide students with a comprehensive understanding of Python programming. It covers the fundamentals of Python, including syntax, data types, control structures, functions, and object-oriented programming concepts. Through a combination of lectures, hands-on exercises, and case studies, students will gain practical experience in solving real-world problems using Python.

Prerequisites:

- There are no specific prerequisites for this course. However, a basic understanding of programming concepts and familiarity with any programming language would be beneficial.

Course Objectives (CO):

- To introduce students to the fundamentals of Python programming language.
- To develop students' problem-solving skills using Python.
- To enable students to apply Python programming techniques to solve real-world problems.
- To provide hands-on experience in Python programming through practical exercises and case studies.
- To prepare students for further studies or careers in software development, data analysis, or scientific computing.

Learning Outcomes (LO):

By the end of this course, students will be able to:

- Understand and apply the core concepts of Python programming.
- Write Python programs to solve a variety of computational problems.
- Design and implement object-oriented programs in Python.

- Utilize Python libraries and modules for specific tasks.
- Analyse and debug Python code for errors and exceptions.
- Develop a basic understanding of GUI programming using Tkinter.

Course Outline:

Unit 1: Introduction to Python - History and features of Python, Installing Python and setting up the development environment, Basic Python syntax and data types, Variables, operators, and expressions. Control Structures, Conditional statements (if, else, elif), Looping statements (for, while), Control flow and branching

Unit 2: Functions and Modules - Defining and calling functions, Function parameters and return values, Recursion, Introduction to modules and libraries, Data Structures - Lists, tuples, and dictionaries, String manipulation, Sets and frozen sets, Working with files and directories

Unit 3: Regular expressions, File handling and input/output operations, Debugging and error handling
Introduction to GUI programming with Tkinter

Case Studies: Throughout the course, students will work on case studies that demonstrate the practical application of Python programming in various domains, such as: a) Analyse and visualizing data using Python libraries like NumPy, Pandas, and Matplotlib, b) Building web applications with frameworks like Django or Flask., c) Implementing algorithms for machine learning and data mining, d) Automating tasks and working with APIs., e) Creating graphical user interfaces (GUI) for desktop applications.

Recommended Reference Book:

1. "Python Programming: An Introduction to Computer Science", John Zelle, Franklin, Beedle & Associates Inc, 2016
2. "Fluent Python" by Luciano Ramalho
3. "Python Cookbook" by David Beazley and Brian K. Jones
4. "Python Crash Course" by Eric Matthes
5. "Python for Data Analysis" by Wes

CourseType(**Skill / Advance Course**			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJP/554	**Advance Python Programming**	2	**4hrs/per week**

Course Description:

The Advanced Python Programming course is designed for individuals who have a solid foundation in Python and want to enhance their skills to an advanced level. This course focuses on advanced concepts, techniques, and best practices that will enable students to develop robust and efficient Python applications. Through a combination of lectures, hands-on exercises, and case studies, participants will deepen their understanding of Python and learn how to leverage its full potential.

Prerequisites:

- Proficiency in Python programming language, including knowledge of basic syntax, data types, control structures, and functions.
- Familiarity with object-oriented programming concepts.

Course Objectives (CO):

- Develop a deep understanding of advanced Python concepts and techniques.
- Master the design and implementation of complex data structures and algorithms in Python.
- Gain proficiency in object-oriented programming and apply design patterns effectively.
- Acquire knowledge of functional programming paradigms and utilize them in Python.
- Learn how to write Python code and follow best practices for code organization and style.

- Understand concurrency and parallelism in Python and apply them to optimize performance.
- Enhance debugging and testing skills to ensure the quality of Python applications.

Learning Outcomes (LO):

By the end of this course, participants will be able to:

- Design and implement advanced data structures and algorithms in Python.
- Utilize object-oriented programming principles to develop modular and reusable code.
- Apply functional programming concepts to write elegant and concise Python code.
- Implement concurrency and parallelism in Python to improve performance.
- Write clean, maintainable, and Pythonic code following best practices.
- Effectively debug and test Python applications for identifying and fixing issues.
- Apply the learned concepts to real-world case studies and solve complex problems.

Course Outline:

Unit 1: Advanced Data Structures and Algorithms in Python - Advanced data structures: sets, dictionaries, heaps, and graphs, Algorithm design and analysis: recursion, sorting, searching, and dynamic programming, Time and space complexity analysis

Unit 2: Object-Oriented Programming (OOP) in Python - Inheritance, polymorphism, and encapsulation, Design patterns and their implementation in Python, Advanced OOP concepts: abstract classes, interfaces, and multiple inheritance, Functional Programming in Python - Higher-order functions, lambda expressions, and closures, Immutable data structures and pure functions, Functional programming techniques: map, filter, reduce, and recursion

Unit 3: Concurrency and Parallelism in Python - Multithreading and multiprocessing, Synchronization and thread safety, Asynchronous programming with async/await. Python Database Libraries - Overview of popular Python database libraries (e.g., SQLAlchemy, psycopg2), Installation and setup of database libraries, connecting to databases using Python. Database Querying with Python - Executing SQL queries using Python, Fetching and manipulating query results, Parameterized queries and prepared statements, Object-Relational Mapping (ORM) - Introduction to ORM frameworks (e.g., SQLAlchemy), Mapping database tables to Python classes, Performing CRUD operations using ORM

Case Studies: Throughout the course, students will analyse and work on various case studies to apply the advanced Python concepts they have learned. The case studies will cover domains such as data analysis, web development, scientific computing, and machine learning. These real-world scenarios will provide practical experience and enable participants to tackle complex problems using advanced Python programming techniques.

