



Entrepreneurship (During vacation)

After the second semester examination the students shall immediately join any the government/semi-government/private organizations for their six week entrepreneurship training and prepare a summary report about the work performed there. Candidate must inform the department about the place where he/she is doing entrepreneurship. In summary report the candidate shall attach a certificate from that organisation. The evaluation of this report and work shall be done with third semester examination.

Department of Computer Science University of Lucknow, Lucknow M.Sc. (Computer Science) Third Semester Syllabus	
Course Title: Computer Network Course Code: MCS -301 Paper Number: I Credit : 04 Maximum Marks: 100	Objective: The course objective include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and gaining practical experience in installation, monitoring, and troubleshooting of current LAN systems
Unit –I Data communication, Application of a Computer Networks; Classification of Computer Networks; Network Topology, Virtual private network, need for Standards. Network architecture and OSI model, TCP/IP Model	
Unit –II Communication media and Data transmission, Analog and Digital Transmission, Modulation and demodulation, Transmission media, Wireless Communication, Transmission Mode, Interfacing, Multiplexing, Error Detection and Correction. Data link control and protocol concepts, Transmission Impairment, Attenuation, Decibel, Distortion, Noise, Data rate limits, Noiseless Channel: Nyquist Bit Rate, Noisy Channel: Shannon Capacity, Performance of Channel: Bandwidth, Throughput, Latency, Propagation time and Transmission Time.	
Unit –III Network Interconnections with repeaters, Switches, Bridges, Routers and gateways, cable modems IEEE Standard 802.3, IEEE 802.4, IEEE 802.5, FDDI, DQDB, Ethernet Technology, Wan Transmission methods, Virtual LANs, Network Layer services, Packetizing, Routing and forwarding,	
Unit –IV Error Control, Flow Control, Congestion Control, switching, packet switching, Circuit switching, Message Switching, Integrated Services and Routing protocols, Internetworking, Global system for Mobile communication, Universal Mobile telecommunication system,	
Unit –V Global packet radio system, TCP, FTP, IPv4, IPv6, Resource Management Issues, Types of Resources.	
Outcome of Course: At the end of this Course, the successful students will be able to: <ul style="list-style-type: none"> • Understand the various topologies and its importance for networking. • Understand the OSI Reference Model and TCP/IP model for networking as well as the functions of various layers. • Know the functions of various devices of networking such as switches, Hubs, routers etc. • Understand various protocols which are involved for functioning of layers. 	

Recommended Books

- [1] Brijendra Singh, "Data Communication and Computer Networks", PHI Publication, Third Edition, 2011.
- [2] Behrouz A. Forouzan, "Data Communication and Networking", McGraw Hill Publication, Fifth Edition, 2017.
- [3] Andrew S. Tanenbaum, "Computer Network", PHI publication, Fifth Edition, 2013.

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Department of Computer Science
University of Lucknow, Lucknow
M.Sc. (Computer Science) Third Semester Syllabus

Course Title: Computer Graphics and Image Processing

Course Code: MCS -302

Paper Number: II Credit : 04

Maximum Marks: 100

Objective: the objective of this course is to focus on the theoretical aspects and implementation of computer graphics. This course shall explain the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two and three dimensions.

Unit –I

Introduction, What is computer Graphics?, Area of Computer Graphics, Design and Drawing, Animation Multimedia applications, Simulation, How are pictures actually stored and displayed, Difficulties for displaying pictures, Cathode Ray Tube, Quality of Phosphors, CRTs for Color Display, Beam Penetration CRT, The Shadow - Mask CRT, Direct View Storage Tube, Tablets, The light Pen, Three Dimensional Devices

Unit –II

Geometric Transformations and Clipping: 2D Transformations, Homogeneous Coordinate System, 3D Transformations, Plane Geometric. Projections, Viewing Transformations, Line and Polygon Clipping, Point Plotting Techniques, Qualities of good line drawing algorithms, The Digital Differential Analyzer (DDA), Bresenham's Algorithm, Generation of Circles

Unit –III

What is transformation?, Matrix representation of points, Basic transformation, Need for Clipping and Windowing, Line Clipping Algorithms, The midpoint subdivision Method, Other Clipping Methods, Sutherland – Hodgeman Algorithm, Viewing Transformations

Unit –IV

Digital Image Fundamentals Light, brightness adaption and discrimination, Human visual system, Image as a 2D data, Image representation Gray scale and Colour images, Image sampling and quantization, Image enhancement and filtering in spatial domain: Intensity transformation functions: Contrast stretching, Thresholding, Image negative, Log transformation, Power-law transformation, Intensity level slicing and Bit-plane slicing. Image histogram, Histogram equalisation process. Fundamentals of spatial filtering, Correlation and convolution, Spatial filtering mask for low pass filtering (smoothing) and high pass filtering (sharpening).

