Affiliated to
University of Mumbai

R.P. Gogate College of Arts & Science and R.V. Jogalekar College of Commerce(Autonomous), Ratnagiri

Bachelor of Science (B.Sc.)
Programme-Computer Science
Three Year Integrated Programme
Six Semesters

Course Structure

T. Y. BSc. Sem V & VI

Choice Based Credit System (CBCS)

Implementation Year – 2023-24

Preamble

This is a third year curriculum in the subject of Computer Science. The revised and restructured curriculum for the three year integrated course is systematically designed considering the National Education Policy (NEP) along with the Autonomy constraints. The syllabus aims to provide students with a comprehensive understanding of computer science concepts, theories, and practical skills, enabling them to excel in the dynamic and rapidly evolving field of technology. The revised and restructured curriculum for the Three-year integrated course is systematically designed considering the current industry needs in terms of skill sets demanded in the new technological environment. It also endeavors to align the program structure and course curriculum with student aspirations and corporate expectations.

The curriculum contains two semesters, each semester contains two Electives: Elective-I and II. Every elective contains three papers based on specific areas of computer science. It also include one skill enhancement paper per semester, helps the student to evaluate his/ her computer science domain specific skill and also to meet industry expectations. The curriculum is contextual, industry-friendly, and suitable to cater to the needs of society and the nation in the present-day environment. The T.Y.BSc Computer Science syllabus is structured as follows: Core Modules: The syllabus comprises core modules that cover essential topics in computer science, ensuring a strong foundation that aim to develop computational thinking, analytical abilities, and problem solving skills among students. The Artificial Intelligence course provides in-depth knowledge of cutting edge AI concepts and techniques empowering them to develop intelligent systems and algorithms. With a focus on safeguarding information and systems the Cyber and Information Security course equips students with essential concepts and practices in cybersecurity. The Data Science course provides students with a solid foundation in data analysis and interpretation, enabling them to extract valuable insights and make data-driven decisions. In an era dominated by cloud-based technologies, the Cloud Computing course focuses on the principles, architectures, and applications of cloud computing. Skill Enhancement Electives: Students are required to choose skill enhancement electives to deepen their knowledge in specific areas of interest. The electives offer specialized courses such as web development, cybersecurity, data science, or software engineering.

By selecting these courses, students can tailor their learning experience according to their career aspirations and industry demands. Skill Enhancement courses such as Linux Server Administration, Software Testing and Quality Assurance, Cyber Forensics, Game Programming, Data Mining and Warehousing, Wireless and Sensor Networks, Ethical Hacking, and Information Retrieval cater to specialized areas of expertise and industry demands. Generic Electives: The syllabus also includes generic electives, which provide students with the option to explore disciplines of interest beyond their choices in Core and Discipline-Specific Elective papers. These courses broaden their horizons and allow for interdisciplinary learning.

Project Work: A significant component of the syllabus involves hands-on project work. Through practical assignments and projects, students have the opportunity to apply their theoretical knowledge to real-world scenarios. This approach fosters creativity, problem-solving skills, and innovation in designing and developing software solutions. Assessment methods for the TY Computer Science syllabus include written examinations, practical assignments, project evaluations, and presentations. This comprehensive approach ensures that students' understanding is evaluated through various mediums, emphasizing both theoretical knowledge and practical skills.

The newly designed TY Computer Science syllabus aims to equip students with the necessary competencies to pursue careers in software development, data analysis, research, or further studies in computer science related disciplines. It seeks to empower students with the knowledge and skills required to thrive in the ever-evolving landscape of technology and contribute to the advancement of the field. We sincerely believe that students who undertake this program will gain a strong foundation and exposure to the basics, advanced concepts, and emerging trends in the subject. We express our gratitude to all the experts who provided valuable feedback and suggestions to improve the curriculum. We have made sincere efforts to incorporate their inputs. In essence, the objective of

this syllabus is to create a pool of technologically savvy, theoretically strong, innovatively skilled and ethically responsible generation of computer science professionals.