Recommended Reference Book:

"Python Cookbook", David Beazley and Brian K. Jones, O'Reilly Media, 2018

"Fluent Python" by Luciano Ramalho

"Python Cookbook" by David Beazley and Brian K. Jones

"Python Crash Course" by Eric Matthes

"Python for Data Analysis" by Wes

CourseType(**Skill / Advance Course**)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/MJP/604	**Open Web Programming (PHP)**	2	**4hrs/per week**

Course Description:

This course is designed to provide students with a comprehensive understanding of PHP programming language, along with practical case studies. Students will learn the fundamentals of PHP, including its syntax, data types, control structures, functions, and object-oriented programming concepts. The course will also cover advanced topics such as database integration, web application development, security considerations, and performance optimization techniques.

Prerequisite:

- Basic understanding of programming concepts
- Familiarity with HTML, CSS, and JavaScript is preferred but not mandatory

Course Objectives (CO):

- To introduce students to the fundamentals of PHP programming language
- To enable students to develop dynamic web applications using PHP
- To provide hands-on experience with database integration and web security in PHP
- To enhance students' problem-solving and critical thinking skills in the context of PHP development

Learning Outcome (LO):

By the end of this course, students will be able to:

- Write PHP code to solve programming problems and develop web applications
- Integrate PHP with databases for efficient data management
- Implement security measures to protect web applications from common vulnerabilities
- Optimize PHP code and database queries for improved performance
- Analyze and troubleshoot PHP applications using debugging tools and techniques

Course Outline:

Unit 1: Introduction to PHP - Basics of PHP syntax, Variables and data types, Control structures (if-else, loops), Functions and array, PHP Programming Fundamentals - File handling and input/output operations, String manipulation, Regular expressions, Error handling and debugging

Unit 2: Object-Oriented Programming in PHP - Classes and objects, Inheritance and polymorphism, Encapsulation and data abstraction, Exception handling. Database Integration - Introduction to databases (MySQL, SQLite, etc.), SQL queries and database operations, Connecting PHP with databases, CRUD operations (Create, Read, Update, Delete).

Unit 3. Web Application Development - Basics of web development (HTML, CSS, JavaScript), Server-side scripting and client-server communication, Handling form (GET, POST) submissions, Session management and cookies. Security Considerations - Common web vulnerabilities (cross-site scripting, SQL injection), Input validation and data sanitization, Password hashing and encryption, User authentication and authorization. Performance Optimization - Caching techniques, Code profiling and optimization, Database query optimization, Load balancing and scalability considerations

Recommended Reference Book:

"PHP and MySQL Web Development" by Luke Welling and Laura Thomson.

Unit 3: Case Studies: a) Building a Desktop Application with Visual Basic: Students will develop a desktop application using Visual Basic, incorporating various concepts covered in the course. The case study will focus on user interface design, data management, and implementing business logic b) Creating Dynamic Web Pages

Discipline Specific Electives - DSE (Elective Group Basket)

Elective Group	Elective1 CNM/DSET/520-524 & CNM/DSEP/520-524	Elective2 CNM/DSET/570-574 & CNM/DSEP/570-574	Elective3 CNM/DSET/620-624 & CNM/DSEP/620-624	Elective4 CNM/DSET/670-674 & CNM/DSEP/670-674
Track-I	Computer Graphics	Digital Image Processing	Augmented Reality and Virtual Reality	Video Processing
Track-II	Foundation of Remote Sensing	Geographical Information System	Spatial & Temporal Computing	Hyper Spectral Image Processing
Track-III	Cryptography	Cyber Security	Multimedia Security	Cloud Security

Track I

CourseType(DSE)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/DSET/520	Computer Graphics	2	**2hrs/per week**
CNM/DSEP/520	Practical Based on Computer Graphics	2	**4hrs/per week**

Course Description:

To provide a broad introduction to the field of Computer Graphics, and to describe the techniques that are commonly used in the graphics industry today.

Prerequisites:

No specific prerequisites.

Course Objectives (CO):

- Understands the core concepts and mathematical foundations of computer graphics
- Knows fundamental computer graphics algorithms and data structures.
- Able to organize and structure problem solving approaches in a team environment

Learning Outcome (LO):

By the end of this course, students will be able to:

- Can apply basic mathematics in the development of graphics applications
- Is able to design and develop interactive 3d programs using opengl
- Can develop software for modern graphics hardware

Course outline:

Unit 1: INTRODUCTION

Introduction, Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices. Output primitives : Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms.

Unit 2: 2-D GEOMETRICAL TRANSFORMS

Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms transformations between coordinate systems. 2-D viewing: The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

Unit 3: 3-D OBJECT REPRESENTATION

Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. 3-D Geometric transformations: Translation, rotation, scaling, reflection and shear transformations, composite transformations. 3-D viewing: Viewing pipeline, viewing coordinates, view volumeand general projection transforms and clipping.