Unit –V

Image filtering in the frequency domain: Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering, 2D- DFT, 2DFFT, 2D- DCT, Fundamentals of 2D-wavelet transform, Image pyramids, sub-band coding, Image restoration: Reasons for image degradation, Model of image degradation/restoration process, Noise probability density functions, Image restoration using spatial filtering (Mean filters, Order statistic filters and adaptive filters), Inverse Filtering, MMSE (Wiener) Filtering.

Outcome of Course:

At the end of this Course, the students will be able to:

- Understand the basic objectives of computer graphics and its application.
- Understand the basic structures of 2D and 3D graphics systems.
- Understand 2D coordinate systems and equations of graphs.
- Implement translation, rotation, scaling, shearing, and reflection.

Recommended Books

- [1] D. F. Rogers, "Procedural Elements for Computer Graphics", Second Edition, McGraw-Hill Publication, 2008.
- [2] D. F. Rogers and J. Alan Adams, "Mathematical Elements for Computer Graphics", Second edition, Tata McGraw Hill Publication, 2004.
- [3] Anil K. Jain, "Fundamentals of Digital Image processing", first edition, Pearson Publication, 2015.
- [4] Donald D. Hearn and M. Pauline Baker, "Computer Graphics", Second edition, Pearson Education, 2002.

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Paper-III Course Code: MCS 303*

In the M.Sc. Computer science Course paper code MCS 303 is reserved for elective subjects (with-in Department), in which students are required to choose one paper from the given list (below).

List of valued added course

1. MCS-303EA-Cyber Security
2. MCS-303EB-Internet of Things
3. MCS-303EC-Data Science
4. MCS-303ED- Artificial Intelligence

Department of Computer Science University of Lucknow, Lucknow M.Sc. (Computer Science) Third Semester Syllabus

Course Title: Cyber Security

Course Code: MCS -303EA

Paper Number: III Credit : 04

Maximum Marks: 100

Objective: The objective of this course is to prepare students with the technical knowledge and skills needed to protect and defend computer systems and networks. With this course graduates can plan, implement, and monitor cyber security mechanisms in order to ensure the protection of information technology assets. This course helps graduates to identify, analyze, and remediate computer security breaches.

Unit -I

Network, Internet, world wide web, threat, vulnerability, information and its security, security of internet, network and worldwide web, cyber crime and its origin, cyber attack, motivation behind cyber crime, cyber terrorism and botnet, cyberspace and its security, cyber security as an international problem, need of cyber security, cyber security as an shared responsibility.

Unit -II

Major types of cyber crimes: Cyber Various forms of Cybercrimes: Cyber Stalking, Spoofing, Salami Attack, e-Mail Bombing, Identity theft, Denial of Services (DoS), Distributed Denial of Services (DDoS) Pornography, Intellectual Property theft, OSI model layer architecture, vulnerabilities in OSI layers,

Unit -III

Vicious Architecture of Cyber crime, information to cyber security, Risk analysis in cyber security, Methods of cyber attack: Physical attack conventional, Electronic cyber attack, computer network attack. Challenges in information security, Intrusion, Intrusion Detection, Intrusion detection system architecture and its components, function of intrusion detection system,

Unit -IV

Host based intrusion and network based intrusion, intrusion prevention system, function of prevention system, Cooperative Intrusion Traceback and Response Architecture (CITRA), attribution in cyber security, major attribution techniques. Stepping stones in cyber security, Connection chain, Direct and Indirect stepping stones, Stepping stone detection parameters.

Unit -V

False positives and false negatives, Importance of real time traffic detection, stepping stone Detection algorithms: Timing Based Algorithm, Brute force content based Algorithm, Content based algorithm, Role of Jitter and Chaff in Detection Algorithm.

Outcome of Course:

At the end of this Course, the students will be able to:

- Analyze and evaluate the cyber security needs of an organization.
- Conduct a cyber security risk assessment.
- Measure the performance and troubleshoot cyber security systems.
- Implement cyber security solutions.

Recommended Books

- [1] William Stallings, "Effective Cybersecurity: A Guide to Using Best Practices and Standards", First Edition, Addison-Wesley Professional publication, 2018.
- [2] Raef Meeuwisse, "Cybersecurity for Beginners", Second Edition", Cyber Simplicity Ltd publication, 2017.
- [3] Nina Godbole and Sunit Belpure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley, First edition, 2009.
- [4] Ross J. Anderson, "Security Engineering: A Guide to Building Dependable Distributed Systems", Wiley, 2008.



