

T.Y.B.Sc. Computer Science Syllabus

Choice Based Credit System (CBCS)

with effect from

Academic year 2023-2024

Semester – V				
Course Code	Course Type	Course Title	Credits	Lectures/Week
USCS501	Core Subject	Artificial Intelligence	3	3
USCSP501	Core Subject Practical	Artificial Intelligence – Practical	1	3
USCS502	Core Subject	Information & Network Security	3	3
USCSP502	Core Subject Practical	Information & Network Security – Practical	1	3
USCS5031	Skill Enhancement Elective 1* (SEE)	Linux Server Administration	3	3
USCSP5031	Skill Enhancement Elective 1* Practical (SEEP)	Linux Server Administration – Practical	1	3
USCS5032	Skill Enhancement Elective 1* (SEE)	Software Testing & Quality Assurance	3	3
USCSP5032	Skill Enhancement Elective 1* Practical (SEEP)	Software Testing & Quality Assurance – Practical	1	3
USCS5041	Skill Enhancement Elective 2* (SEE)	Cyber Forensics	3	3
USCSP5041	Skill Enhancement Elective 2* Practical (SEEP)	Cyber Forensics – Practical	1	3
USCS5042	Skill Enhancement Elective 2* (SEE)	Game Programming	3	3
USCSP5042	Skill Enhancement Elective 2* Practical (SEEP)	Game Programming – Practical	1	3
USCS5051	Generic Elective**	Project Management	2	3
USCS5052	Generic Elective**	Operations Research	2	3
USCSP505	Project	Project Work – I	2	3

* One course each from Skill Enhancement Elective 1 and Skill Enhancement Elective 2 should be selected by the student.

** One course from Generic Elective should be selected by the student

Semester V

Course Code	Course Title	Credits	Lectures /Week
USCS501	Artificial Intelligence	2	3
Unit	Topics		No of Lectures
I	Introduction to AI and Intelligent Agents What Is AI: Foundations, History and State of the Art of AI Intelligent Agents: Agents and Environments, Nature of Environments, Structure of Agents. Problem Solving by searching: Problem-Solving Agents, Uninformed Search Strategies, Informed (Heuristic) Search Strategies		15
Textbook(s): 1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition, Pearson, 2010.			
Additional Reference(s): 1. Artificial Intelligence: Foundations of Computational Agents, David L Poole, Alan K. Mackworth, 2nd Edition, Cambridge University Press, 2017. 2. Artificial Intelligence, Kevin Knight and Elaine Rich, 3rd Edition, 2017 3) The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani and Jerome Friedman, Springer, 2013			

Course Code	Course Title	Credits	Lectures /Week
USCSP501	Artificial Intelligence – Practical	1	3
1	Breadth First Search & Iterative Depth First Search <ul style="list-style-type: none"> Implement the Breadth First Search algorithm to solve a given problem. Implement the Iterative Depth First Search algorithm to solve the same problem. Compare the performance and efficiency of both algorithms. 		
2	A* Search and Recursive Best-First Search <ul style="list-style-type: none"> Implement the A* Search algorithm for solving a pathfinding problem. Implement the Recursive Best-First Search algorithm for the same problem. Compare the performance and effectiveness of both algorithms. 		
3	Decision Tree Learning <ul style="list-style-type: none"> Implement the Decision Tree Learning algorithm to build a decision tree for a given dataset. Evaluate the accuracy and effectiveness of the decision tree on test data. Visualize and interpret the generated decision tree. 		

Course Code	Course Title	Credits	Lectures /Week
USCS502	Information & Network Security	2	3
Unit	Topics	No of Lectures	
I	<p>Introduction: Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms</p> <p>Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, AES (round details not expected), Multiple Encryption and Triple DES, Block Cipher Modes of Operation, Stream Ciphers</p> <p>Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm</p>	15	
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Cryptography and Network Security: Principles and Practice 7th edition, William Stallings, Pearson <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1. Cryptography and Network, 2nd edition, Behrouz A Fourouzan, Debdeep Mukhopadhyay, TMH. 2. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill. 			

Course Code	Course Title	Credits	Lectures /Week
USCSP502	Information & Network Security – Practical	1	3
1	Implementing Substitution and Transposition Ciphers: Design and implement algorithms to encrypt and decrypt messages using classical substitution and transposition techniques.		
2	RSA Encryption and Decryption: Implement the RSA algorithm for public-key encryption and decryption, and explore its properties and security considerations.		
3	Message Authentication Codes: Implement algorithms to generate and verify message authentication codes (MACs) for ensuring data integrity and authenticity.		