Recommended Reference Books:

1. Peter Shirley, Michael Ashikhmin and Steve Marschner, " Fundamentals of Computer Graphics" , 3rd

Edition, 2009.

2. Donald Hearn & M. Paulin Baker, " Computer Graphics", Pearson Education, 3nd Edition, 2003.

3. Foley J.D, Van Dam A, Feiner S. K and Hughes J. F, "Computer Graphics", Addison Wesley, 2nd

Edition,1993.

Course Type(DSE)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/570	**Digital Image Processing**	2	**2hrs/per week**
CNM/DSEP/570	Practical Based on **Digital Image Processing**	2	**4hrs/per week**

Course Description:

This course provides the understanding of the fundamentals blocks of DIP. It helps to learn various image transforms, image enhancement techniques , restoration techniques and segmentation methods to improve the image analysis and recognition.

Prerequisites: To have deep understanding of linear algebra and good programming skill.

Course Objectives (CO):

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques, image restoration and image compression procedures

Learning Outcomes (LO):

- Analyze images in the frequency domain using various transforms.
- Evaluate the techniques for image enhancement and image restoration.
- Interpret image segmentation and representation techniques.

Course Outline:

Unit 1: Introduction to Image Processing**:**

Example of fields that uses image processing, Steps of image processing, Components, Applications, Image sensors and Image formats. Visual Preliminaries Brightness adaptation and contrast, Acuity and contour, Texture and pattern discrimination, Shape detection and recognition, perception of color, Computational model of perceptual processing, Image sampling and quantization, Basic relationship between pixels.

Unit 2: Intensity transformations and Colour Image Processing**:**

Introduction, Basic intensity transformation functions, Histogram equalization, Local histogram processing, and Using histogram statistics for image enhancement. Spatial filtering Fundamentals of spatial filtering, Smoothing and sharpening spatial filters, combining spatial enhancement methods,**:** Colour fundamentals, Colour models, Pseudo color image processing, Basic of full, color image processing, colour transformations, Smoothing and sharpening, Image segmentation bases on colour, Noise in colour images,

Unit 3: Morphological Image Processing**:**

Introduction, Erosion and Dilation, Opening and closing, History, Miss transformation, Basic morphological algorithms, Gray scale morphology. Segmentation Fundamentals, Point, Line and Edge detection, Thresholding, Region based segmentation, Segmentation using morphological watersheds, Use of motion in segmentation – Spatial techniques.

References Books:

1. "Digital Image Processing", Gonzalez and Woods, 3rd Edition, Pearson Education.
2. "Digital Image Processing and Analysis", Bhabatosh Chanda, Dwijesh Dutta Majumder, 2nd Edition, PHI.
3. "Fundamentals of Digital Image Processing", Anil K Jain, 1st Edition, PHI.
4. "Hands-on image processing with Python: expert techniques for advanced image analysis and effective interpretation of image data", DEY S, Birmingham, UK : Packt Publishing, 2018.
5. "Digital Image Processing", M.Anji Reddy, Y.Hari Shankar, BS Publications.
6. "Fundamentals of Digital Image Processing", S.Annadurai, R.Shanmugalakshmi,Pearson Education, 2007

E-Resources:

https://www.geo.university/courses/digital-image-processing-with-opencv-in-python

Course Type(DSE)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/620	**Augmented Reality and Virtual Reality**	2	**2hrs/per week**
CNM/DSEP/620	Practical Based on **Augmented Reality and Virtual Reality**	2	**4hrs/per week**

Course Description:

Recent advances in technology have allowed AR/VR systems to become extremely sophisticated and realistic. This course introduces students to the technologies that under pin AR/VR systems. After this course the student is able to make new games or applications.

Prerequisites:

Basic knowledge of Should have knowledge of basic programming

Course Objectives(CO):

- To have the scientific, technical and engineering aspects of augmented and virtual reality systems.
- To learn the Evaluation of virtual reality from the lens of design.

Learning Outcomes (LO):

Students will be able

- Identify, examine and develops of software that reflects fundamental techniques for the design and deployment of VR and AR experiences.
- Describe how VR and AR systems work.
- Develop, explain, and defend the use of particular designs for AR and VR experiences.

CourseOutline:

Unit1: Introduction: Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR ,VR and MR, Challenges with AR, AR systems and functionality ,Augmented reality methods ,visualization techniques for augmented reality.

Unit 2: VR systems: VR as a discipline, Basic features of VR systems, Architecture of VR systems, VR hardware: VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays. Challenges in VR software development, Master/slave and Client/server architectures, Cluster rendering, Game Engines and available sdk to develop VR applications for different hardware (HTC VIVE, Oculus, Google VR).

Unit3: 3D interaction techniques and AR software development: 3DManipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation.AR software, Camera parameters and camera calibration, Marker-based augmented reality, ARToolkit.

ReferenceBooks:

- George Mather, Foundations of Sensation and Perception:PsychologyPress;2edition,2009.
- The VR Book: Human Centered Design for Virtual Reality ,byJasonJerald
- Learning Virtual Reality byTony Parisi,O'Reilly
- Burdea,G.C.andP. Coffet., Virtual Reality Technology,Second Edition.Wiley IEEEPress,2003/200
- Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann,2013.
- Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, FoundationsofEffectiveDesign, MorganKaufmann,2009.