Special thanks to the Department of Computer Science, Gogate Jogalekar College(Autonomous), Ratnagiri and all honorable members of the Board of Studies of Computer Science, who volunteered or have directly or indirectly, helped design certain specialized courses and the syllabus as a whole.

Name of Programme	**B Sc Computer Science**
Level	UG
No of Semesters	06
Year of Implementation	**2023**
Programme Specific Outcomes (PSO)	1. To formulate, model, design solutions, procedure and to use software tools to solve real world problems. 2. To design and develop computer programs/computer -based systems in the areas such as networking, web design, security, cloud computing, IoT, data science and other emerging technologies. 3. To familiarize with the modern-day trends in industry and research based settings and thereby innovate novel solutions to existing problems. 4. To apply concepts, principles, and theories relating to computer science to new situations. 5. To use current techniques, skills, and tools necessary for computing practice 6. To apply standard Software Engineering practices and strategies in real-time software project development 7. To pursue higher studies of specialization and to take up technical employment. 8. To work independently or collaboratively as an effective team member on a substantial software project. 9. To communicate and present their work effectively and coherently. 10. To display an ethical code of conduct in usage of Internet and Cyber systems. 11. To engage in independent and life-long learning in the background of rapid changing IT industry
Relevance of PSOs to the local, regional, national, and global developmental needs (200 words)	The revised and restructured curriculum for the Three-year integrated course is systematically designed considering the National Education Policy(NEP) along with the Autonomy constraints.The focusis on current industry needs in terms of skills sets demanded under thenew technological environment. It also endeavors to align the programme structure and course curriculum with student aspirations and corporate expectations. The curriculum is more contextual, industry friendly and suitable to cater the needs of society and nation in the present day context. As the world is heading towards digitalization, the syllabus is framed by concentrating on such needs. With the help of basic programming skills and designing technique, a student is able to make small workable projects which can be beneficial for local vendors. To make these projects strong, various concepts of project management, database management are involved. Various industries need IT support at loca or across the country. Students having the skills of computers are able to sustain in the IT industry at various locations. Development in thought processes can lead one in a research area to contribute to an upcoming trend. Students can become entrepreneurs since the techniques of management and entrepreneurship are taught

	to them. Due to the learning of cyber safety, ethical hacking, students can become ethical hackers where students can contribute to national security. Students can make community awareness due to learning about cyber safety. Continuous growth in trends requires students updated which will help them mercurial. This will help in sustaining the IT industry and become employable.

T.Y.B.Sc. Computer Science Syllabus

Choice Based Credit System (CBCS)

Implementation Year- 2023-24

SEMESTER V			
Course	**TOPICS**	**Credits**	**L / Week**
	Elective-I (Select Any Two)		
USCS501	Artificial Intelligence	3	3
USCS502	Linux Server Administration	3	3
USCS503	Software Testing and Quality Assurance	3	3
	Elective-II (Select Any Two)		
USCS504	Information and Network Security	3	3
USCS505	Architecting of IoT	3	3
USCS506	Web Services	3	3
	Skill Enhancement		
USCS507	Game Programming	2	3
	Practical		
USCSP501	Practical of Elective-I	2	6
USCSP502	Practical of Elective-II	2	6
USCSP503	Project Implementation	1	3
USCSP504	Practical of Skill Enhancement : USCS507	1	3

T.Y.B.Sc. Computer Science Syllabus

Choice Based Credit System (CBCS)

Implementation Year- 2023-24

	SEMESTER VI		
Course	**TOPICS**	**Credits**	**L / Week**
	Elective-I (Select Any Two)		
USCS601	Wireless Sensor Networks and Mobile Communication	3	3
USCS602	Cloud Computing	3	3
USCS603	Cyber Forensics	3	3
	Elective-II (Select Any Two)		
USCS604	Information Retrieval	3	3
USCS605	Digital Image Processing	3	3
USCS606	Data Science	3	3
	Skill Enhancement		
USCS607	Ethical Hacking	2	3
	Practical		
USCSP601	Practical of Elective-I	2	6
USCSP602	Practical of Elective-II	2	6
USCSP603	Project Implementation	1	3
USCSP604	Practical of Skill Enhancement : USCS607	1	3