Course Code	Course Title	Credits	Lectures /Week
USCS5031	Linux Server Administration	2	3
Unit	Topics	No of Lectures	
I	<p>Introduction: Technical Summary of Linux Distributions, Managing Software</p> <p>Single-Host Administration: Managing Users and Groups, Booting and shutting down processes. File Systems, Core System Services, Process of configuring, compiling, Linux Kernel</p> <p>Networking and Security: TCP/IP for System Administrators, basic network Configuration, Linux Firewall (Netfilter), System and network security</p>	15	
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Linux Administration: A Beginner's Guide, Wale Soyinka, Seventh Edition, McGraw-Hill Education, 2016 2. Ubuntu Server Guide, Ubuntu Documentation Team, 2016 <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1. Mastering Ubuntu Server, Jay LaCroix, PACKT Publisher, 2016 			

Course Code	Course Title	Credits	Lectures /Week
USCSP5031	Linux Server Administration – Practical	1	3
1	Install DHCP Server in Ubuntu 16.04		
2	Initial settings: Add a User, Network Settings, Change to static IP address, Disable IPv6 if not needed, Configure Service, display the list of services which are running. Stop and turn OFF auto-start setting for a service if you don't need it, Sudo Settings		
3	Configure NP Server (NTPd), Install and configure NTPd, Configure NTP Client (Ubuntu and Windows)		

Course Code	Course Title	Credits	Lectures /Week
USCS5032	Software Testing & Quality Assurance	2	3
Unit	Topics	No of Lectures	
I	<p>Introduction to Software Testing and Quality Assurance</p> <p>Introduction to Software Testing: Nature of errors and the need for testing</p> <p>Definition of Quality and Quality Assurance: Understanding quality in software development, Distinction between Quality Assurance (QA), Quality Control (QC), Quality Management (QM), and Software Quality Assurance (SQA)</p> <p>Software Development Life Cycle (SDLC): Overview of SDLC phases and their relationship to testing, Role of testing in each phase, Software quality factors and their impact on testing</p> <p>Verification and Validation (V&V): Definition of V&V and its significance in software development, Different types of V&V mechanisms, Concepts of Software Reviews, Inspection, and Walkthrough</p>	15	
<p>Textbook(s):</p> <ol style="list-style-type: none"> Software Engineering for Students, A Programming Approach, Douglas Bell, 4th Edition,, Pearson Education, 2005 Software Engineering – A Practitioners Approach, Roger S. Pressman, 7th Edition, Tata McGraw Hill <p>Additional Reference(s):</p> <ol style="list-style-type: none"> Quality Management, Donna C. S. Summers, 5th Edition, Prentice-Hall. Software Testing and Quality Assurance Theory and Practice, Kshirsagar Naik, Priyadarshi Tripathy , John Wiley & Sons, Inc. , Publication. 			

Course Code	Course Title	Credits	Lectures /Week
USCSP5032	Software Testing & Quality Assurance – Practical	1	3
1	Install Selenium IDE and create a test suite containing a minimum of 4 test cases for different web page formats (e.g., HTML, XML, JSON, etc.).		
2	Conduct a test suite for two different websites using Selenium IDE. Perform various actions like clicking links, filling forms, and verifying content.		
3	Install Selenium Server (Selenium RC) and demonstrate its usage by executing a script in Java or PHP to automate browser actions.		

Course Code	Course Title	Credits	Lectures /Week
USCS5041	Cyber Forensics	2	3
Unit	Topics	No of Lectures	
I	<p>Introduction: Understanding Computer Forensics, Preparing for Computer Investigations, Maintaining Professional Conduct</p> <p>Computer Investigations: Preparing a Computer Investigation, Taking a Systematic Approach, Procedures for Corporate High-Tech Investigations, Understanding Data Recovery Workstations and Software, Conducting an Investigation</p> <p>Data Acquisition: Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions</p>	15	
<p>Textbook(s):</p> <p>1. Bill Nelson, Amelia Philips and Christopher Steuart, "Guide to computer forensics and investigations", course technology, 6th edition</p> <p>Additional Reference(s):</p> <p>1. Kevin Mandia, Chris Proise, "Incident Response and computer forensics", Tata McGrawHill</p>			

Course Code	Course Title	Credits	Lectures /Week
USCSP5041	Cyber Forensics – Practical	1	3
1	<p>Creating a Forensic Image using FTK Imager/Encase Imager :</p> <ul style="list-style-type: none"> • Creating Forensic Image • Check Integrity of Data • Analyze Forensic Image 		
2	<p>Data Acquisition:</p> <ul style="list-style-type: none"> • Perform data acquisition using: • USB Write Blocker + Encase Imager • SATA Write Blocker + Encase Imager • Falcon Imaging Device 		
3	<p>Analyze the memory dump of a running computer system.</p> <ul style="list-style-type: none"> • Extract volatile data, such as open processes, network connections, and registry information. 		