E-Resources:

http://msl.cs.uiuc.edu/vr/

Course Type(**Mandatory**)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/670	**Video Processing**	2	**2hrs/per week**
CNM/DSEP/670	Practical Based on **Video Processing**	2	**4hrs/per week**

Course Description:

Video Processing with Python: Case Studies is an advanced course that explores the principles and techniques of video processing using the Python programming language. This course focuses on practical applications and provides hands-on experience with real-world case studies. Students will learn how to manipulate, analyze, and enhance video data, enabling them to extract meaningful information and insights from video streams.

Prerequisites:

- Proficiency in Python programming language
- Basic understanding of image processing concepts
- Familiarity with fundamental concepts of computer vision

Course Objectives (CO):

- Understand the fundamental principles and techniques of video processing.
- Gain proficiency in using Python libraries and frameworks for video manipulation and analysis.
- Apply various video processing techniques to extract meaningful information from video streams.
- Acquire the skills to enhance and restore video quality using advanced algorithms.
- Explore the application of deep learning for video analysis and synthesis.
- Develop the ability to design and implement video processing solutions for real-world problems.

Learning Outcomes (LO):

By the end of this course, students will be able to:

- Understand the underlying concepts and techniques of video processing.
- Manipulate and preprocess video data using Python.
- Implement motion detection, object recognition, and face detection algorithms.
- Enhance video quality through denoising, deblurring, and color correction.
- Apply video compression techniques for efficient storage and transmission.
- Utilize deep learning models for video analysis, classification, and synthesis.
- Design and develop video processing solutions for real-world applications.

Course Outline:

Unit 1: Introduction to Video Processing - Fundamentals of video representation and formats, Video acquisition and preprocessing techniques. Video Analysis Techniques - Motion detection and tracking, Object recognition and tracking, Face detection and recognition

Unit 2: Video Enhancement and Restoration - Noise reduction and image stabilization, Video denoising and deblurring, Contrast enhancement and colour correction. Video Compression and Encoding, Principles of video compression, Video encoding algorithms and standards, Codecs and formats for efficient storage and transmission

Unit 3: Deep Learning for Video Processing - Convolutional neural networks for video analysis, Video classification and action recognition, Video generation and synthesis. Case Studies a) Real-world applications of video processing using Python, b) Case studies on surveillance systems, video analytics, etc. c) Hands-on projects to reinforce concepts learned.

Recommended Reference Book:

- "Python for Video Processing: Techniques and Case Studies"
- "Digital Video Processing", Second Edition by A. Murat Tekalp, June 2015, Pearson, ISBN: 9780133991116

Track II

Course Type(DSE)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/521	**Foundation Of Remote Sensing**	2	**2hrs/per week**
CNM/DSEP/521	Practical Based on **Foundation Of Remote Sensing**	2	**4hrs/per week**

Course Description:

Student should be able understand the basic principles of Remote sensing and its utilization on natural resource managements. Use various techniques of computer for spatial inventory & analysis of natural resources.

Prerequisites: No prerequisites required

Course Objectives (CO):

- To understand and be able to articulate the basics of how electromagnetic energy enables remote sensing
- To be able to explain the concepts of spatial, spectral, radiometric and temporal resolution.

Learning Outcomes (LO):

- Understanding basic components of remote Sensing
- To understand functioning, data acquisition and orbit operations of missions.

Course Outline:

Unit 1:Introduction:

History of Remote Sensing; Physics of Remote Sensing: Electromagnetic Radiation (EMR), Characteristics; Electromagnetic Spectrum (EMS); Interactions Between Matter and Electro-Magnetic Radiation; Energy Interaction in The Atmosphere; Energy Interactions with The Earth's Surface. Radiation Laws. Atmospheric Windows; Types of Remote Sensing with Respect to Wavelength Regions.

Unit 2: Sensor and Platforms.

Sensor Technology; Historical Development; Types of Platforms and Sensors– Airborne Remote Sensing; Space Borne Remote Sensing; Orbital Elements of Satellite; Sensor Types Characteristics: Active and Passive Remote Sensing; Imaging Systems; Non-Imaging Sensors; Across Track and Along Track Scanners; Framing and Scanning Systems; Characteristics of Optical Sensors; Resolution.

Unit 3:Remote Sensing Satellites and Data Products:

Overview of Different Satellite and Sensors for Earth Observations– Coarse; Medium and High-Resolution Missions (LandsatSeries); SPOT; Ikonos; Quickbird; ASTER; Sentinel; Aqua and Terra (MODIS); SAR and Future Missions.

References Books:

1. Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote Sensing and Image Interpretation. John Wiley & Sons.
2. Rees, W. G. (2012). Physical Principles of Remote Sensing. Cambridge University Press.
3. Jensen, J. R. (2009). Remote Sensing of The Environment: An Earth Resource Perspective 2/E. Pearson Education India.
4. Sabins, F. F. (2007). Remote Sensing: Principles and Applications. Waveland Press. "Digital Image Processing", Gonzalez and Woods, 3rd Edition, Pearson Education.