Revised Syllabus of Courses of B.Sc. Computer Science Programme at Semester V
Implementation Year 2023-2024

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Artificial Intelligence**
Course Code (refer to student handbook)	**USCS501**
Class	TYBSc
Semester	V
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	---
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	---

Nomenclature: Artificial Intelligence

Course Outcomes:

- To get a clear understanding of AI and different search algorithms used for solving problems.
- To get acquainted with different learning algorithms and models used in machine learning.
- To study Machines capability.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**What Is AI**	Foundations, History and State of the Art of AI.	**15**
	Intelligent Agents	Agents and Environments, Nature of Environments, Structure of Agents.	
	Problem Solving by searching	Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.	
II	**Learning from Examples**	Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Support Vector Machines, Ensemble Learning, Practical Machine Learning	**15**
III	**Learning probabilistic models**	Statistical Learning, Learning with Complete Data, Learning with Hidden Variables: The EM Algorithm. Reinforcement learning: Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, Applications of Reinforcement Learning.	**15**

Learning Resources recommended:

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

Evaluation Pattern

A . Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modularobject-orienteddynamiclearning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B .Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Artificial Intelligence**
Course Code (refer to student handbook)	**USCSP501**
Class	TYBSc
Semester	V
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	__
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	__

Curriculum:

Lecture/ week : 3

Practical shall be implemented using Python Minimum 8 practical to be implemented as a journal work	
Sr. No.	**Practical Title**
1.	Implement Breadth first search algorithm for Romanian map problem.
2.	Implement Iterative deep depth first search for Romanian map problem.
3.	Implement A* search algorithm for Romanian map problem.
4.	Implement recursive best-first search algorithm for Romanian map problem.
5.	Implement decision tree learning algorithm for the restaurant waiting problem.
6.	Implement feed forward back propagation neural network learning algorithm for the restaurant waiting problem.
7.	Implement Adaboost ensemble learning algorithm for the restaurant waiting problem.
8.	Implement Naive Bayes' learning algorithm for the restaurant waiting problem.
9.	Implement passive reinforcement learning algorithm based on adaptive dynamic programming (ADP) for the 3 by 4 world problem
10.	Implement passive reinforcement learning algorithm based on temporal differences (TD) for 3 by 4 world problem.

Evaluation Pattern

A) Internal Examination: 20 Marks

Sr No	**Criterion**	**Marks**
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B) Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Linux Server Administration**
Course Code (refer to student handbook)	**USCS502**
Class	TYBSc
Semester	V
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	---
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	---

Nomenclature: Linux Server Administration

Course Outcomes:

- To develop Linux based systems and maintain.
- To install appropriate service on Linux server as per requirement.
- To become proficient in Linux server administration.
- To handle troubleshoot challenging technical problems typically encountered when operating and administering Linux systems

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Introduction:**	Technical Summary of Linux Distributions, Managing Software	15
	Single-Host Administration	Managing Users and Groups, Booting and shutting down processes, File Systems, Core System Services, Process of configuring, compiling, Linux Kernel	
	Networking and Security	TCP/IP for System Administrators, basic network Configuration, Linux Firewall (Netfilter), System and network security	
II	**Internet Services:**	Domain Name System (DNS), File Transfer Protocol (FTP), Apache web server, Simple Mail Transfer Protocol (SMTP), Post Office Protocol and Internet Mail Access Protocol (POP and IMAP), Secure Shell (SSH), Network Authentication, OpenLDAP Server, Samba and LDAP, Network authentication system (Kerberos), Domain Name Service (DNS), Security	15
III	**Intranet Services**	Network File System (NFS), Samba, Distributed File Systems (DFS), Network Information Service (NIS), Lightweight Directory Access Protocol (LDAP), Dynamic Host Configuration Protocol (DHCP), MySQL, LAMP Applications File Servers, Email Services, Chat Applications, Virtual Private Networking	15

Learning Resources recommended:

Textbook(s):