Course Code	Course Title	Credits	Lectures /Week
USCS5042	Game Programming	2	3
Unit	Topics	No of Lectures	
I	<p>Introduction to Vectors: Vectors: Vector Manipulation, multiplying a Vector by a Scalar, Vector Addition and Subtraction, Position Vectors, Unit Vectors, Cartesian Vectors, Vector Multiplication, Scalar Product, Example of the Dot Product, The Dot Product in Lighting Calculations, The Dot Product in Back-Face Detection, The Vector Product, The Right-Hand Rule, deriving a Unit Normal Vector for a Triangle Areas, Calculating 2D Areas</p> <p>Transformations: 2D Transformations, Matrices, Homogeneous Coordinates, 3D Transformations, Change of Axes, Direction Cosines, rotating a Point about an Arbitrary Axis, Transforming Vectors, Determinants, Perspective Projection, Interpolation</p> <p>3D Graphics for Game Programming: 3D Transformations, Quaternions, 3D Modeling and Rendering, Ray Tracing, Shader Models, Lighting, Color, Texturing, Camera and Projections, Culling and Clipping, Character Animation, Physics-based Simulation, Scene Graphs.</p>	15	
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Mathematics for Computer Graphics, John Vince, Springer-Verlag London, 5th Edition,2017 2. Mathematics for 3D Game Programming and Computer Graphic, Eric Lengyel, Delmar 3. Introduction To 3D Game Programming With DirectX® 11, Frank D Luna, Mercury Learning And Information,2012. <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1. Computer Graphics, C Version, Donald Hern and Pauline Baker, Pearson Education, 2nd Edition, 1997 2. HLSL Development Cookbook, Doron Feinstein, PACKT Publishing,2013 3. https://docs.unity3d.com/Manual/index.html 			

Course Code	Course Title	Credits	Lectures /Week
USCSP5042	Game Programming – Practical	1	3
1	Setup DirectX 11, Window Framework and Initialize Direct3D Device, Loading models into DirectX 11 and rendering		
2	Learn Basic Game Designing Techniques with pygame.		
3	Develop Snake Game using pygame		

Course Code	Course Title	Credits	Lectures /Week
USCS5051	Project Management	2	3
Unit	Topics	No of Lectures	
I	<p>Introduction to Project Management</p> <p>Introduction to Project Management: Definition and characteristics of a project, Importance of project management, Project management processes and knowledge areas</p> <p>Project Selection, Initiation and scope Management: Project selection criteria and methods, Project initiation and charter development, Stakeholder identification and analysis, Scope planning and definition, Work Breakdown Structure (WBS) development, Scope verification and change control</p> <p>Project Time & Cost Management: Activity definition and sequencing, Estimating activity durations and resources, Developing the project schedule, Schedule control and monitoring, Cost estimation techniques, Budget development and monitoring, Earned Value Management (EVM), Cost control and analysis</p>	15	
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Project Management for Business and Technology, 3rd edition, Pearson Education. John M. Nicholas, 2000 2. Information Technology Project Management, by Jack T. Marchewka, 4th Wiley India 2013. 3. A Guide to the Project Management Body of Knowledge (PMBOK® Guide)–Sixth Edition 6th Edition, Project Management Institute, 2017 <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1. Introduction to Software Project Management by Adolfo Villafiorita · 2016, CRC press, e book format. 2. Project Management Professional Workbook, Claudia M. Baca, Patti M. Jansen, Sybex Publication, 2013 3. Project Management, by S. J. Mantel, J. R. Meredith and etal., 1st edition, Wiley India, 2009. 			