E-Resources:

https://www.geo.university/courses/digital-image-processing-with-opencv-in-python

Course Type(**Mandatory**)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/571	**Geographic Information System (GIS)**	2	**2hrs/per week**
CNM/DSEP/571	Practical Based on Geographic Information System (GIS)	2	**4hrs/per week**

Course Description:

This GIS course is designed to provide students with an in-depth understanding of advanced concepts, techniques, and applications in Geographic Information Systems (GIS). The course focuses on enhancing students' knowledge and skills in spatial analysis, data management, cartography, and geospatial modeling. Through a combination of theoretical knowledge and practical hands-on exercises, students will gain the expertise required to address complex spatial problems and develop solutions using advanced GIS tools and methodologies.

Prerequisite:

- Basic knowledge of Geographic Information Systems (GIS)
- Familiarity with spatial data concepts and formats
- Proficiency in using GIS software (e.g., ArcGIS, QGIS)

Course Objectives (CO):

- Develop a deep understanding of advanced GIS concepts and techniques
- Acquire practical skills in spatial analysis and modeling
- Enhance proficiency in data management and integration
- Explore advanced cartography and visualization techniques
- Gain knowledge in geospatial modeling and simulation
- Apply advanced GIS methods to solve real-world problems

Learning Outcomes (LO):

By the end of this course, students will be able to:

- Apply advanced spatial analysis techniques to solve complex spatial problems
- Design and implement advanced data management strategies in GIS
- Create visually compelling and informative maps using advanced cartographic techniques
- Develop geospatial models and simulations to understand and predict spatial phenomena
- Evaluate and select appropriate GIS tools and methodologies for specific applications
- Apply critical thinking skills to analyze and solve real-world spatial problems using GIS

Course Outline:

Unit 1: Introduction to GIS Concepts - Overview of advanced GIS techniques and applications, Spatial analysis and modelling, Data integration and interoperability, Advanced Spatial Analysis Techniques - Spatial statistics and analysis, Network analysis and routing, Geo-statistics and interpolation, Multicriteria decision analysis (MCDA), Spatial regression analysis

Unit 2: Advanced Data Management in GIS - Database design and management, Data quality assessment and improvement, Data integration and fusion, Spatial data infrastructure (SDI) concepts, Data privacy and security in GIS

Unit 3: Advanced Cartography and Visualization - Advanced cartographic design principles, Thematic mapping techniques, 3D visualization and virtual reality (VR) in GIS, Web-based mapping and interactive applications, Data-driven cartography and dynamic mapping, Geospatial Modelling and Simulation - Introduction to geospatial modelling, Cellular automata and agent-based modelling, Time-series analysis and forecasting, Risk assessment and hazard modelling, Urban growth modelling

Recommended Reference Book:

1. "Advanced Geographic Information Systems: Spatial Analysis and Modeling", Robert P. Haining, Wiley, 2021

CourseType(DSE)			
CourseCode	**CourseTitle**	**Credits**	**ContactHours**
CNM/DSET/621	**Spatial & Temporal Computing**	2	**2hrs/per week**
CNM/DSEP/621	Practical Based on **Spatial & Temporal Computing**	2	**4hrs/per week**

Course Description:

The course is conceptualized to introduce students to statistical analysis in temporal and spatial domain. It leads students into analysis and interpretation of spatial and temporal data, using different tools. The goal of the course is to familiarize the students with the basic techniques for use in further research. The course would enable the students to analyse environmental data for improved decision-making, enabling efficient resource management.

Prerequisites:

- There are no perquisites required for attending this course

Course Objectives(CO):

- To understand and able to compute basic time series components
- Tounderstandtheconceptofgeostatisticalmodellingforspatialprediction

Learning Outcomes (LO):

- To analyze data with time series techniques
- To understand spatio-temporal models

Course Outline:

Unit 1: Introduction: types of data, collection of temporal and spatial data, preparation of data. Time series: classification, components, concept of stationarity, decomposition of timeseries. Analysis for trenddetectionand slope estimation: Parametric approach - Linear Regression; Non-Parametric approach – Turning Point test,Man-KendallTest, PreWhitened Mann Kendalltest, TheilandSen's Median Slope.

Unit 2: Autocorrelation analysis: Estimation of Autocorrelation coefficient, Correlogram, Moving Average process, Autoregressive Process, Autoregressive Integrated Moving Average Process, Cross correlation analysis. Change point detection and its various frameworks. Spatial continuity, Anisotropy axes, directional tolerance,variogram, relative variogram, correlogram, cross-variogram. Estimation: Weighted linear combinations, Global and local estimation ,point and block estimates.

Unit3: Random function models in Geostatistics: Deterministic model, probabilistic models, random variables, parameters for random function. Ordinary kriging and block kriging, cokrigging. Spatio-temporal models and its applications :S-and T-mode Empirical Orthogonal Function, Canonical Correlation Analysis, Singular Spectrum Analysis, Contextual Mann-Kendall, Seasonal Trend Analysis.

ReferenceBooks:

1. Burrough P.A. and McDonnel R.A. (2007) Principles of Geographical Information Systems, 3e, Oxford University Press, New York.
2. ChatfieldC.(2003)TheAnalysisofTimeSeries:AnIntroduction,6e,ChapmanandHall,London.
3. ConoverW.J.(2006)PracticalNonparametricStatistics,JohnWiley&Sons,584pp.
4. Daniel W.W.(2000)AppliedNonparametricStatistics,HoughtonMiffinCompany,USA.
5. BarnettV.(2004)EnvironmentalStatistics,MethodsandApplications,JohnWiley&Sons.
6. BoxG.E.P.,Jenkins G.M.and Reinsel G.C.(2007) Time Series Analysis Forecasting and Control,3e,Pearson Education,Delhi.
7. Isaaks E.H.and Srivastava R.M.(1989)Applied Geostatistics, Oxford UniversityPress, NewYork.
8. Jolliffe,I.(2002).Principal component analysis .John Wiley& SonsLtd.