Department of Computer Science
University of Lucknow, Lucknow
M.Sc. (Computer Science) Third Semester Syllabus

Course Title: Internet of Things

Course Code: MCS -303EB

Paper Number: III Credit : 04

Maximum Marks: 100

Objective: The objective of this course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and to look at real-world solutions.

Unit –I

What is the Internet of Things? : History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities

Unit –II

Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology,

Unit –III

RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPCGlobal Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things. Wireless Sensor Networks: History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure establishment.

Unit –IV

Host based intrusion and network based intrusion, intrusion prevention system, function of prevention system, Cooperative Intrusion Traceback and Response Architecture (CITRA), attribution in cyber security, major attribution techniques. Stepping stones in cyber security, Connection chain, Direct and Indirect stepping stones, Stepping stone detection parameters.

Unit –V

Vulnerabilities of IoT, Security requirements, Threat analysis, Use cases and misuse cases, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT, Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things. Internet of Things Application : Smart Metering Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards,

Outcome of Course:

At the end of this Course, the successful students will be able to:

- Understand the definition and significance of the Internet of Things
- Discuss the architecture, operation, and business benefits of an IoT solution
- Examine the potential business opportunities that IoT can uncover
- Explore the relationship between IoT, cloud computing, and big data
- Identify how IoT differs from traditional data collection systems

Recommended Books

- [1] Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
- [2] Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014

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Department of Computer Science
University of Lucknow, Lucknow
M.Sc. (Computer Science) Third Semester Syllabus

Course Title: Data Science

Course Code: MCS -303EC

Paper Number: III Credit : 04

Maximum Marks: 100

Objective: The key objective of Data Science is to extract valuable information for use in strategic decision making, product development, trend analysis, and forecasting.

Unit –I

Introduction to Data Science: Data Science Process, roles, Stages in Data Science Project, working with data from files, working with database, exploring data, managing data, cleaning and sampling for modelling and validation.

Unit –II

Visualization- Basic Charts and Plots- Multivariate Data Visualization- Data Visualization Techniques- Pixel-Oriented Visualization Techniques- Geometric Projection Visualization Techniques- Icon-Based Visualization Techniques- Hierarchical Analysis Tools Multivariate Analysis Tools- Distribution Analysis Tools- Correlation Analysis Tools Geographical Analysis Tools.

Unit –III

Modelling Methods: Choosing and evaluating models, Mapping Problem to Machine learning, evaluating clustering models, validating models, cluster analysis, K-means Algorithm, Naive Byes, Memorization Methods, Linear and logistic Regression, Unsupervised methods

Unit –IV

Relational database design, features of good relational design, Design alternative: large schemas and smaller schemas, Atomic domains and first normal form, Decomposition using functional dependencies, keys and functional dependencies, boyce-codd normal form, BCNF and Dependency preservation, third normal form, higher normal forms.

Unit –V

Introduction to Different Tools used for data Science Ex. SPSS, STATISTICA, R, Python

Outcome of Course:

At the end of this Course, the successful students will be able to:

- Create effective mathematical solutions to analytical problems.
- Create effective solutions to computing challenges in analytical projects.
- Effectively organize and manage datasets for analytical projects.
- Critically analyze problems and identify analytical solutions.
- Communicate analytics problems, methods, and findings effectively orally, visually, and in writing.
- Critically evaluate ethical, privacy and security challenges in data analytics.

Recommended Books

- [1] G. Golemund, H. Wickham, "R for Data Science", first edition, O'Reilly publication, 2016.
[2] Cathy O'Neil, Rachel Schutt, "Doing Data Science: Straight Talk from the Frontline", First Edition, O'Reilly Media, 2013.

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Department of Computer Science
University of Lucknow, Lucknow
M.Sc. (Computer Science) Third Semester Syllabus

Course Title: Artificial Intelligence

Course Code: MCS -303ED

Paper Number: III Credit : 04

Maximum Marks: 100

Objective: The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches. Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning.

Unit –I

Introduction of artificial Intelligence, AI techniques, problem solving with AI, AI models, data acquisition and learning aspects in AI. Scope of AI: Games, Theorem proving, Natural Language Processing, Computer Vision and Speech Processing, Robotics, Introduction to Intelligent agents and expert system.