1) Linux Administration: A Beginner's Guide, Wale Soyinka, Seventh Edition, McGraw-Hill Education, 2016
2) Ubuntu Server Guide, Ubuntu Documentation Team, 2016

Additional Reference(s):

1) Mastering Ubuntu Server, Jay LaCroix, PACKT Publisher, 2016

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Linux Server Administration**
Course Code (refer to student handbook)	**USCSP501**
Class	TYBSc
Semester	V
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Curriculum:
Lecture/ week : 3

Sr. No.	**Practical shall be implemented using Ubuntu Minimum 8 practical to be implemented as a journal work**
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 Services, 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 NTP Server (NTPd), Install and Configure NTPd, Configure NTP Client (Ubuntu and Windows)
4.	SSH Server : Password Authentication Configure SSH Server to manage a server from the remote computer, SSH Client : (Ubuntu and Windows)
5.	Install DNS Server BIND, Configure DNS server which resolves domain name or IP address, Install BIND 9, Configure BIND, Limit ranges you allow to access if needed.
6.	Configure DHCP Server, Configure DHCP (Dynamic Host Configuration Protocol) Server, Configure NFS Server to share directories on your Network, Configure NFS Client. (Ubuntu and Windows Client OS)
7.	Configure LDAP Server, Configure LDAP Server in order to share users' accounts in your local networks, Add LDAP User Accounts in the OpenLDAP Server, Configure LDAP Client in order to share users' accounts in your local networks. Install phpLDAPadmin to operate LDAP server via Web browser.
8.	Configure NIS Server in order to share users' accounts in your local networks, Configure NIS Client to bind NIS Server
9.	nstall MySQL to configure database server, Install phpMyAdmin to operate MySQL on web browser from Clients.
10.	Install Samba to share folders or files between Windows and Linux.

Evaluation Pattern

A . Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B .Semester End Examination: 30 Marks **Duration: 1 hrs**

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Software Testing and Quality Assurance**
Course Code (refer to student handbook)	**USCS503**
Class	TYBSc
Semester	V
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	---
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	---

Nomenclature: Software Testing and Quality Assurance

Course Outcomes:

- To study various software testing methods and strategies.
- To understand a variety of software metrics.
- To identify the defects in software and manage those defects for improvement in quality for given software.
- To design SQA activities, SQA strategy, formal technical review report for software quality control and assurance.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Software Testing and Introduction to quality**	Introduction, Nature of errors, an example for Testing, Definition of Quality , QA, QC, QM and SQA , Software Development Life Cycle, Software Quality Factors	15
	Verification and Validation	Definition of V &V , Different types of V & V Mechanisms, Concepts of Software Reviews, Inspection and Walkthrough	
	Software Testing Techniques	Testing Fundamentals, Test Case Design, White Box Testing and its types, Black Box Testing and its types	
II	**Software Testing Strategies**	Strategic Approach to Software Testing, Unit Testing, Integration Testing, Validation Testing, System Testing	15
	Software Metrics	Concept and Developing Metrics, Different types of Metrics, Complexity metrics	
	Defect Management	Definition of Defects, Defect Management Process,	

		Defect Reporting, Metrics Related to Defects, Using Defects for Process Improvement.	
III	**Software Quality Assurance**	Quality Concepts, Quality Movement, Background Issues, SQA activities, Software Reviews, Formal Technical Reviews, Formal approaches to SQA, Statistical Quality Assurance, Software Reliability, The ISO 9000 Quality Standards, , SQA Plan , Six sigma, Informal Reviews	**15**
	Quality Improvement	Introduction, Pareto Diagrams, Cause-effect Diagrams, Scatter Diagrams, Run charts	
	Quality Costs	Defining Quality Costs, Types of Quality Costs, Quality Cost Measurement, Utilizing Quality Costs for Decision-Making	

Learning Resources recommended:

Textbook(s):

1. Software Engineering for Students, A Programming Approach, Douglas Bell, 4th Edition,, Pearson Education, 2005
2. Software Engineering – A Practitioners Approach, Roger S. Pressman, 5th Edition, Tata McGraw Hill, 2001
3. Quality Management, Donna C. S. Summers, 5th Edition, Prentice-Hall, 2010.
4. Total Quality Management, Dale H. Besterfield, 3rd Edition, Prentice Hall, 2003.