LAB WORK: Students are required to complete minimum 5 practical's on each unit in addition to the assignments published by the teacher on notice board/ during practical's etc.

Course Type(DSE)			
Course Code	**Course Title**	**Credits**	**ContactHours**
CNM/DSET/671	**Hyper Spectral Image Processing**	2	**2hrs/per week**
CNM/DSEP/671	Practical Based on Hyper Spectral Image Processing	2	**4hrs/per week**

Course Description:

The course is designed to gain the knowledge of hyperspectral imaging & its different tools. To developed skills for processing of multispectral & hyperspectral images.

Prerequisites:

Linear Algebra ,and Calculus and statistics should be known.

Course Objectives (CO):

To study the spectral tool for processing Hyperspectral images.

- To study the concept of Hyperspectral remote sensing
- To know the basics, importance ,and methods of Spectral remote sensing
- To study machine learning technology for processing hyperspectral images

Learning Outcomes (LO):

- To understand the structure of spectral data including band associations, shape and size of a hyperspectral images.
- To develop software skills in programs used for map production in themoderncartographic workflow.
- To develop skills for deploy machine learning technology for processing multispectral and hyperspectral images.

CourseOutline:

Unit- 1: Reflectance spectroscopy, dimensionality reduction, feature selection,subspace modelling,end member extraction, Hyperspectral Concepts and System Trade offs: Signal-to-Noise ratio (SNR) – spectral resolution–sampling –range.

Unit –2: Hyperspectral band ratios and vegetation indices, hyperspectral classification methods, target detection, data collection systems – current HIS systems: Ground – airborne – space borne – calibration techniques – HSIData Processing Software – HSI Data Processing Techniques: Image Space – spectral space – feature space, spectral angle mapping – N-dimensional scatterplots – projection pursuit – spectral mixture analysis – Principal Component Analysis(PCA).

Unit-3: Spectral unmixing, spectral libraries, applications of hyperspectral remote sensing, Spectral mapping –Pixel Purity Index (PPI) – Minimum Noise Fraction (MNF) – Mixture Tuned Matched Filtering (MTMF) –ClassificationTechniques:Supervised–Unsupervised–Hybrid–Detection,Classification,andQuantificationinHyperspectralImagesUsingClassicalLeastSquaresModels.

References

1. Hyper spectral Remote Sensing by Michael TEismann,SPIE,2012
2. Hyper spectral DataExploitation: Theory and ApplicationsbyChein-IChang,Wiley&SonsLtd.2007
3. Techniques and Applications of Hyperspectral Image Analysis by Hans F.Grahnand PaulGeladi, Wiley & SonsLtd.

4.Chein –I Chang, "Hyperspectral Techniques for Spectral Detection and Classification Graphics and General-Purpose Computation," Kluwer Academic Publishers, 2003.

Track III

Course Type(DSE)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/522	**Cryptography**	2	**2hrs/per week**
CNM/DSEP/522	Practical Based on **Cryptography**	2	**4hrs/per week**

Course Description:

he course introduces the underlying the principles and design of cryptosystems. The course covers the basics concepts of cryptography including: traditional ciphers, block ciphers, stream ciphers, public and private key cryptosystems.

Prerequisites:

- Basic knowledge of networking concepts

Course Objectives (CO):

- Understand the fundamental principles and concepts of cryptography.
- Aims to provide an overview of cryptographic concepts, primitives, protocols and applications.

Learning Outcomes (LO):

By the end of this course, students will be able to:

- describe goals and design principles for and common structures of secret key primitives such as block and stream ciphers and message authentication codes
- identify, analyse and explain various forms of attacks based on improper usage of primitives, modes or protocols
- explain basic key management techniques in both secret key and public key cryptography

Course Outline:

Unit 1: Introduction :What is modern cryptography, Historical ciphers and their cryptanalysis, The heuristic versus the rigorous approach; adversarial models and principles of defining security . Perfectly-Secret Encryption: Definitions, the one-time pad; proven limitations.. Private-Key (Symmetric) Encryption: Computational security, Defining secure, encryption, Constructing secure encryption; pseudo randomness, Stronger security notions, Constructing CPA-secure encryption, Modes of operation; CBC vs. CTR, Security of CTR with n − k bit counter for messages to size 2k blocks with proof directly to the LR definition, CCA attacks.

Unit 2: Message Authentication Codes: Message integrity, Definition of security, Constructions from pseudorandom functions, CBC-MAC, Authenticated encryption. Collision-Resistant Hash Functions: Definitions, The Merkle-Damgard transform, HMAC, Birthday attacks, The Random oracle model, Password hashing, Constructions of Pseudorandom Permutations (Block Ciphers) in Practice, Substitution-permutation and Feistel networks, DES and attacks on reduced-round versions, double-DES and triple-DES, AES, Hash functions from block ciphers

Unit 3: Number Theory: Preliminaries and basic group theory, Primes, factoring and RSA, Cryptographic assumptions in cyclic groups, Collision resistant hash functions from discrete log, Public-Key (Asymmetric) Cryptography: Introduction and motivation, Diffie-Hellman key exchange.Public-Key (Asymmetric) Encryption: The model and definitions, Hybrid encryption and KEM/DEM, El Gamal, RSA: textbook encryption, attacks on textbook RSA, padded RSA; CCA-secure RSA KEM.