Course Code	Course Title	Credits	Lectures /Week
USCS5052	Operations Research	2	3
Unit	Topics	No of Lectures	
I	<p>Introduction to Operations Research(OR)</p> <p>Exploring Operations Research – A Quantitative Approach to Decision-Making, Definitions, Features, OR Approach to Problem Solving, Models and Modelling in Operations Research, Advantages of Model Building and Operations Research Study, Applications of Operations Research, Computer Software for Operations Research</p> <p>Linear Programming and Duality: Linear Programming: Applications and Model Formulation, Structure of Linear Programming Model, General Structure of an LP Model, Assumptions of an LP Model, Advantages & Limitations Linear Programming, Application Areas, General Mathematical Model of Linear Programming Problem, Examples of LP Model Formulation</p> <p>Linear Programming-The Graphical Method: Important Definitions, Graphical Solution Methods of LP Problems, The Simplex Method: Introduction, Standard form of an LP Problem, Simplex Algorithm (Maximization Case), Simplex Algorithm (Minimization Case), Two-Phase Method, Big-M Method</p>	15	
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Operations Research: Theory and Applications, J K Sharma, Trinity Press, 6th Edition , 2017 2. Introduction to Operations Research, Frederick S. Hillier, Gerald J. Lieberman, McGraw Hill Education; 11th edition, 2021 <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1. Operations Research, P K Gupta, S. Chand Publications, 7th Edition, 2018 2. Operations Research, P. Rama Murthy, New Age Publication, 2nd Edition 3. Operations Research: An Introduction, 10th Edition, Hamdy A. Taha, Pearson Education, 2019 4. Operations Research (Schaums Outline Series), Richard Bronson and Govindasami Naadimuthu, McGraw Hill Education, 2nd Edition, 2017 			

Course Code	Course Title	Credits	Lectures /Week
USCSP505	Project Work – I	2	3
<u>Refer to the Project Guidelines at the end</u>			

Project Guidelines *(for USCSP505 and USCSP605)*

Project Types:

- a) **Developing a solution for a real-life problem:** In this case, the project focuses on addressing an existing requirement for a computer-based solution that has practical applications. The project should successfully implement the different stages of the system development life cycle. Examples: Secure Online Banking System, Machine Learning-based Disease Diagnosis System, Cloud-based Document Management System.
- b) **Innovative Product Development:** These projects involve exploring and developing a computer-based solution with a unique and innovative utility. Examples: Cybersecurity Monitoring and Threat Detection System, Machine Learning-powered Predictive Maintenance System for Industrial Equipment, IoT-based Smart Energy Management System.
- c) **Research-Level Project:** These projects involve conducting research and development to explore advanced technologies and solve complex problems. Examples: Deep Learning-based Image Recognition System for Medical Imaging, Cloud Computing Infrastructure Optimization for Big Data Processing, Data Science-driven Predictive Analytics for Sales Forecasting. The methodology and reporting of such projects may vary based on the project supervisor's guidance.

Tools & Technologies:

In the project work, students are granted complete freedom to select platforms, tools, and programming languages without any imposed restrictions. This approach encourages creativity, flexibility, and exploration of various technologies. By prioritizing open-source technologies, students can leverage a vast array of resources and community support. Commonly employed tools include IDEs, version control systems (e.g., Git), programming languages (e.g., Python, Java), databases (e.g., MySQL), and web frameworks (e.g., Django, Ruby on Rails). The evaluation process focuses on the project's content and implementation rather than the specific tools chosen, ensuring a fair assessment of the students' skills and problem-solving abilities.

Project Guide:

Assigning a project guide to each project or group is a mandatory requirement to ensure the successful completion of the project work. The guide plays a crucial role as a mentor and technical expert, providing invaluable support and guidance to students. They are expected to facilitate effective communication and teamwork, review project proposals, assign schedules, and monitor progress on a regular basis. Additionally, guides are expected to offer timely feedback, provide guidance on project planning and implementation strategies, evaluate the quality of work, and promote professionalism and ethical conduct. Their expertise and involvement are essential in helping students navigate challenges, make informed decisions, and achieve their project goals effectively.

Project Team Size: 1 – 2 members

Project Proposal: The project proposal is a mandatory document that serves as a foundation for the project. It helps students define their project idea, receive early evaluation and feedback, establish clear communication with the project guide, and take ownership of the project's successful execution. A formal proposal ensures systematic and professional project planning, fostering critical thinking, effective communication, and project management skills. The proposal provides a roadmap and increases the chances of a successful outcome. Before initiating a project, it is mandatory to submit a project proposal for approval. **The original duly approved project proposal should be attached to the final project report.** The project proposal for UG computer science projects should include the following contents:

- Title
- Introduction
- Objectives: Clearly state the objectives of the project. What specific goals do you aim to achieve?
- Scope
- Methodology
- Tools and Technologies
- Timeline
- Resources
- Expected Outcomes
- References