Unit –II

Knowledge Representation: Procedural Vs Declarative Knowledge, Representations & Approaches to Knowledge Representation, Forward Vs Backward Reasoning, Matching Techniques, Partial Matching, Fuzzy Matching Algorithms and RETE Matching Algorithms; Logic Based Programming- AI Programming languages: Overview of LISP, Search Strategies in LISP, Pattern matching in LISP, An Expert system Shell in LISP, Over view of Prolog, Production System using Prolog

Unit –III

Symbolic Logic: Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Syntax & Semantics of FOPL, Normal Forms, Unification & Resolution, Representation Using Rules, Natural Deduction; Structured Representations of Knowledge: Semantic Nets, Partitioned Semantic Nets, Frames, Conceptual Dependency, Conceptual Graphs, Scripts, CYC.

Unit –IV

Reasoning under Uncertainty: Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Logics for Non-Monotonic Reasoning, Model and Temporal Logics; Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic: Crisp Sets, Fuzzy Sets, Fuzzy Logic Control, Fuzzy Inferences & Fuzzy Systems.

Unit –V

Experts Systems: Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells, Fuzzy Expert systems.

Outcome of Course:

At the end of this Course, the successful students will be able to:

- Design a knowledge based system,
- Familiar with terminology used in this topical area,
- have read and analyzed important historical and current trends addressing artificial intelligence.

Recommended Books

- [1] Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", second edition, PHI publication, 2002.
- [2] Nils Nilsson, "Artificial Intelligence: A New Synthesis", first edition, Morgan Kaufmann Publication, 1998.
- [3] Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", Third edition, McGraw Hill publication, 2017.

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Paper-IV Course Code: MCS 304*

Elective Papers in Third Semester (E-II) (Outside Department)		Elective Papers for third Semester (MOOC's/Swayam Subjects)
Student shall Opt one subject from following Department of university • M.Sc. Third semester in Physics • M.Sc. Third semester in Statistics • M.Sc. Third semester in Mathematics	OR	After completing any one of the following listed or online courses under MOOC's/Swayam (MCS 304) student must submit the self attested pass/satisfactory certificate to COE office University of Lucknow MCS-304MA Animation MCS-304MB Communication Skill MCS-304MC Academic Writing MCS-304MD Academic and Research Report MCS-304ME Advertising and Marketing

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Project Course Code: MCS 305

Minor Project: In this course student shall develop a minor project in the form of software, web application or research report under the supervision of Departmental supervisor.

Department of Computer Science University of Lucknow, Lucknow M.Sc. (Computer Science) Third Semester Syllabus	
Course Title: Lab based on MCS 302	Objective: The objective of this course is to provide practical exposure to students about the basics of computer graphics. It starts with an overview of interactive computer graphics, two dimensional system and mapping, then it presents the most important drawing algorithms, two-dimensional transformation, Clipping, filling and an introduction to 3-D graphics.
Course Code: MCS -306	
Practical Credit : 04	
Maximum Marks: 100	
Practical Paper	
List of Exercise based on Computer Graphics and Image Processing	
<ol style="list-style-type: none">1. Write a Program to draw basic graphics construction like line, circle, arc, ellipse and rectangle.2. Write a Program to draw animation using increasing circles filled with different colors and patterns.3. Program to make screen saver in that display different size circles filled with different colors and at random places.4. Program to Draw a Line using DDA Algorithm5. Program to Draw a Line using Bresenham's Algorithm6. Program to Draw a Circle using Mid - Point Algorithm.7. Program to Draw a Circle using Bresenham's Algorithm.8. To draw a line using Simple DDA Algorithm for positive line slope.9. To draw a line using Symmetrical DDA Algorithm for positive line.10. To draw a line using Simple DDA Algorithm for negative line slope.11. To draw a line using Symmetrical DDA for negative line slope.12. To draw a line using Bresenham's Algorithm for negative line slope.13. To draw a line, triangle and circle using functions of graphics.h header file.14. To display simple shapes (Like hut, star, car etc.) Using graphics primitives.15. To perform translation transformation on a given triangle.16. To perform scaling transformation on a given triangle.17. To perform rotation transformation on a given triangle.	
Outcome of Course: At the end of this Course, the successful students will be able to:	
<ul style="list-style-type: none">• Understand the fundamental concepts and theory of computer graphics.• Understand the modelling, and interactive control of 2D and 3D computer graphics applications.• Write basic graphics application programs including animation.• Design programs to display graphic images to given specifications	

Recommended Books

- [1] D. F. Rogers, "Procedural Elements for Computer Graphics", Second Edition, McGraw-Hill Publication, 2008.
- [2] D. F. Rogers and J. Alan Adams, "Mathematical Elements for Computer Graphics", Second edition, Tata McGraw Hill Publication, 2004.
- [3] Anil K. Jain, "Fundamentals of Digital Image processing", first edition, Pearson Publication, 2015.
- [4] Donald D. Hearn and M. Pauline Baker, "Computer Graphics", Second edition, Pearson Education, 2002.

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