Recommended Reference Books:

- Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, second edition 2014, CRC Press.
- Cryptography: Theory and Practice by Douglas Stinson, Third edition, CRC Press.
- Handbook of Applied Cryptography by Alfred Menezes, Paul Oorschot and Scott Vanstone. Available Online.
- Foundations of Cryptography by Oded Goldreich. Available Online.
- Cryptography, an Introduction by Nigel Smart. Available Online

Course Type(DSE)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/572	**Cyber Security**	2	**2hrs/per week**
CNM/DSEP/572	Practical Based on Cyber Security	2	**4hrs/per week**

Course Description:

This course provides a comprehensive overview of cyber security, focusing on various tools, practical case studies, and essential reference books. Students will learn the fundamental concepts, techniques, and best practices in cyber security, gaining hands-on experience with popular tools used in the industry. The course incorporates real-world case studies to illustrate the application of these tools and concepts. Students will also explore relevant reference books to deepen their understanding and develop a strong foundation in cyber security.

Prerequisite:

Basic understanding of computer networks and information technology.

Course Objectives (CO):

- To provide students with a solid foundation in cyber security concepts and principles.
- To develop an understanding of common cyber threats and vulnerabilities.
- To familiarize students with various tools and techniques used in cyber security.
- To enable students to assess and mitigate risks to digital systems and data.
- To promote ethical considerations and legal compliance in cyber security practices.

Learning Outcomes (LO):

By the end of the course, students will be able to:

- Identify and analyze common cyber threats and vulnerabilities.
- Implement network security measures to protect against attacks.
- Apply cryptographic techniques to ensure data confidentiality and integrity.
- Develop and implement secure software development practices.
- Demonstrate incident response and management skills.
- Conduct ethical hacking and penetration testing activities.
- Evaluate and recommend security measures for different scenarios.

Course Outline:

Unit 1: Introduction to Cyber Security - Overview of cyber security fundamentals, Importance of cyber security in modern society, Legal and ethical considerations. Cyber Threats and Attacks - Types of cyber threats: malware, social engineering, phishing, etc. Attack vectors and methods, Risk assessment and vulnerability analysis

Unit 2: Cybersecurity Tools - Firewall and intrusion detection systems, Anti-malware software and endpoint protection, Network monitoring and log analysis tools, Encryption and data protection tools, Securing Networks and Systems - Network security principles and protocols, Secure configuration of operating systems and applications, Authentication and access control mechanisms, Patch management and vulnerability mitigation

Unit 3: Incident Response and Forensics - Incident response lifecycle, Digital forensics techniques, Evidence collection and analysis, Post-incident recovery and lessons learned, Case Studies in Cyber Security – a) Analysis of real-world cyber security incidents, b) Examination of incident response strategies c) Lessons learned and best practices

Recommended Reference Books:

"The Art of Invisibility" by Kevin Mitnick

"Hacking: The Art of Exploitation" by Jon Erickson

"Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software" by Michael Sikorski and Andrew Honig

"The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" by Dafydd Stuttard and Marcus Pinto

"Network Security Bible" by Eric Cole

"Blue Team Handbook: Incident Response Edition" by Don Murdoch, Jr.

"Digital Forensics and Incident Response: Developing an Incident Response Plan" by Gerard Johansen

Course Type(DSE)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/622	**Multimedia Security**	2	**2hrs/per week**
CNM/DSEP/622	Practical Based on **Multimedia Security**	2	**4hrs/per week**

Course Description:

This course is designed to provide students with a comprehensive understanding of the field of cyber forensics, including the tools and techniques used for investigating and analyzing digital evidence. The course will cover the fundamental concepts of cyber forensics, explore various forensic tools and methodologies, and present real-world case studies to demonstrate the application of these tools in solving cybercrime investigations.

Prerequisites:

Basics of 2D animation

Course Objectives (CO):

- To learn the basics and Fundamentals of Multimedia.
- To introduce Multimedia components and Tools.
- To understand how Multimedia can be incorporated

Learning Outcome (LO):

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

- Define what Multimedia is and how that works.
- Understand multimedia components using various tools and techniques.
- Analyze and interpret Multimedia data.
- Discuss about different types of media format and their properties.
- Justify the right way of manipulating multimedia systems

Course Outline:

Unit 1: Multi Media Fundamentals: Multimedia, Multimedia Objects, Multimedia in business and work, Multimedia hardware, Memory & Storage devices, Communication devices. Multimedia Tools: Presentation

tools, object generation which includes video sound; image capturing, Authoring tools , card and page based authoring tools.

Unit 2: Sound/Audio Perception of sound, hearing sensitivity, frequency range, sound- wave length, the speed of sound. Measuring the sound, musical sounds, noise signal, dynamic range, pitch, harmonics-equalization-reverberation time, Sound isolation and room acoustics-treatments-studio layout–room dimensions. The Basic set-up of recording systems ; the production chain and responsibilities. Microphones types-phantom power, noise, choosing the right mike ; Mixing console ; Input devices ; Output devices; Audio Publishing.

Unit 3: Graphics/Image :Image file formats and how and where it is used, Video Conferencing, Web Streaming, Video Streaming, Internet Telephony -VirtualReality-Artificial intelligence. Multimedia Authoring: Steps to multimedia authoring , Parameters of authoring systems' evaluation , Fundamentals of content authoring tools Fundamentals of authoring for sharing , Assessment , Design and development processes of Multimedia project and documentation. Multimedia project : Multimedia project evaluation process , Factors that affect multimedia project management , Steps of multimedia project development , Assessment .

Recommended Reference Books:

1) "Multimedia Fundamentals: Vol 1 - Media Coding and Content
2) Processing", Ralf Steinmetz, Klara Narstedt, Pearson Education, 2004.
3) Rajneesh Aggarwal & B. B Tiwari, " Multimedia Systems", Excel Publication, New Delhi , 2007.
4) Li & Drew, " Fundamentals of Multimedia" , Pearson Education, 2009.

https://users.dimi.uniud.it/~antonio.dangelo/MMS/materials/Fundamentals_of_Multimedia.pdf

Course Type(DSE)			
Course Code	**Course Title**	**Credits**	**Contact Hours**
CNM/DSET/672	**Cloud Security**	2	**2hrs/per week**
CNM/DSEP/672	Practical Based on **Cloud Security**	2	**4hrs/per week**

Course Description:

This introductory course provides students with a comprehensive understanding of cryptography and blockchain technologies. Students will learn the fundamental principles, techniques, and applications of cryptography and explore the underlying concepts and mechanisms behind blockchain technology. Through case studies and real-world examples, students will gain practical knowledge and insight into the use of these technologies in various industries. The course aims to equip students with the necessary foundation to understand and work with cryptography and blockchain in a professional context.

Prerequisite:

- Basic understanding of computer science concepts and programming
- Familiarity with data structures and algorithms
- Knowledge of networking and internet protocols

Course Objectives (CO):

- Understand the fundamental concepts and principles of cryptography and blockchain technology.
- Analyze and evaluate different cryptographic algorithms, protocols, and systems.
- Gain hands-on experience in implementing and securing cryptographic systems.
- Explore the inner workings of blockchain networks and consensus mechanisms.
- Develop the skills to design and deploy decentralized applications using smart contracts.
- Investigate real-world use cases of cryptography and blockchain in various industries.

Learning Outcome (LO):

Upon completion of this course, students will be able to:

- Demonstrate a comprehensive understanding of cryptographic algorithms and their applications.
- Evaluate the security of cryptographic systems and propose countermeasures.
- Analyze and design blockchain networks for specific use cases.
- Develop and deploy smart contracts for decentralized applications.
- Apply cryptography and blockchain principles to address real-world challenges.

Course Outline:

Unit 1: Understanding cloud computing, cloud scale IT foundation for cloud, the bottom line, roots of cloud computing, a brief primer on security, architecture, defense in depth, cloud is driving broad changes. Securing the cloud: architecture-requirements, patterns and architectural elements, cloud security architecture, key strategies for secure operations. Overview of data security in cloud computing, data encryption: applications and limits, sensitive data categorization, cloud storage, cloud lock-in Securing cloud : key strategies and best practises- Overall strategy, security controls, limits of security controls, best practices, security monitoring

Unit 2:. Building an internal cloud, Security Criteria-private clouds: selecting an external cloud provide Selecting CSP,-overview of assurance, over view of risks, security criteria, Evaluating clouds security: An information security framework- evaluation cloud security, checklist for evaluating cloud security.

Trust Boundaries, IAM Challenges, IAM Definitions ,IAM Architecture and Practice , Getting Ready for the Cloud 80 Relevant IAM Standards and Protocols for Cloud Services , IAM Practices in the Cloud, Cloud Authorization Management , Security Management in the Cloud, Security Management Standards

Unit 3: Privacy: Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy, Risk Management and Compliance in Relation to Cloud Computing , Legal and Regulatory Implications , U.S. Laws and Regulations , International Laws and Regulations, Audit and compliance, Internal Policy Compliance, Governance, Risk, and Compliance (GRC) Illustrative Control Objectives, for Cloud Computing , Incremental CSP-Specific Control Objectives Additional Key Management Control Objectives, Control Considerations for CSP Users, Regulatory/External Compliance, Other Requirements , Cloud Security Alliance, Auditing the Cloud for Compliance.

Recommended Reference Books:

- Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumara swamy, Shahed Latif, O'Reilly Media; 1st Edition, 2009, ISBN: 0596802765
- Securing the Cloud: Cloud Computer Security Techniques and Tactics Vic (J.R.) Winkler, Imprint: Syngress, 1st Edition, 2011, ISBN: 9781597495929
- Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vine, 1st Edition, 2010, ISBN-13: 978-0470589878, 2010, ISBN-10: 0470589876
- Cloud Computing: Implementation, Management, and Security, John Ritting house, James Ransome, 1st Edition, 2009, ISBN-13: 978-1439806807, ISBN-10: 1439806802