Additional Reference(s):

1. Software engineering: An Engineering approach, J.F. Peters, W. Pedrycz , John Wiley,2004
2. Software Testing and Quality Assurance Theory and Practice, Kshirsagar Naik, Priyadarshi Tripathy , John Wiley & Sons, Inc. , Publication, 2008
3. Software Engineering and Testing, B. B. Agarwal, S. P. Tayal, M. Gupta, Jones and Bartlett Publishers, 2010

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Software Testing and Quality Assurance**
Course Code (refer to student handbook)	**USCSP501**
Class	TYBSc
Semester	V
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	__
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	__

Curriculum:

Lecture/ week : 3

Practical shall be implemented using Netbeans and Selenium IDE Minimum 8 practical to be implemented as a journal work	
Sr. No.	**Practical Title**
1.	Install Selenium IDE; Write a test suite containing minimum 4 test cases for different formats.
2.	Conduct a test suite for any two web sites.
3.	Install Selenium server (Selenium RC) and demonstrate it using a script in Java/PHP.
4.	Write and test a program to login a specific web page.
5.	Write and test a program to update 10 student records into table into Excel file
6.	Write and test a program to select the number of students who have scored more than 60 in any one subject (or all subjects).
7.	Write and test a program to provide total number of objects present / available on the page.
8.	Write and test a program to get the number of items in a list / combo box.
9.	Write and test a program to count the number of check boxes on the page checked and unchecked count.
10.	Load Testing using JMeter, Android Application testing using Appium Tools, Bugzilla Bug tracking tools.

Evaluation Pattern

A. Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B. Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Information and Network Security**
Course Code (refer to student handbook)	**USCS504**
Class	TYBSC
Semester	V
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	----
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	----

Nomenclature: Information and Network Security

Course Outcomes:

- To study the principles and practices of cryptographic techniques.
- To understand a variety of generic security threats and vulnerabilities
- To identify & analyze particular security problems for a given application.
- To understand various protocols for network security to protect against the threats in a network

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Introduction**	Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms	**15**
	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	
	Public-Key Cryptography and RSA	Principles of Public-Key Cryptosystems, The RSA Algorithm	
II	**Key Management:**	Public-Key Cryptosystems, Key Management, Diffie-Hellman Key Exchange	**15**
	Message Authentication and Hash Functions:	Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and Macs, Secure Hash Algorithm, HMAC	
	Digital Signatures and Authentication:	Digital Signatures, Authentication Protocols, Digital Signature Standard	
	Authentication	Kerberos, X.509 Authentication, Public-Key	

	Applications:	Infrastructure	
III	**Electronic Mail Security**	Pretty Good Privacy, S/MIME	**15**
	IP Security	Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management	
	Web Security	Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction	
	Intrusion	Intruders, Intrusion Techniques, Intrusion Detection	
	Malicious Software	Viruses and Related Threats, Virus Countermeasures, DDOS	
	Firewalls	Firewall Design Principles, Types of Firewalls	

Learning Resources recommended:

Textbook(s):

1. Cryptography and Network Security: Principles and Practice 5th Edition, William Stallings, Pearson,2010

Additional Reference(s):

1. Cryptography and Network Security, Atul Kahate, Tata McGraw-Hill, 2013.
2. Cryptography and Network, Behrouz A Fourouzan, Debdeep Mukhopadhyay, 2nd Edition,TMH,2011

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modularobject-orienteddynamiclearning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Information and Network security**
Course Code (refer to student handbook)	**USCSP502**
Class	TYBSc
Semester	V
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Curriculum:

Lecture/ week: 3

Practical shall be implemented using Netbeans Minimum 8 practical to be implemented as a journal work	
Sr. No.	**Practical Title**
1.	Write programs to implement the following Substitution Cipher Techniques: - Caesar Cipher - Monoalphabetic Cipher
2.	Write programs to implement the following Substitution Cipher Techniques: - Vernam Cipher - Playfair Cipher
3.	Write programs to implement the following Transposition Cipher Techniques: - Rail Fence Cipher - Simple Columnar Technique
4.	Write program to encrypt and decrypt strings using - DES Algorithm - AES Algorithm
5.	Write a program to implement RSA algorithm to perform encryption / decryption of a given string.
6.	Write a program to implement the Diffie-Hellman Key Agreement algorithm to generate symmetric keys.
7.	Write a program to implement the MD5 algorithm compute the message digest.
8.	Write a program to calculate HMAC-SHA1 Signature
9.	Write a program to implement SSL.
10.	Configure Windows Firewall to block: - A port - An Program - A website

Evaluation Pattern

A. Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B. Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**IoT Architecture**
Course Code (refer to student handbook)	**USCS505**
Class	TYBSC
Semester	V
No of Credits	02
Nature	Theory
Type (applicable to NEP only)	-----
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-----

Nomenclature: IoT Architecture

Course Outcomes:

- To study architecture of IoT
- To design & develop IoT Devices.
- To study M2M Communications.
- To study IoT analytics.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**IoT-An Architectural Overview**	Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	**15**
	IoT Architecture-State of the Art	Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views	
II	**IoT Data Link Layer and Network Layer Protocols**	PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy DASH7	**15**
	Network Layer	IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP	
III	**Transport layer protocols**	Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS)	**15**
	Session layer	Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT	
	Service layer protocols	Service Layer -oneM2M, ETSI M2M, OMA, BBF	

Learning Resources recommended:

Textbook(s):

1. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle,1st Edition, Academic Press, 2014.
2. Learning Internet of Things, Peter Waher, PACKT publishing, BIRMINGHAM – MUMBAI,2015

Additional References(s):

1. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Daniel Minoli, Wiley Publications,2013
2. Internet of Things (A Hands-onApproach), Vijay Madisetti and ArshdeepBahga,1st Edition, VPT, 2014.
3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**IoT Architecture**
Course Code (refer to student handbook)	**USCSP502**
Class	TYBSc
Semester	V
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Curriculum:

Lecture/ week : 3

Practical shall be implemented using Ubuntu Minimum 8 practical to be implemented as a journal work	
Sr. No.	**Practical Title**
1.	**a)** Edit text files with nano and cat editor, Learn sudo privileges and Unix shell commands such as cd , ls , cat, etc **b)** Learn to set dynamic and static IP. Connect to and Ethernet and WiFi network. Learn to vnc and ssh into a raspberry pi using vnc and putty from a different computer on the network. **c)** Write a basic bash script to open programs in kiosk mode. Learn how to autostart programs on boot.
2.	Run the node red editor and run simple programs and trigger gpios. Use basic nodes such as inject, debug, gpio
3.	Open the python idle editor and run simple Python scripts such as to print Fibonacci numbers, string functions. Learn how to install modules using Pip and write functions
4.	Setup a physical button switch and trigger an led in node red and python w debounce
5.	Write simple JavaScript functions in Node-Red simple HTTP server page using node red
6.	Setup a TCP server and client on a raspberry pi using Python modules to send messages and execute shell commands from within python such as starting another application
7.	Trigger a set of led Gpios on the pi via a Python Flask web server
8.	Interface the raspberry pi with a 16x2 LCD display and print values.
9.	Setup a Mosquitto MQTT server and client and write a Python script to communicate data between Pi's.
10.	Interface with an Accelerometer Gyro Mpu6050 on the i2c bus and send sensor values over the

Evaluation Pattern

A. Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B. Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Web Services**
Course Code (refer to student handbook)	**USCS506**
Class	TYBSC
Semester	V
No of Credits	2
Nature	Theory
Type (applicable to NEP only)	--
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	--

Nomenclature: Web Services

Course Outcomes:

- To study SOAP based web services and associated standards such as WSDL.
- To design SOAP based / RESTful / WCF services.
- To study web services which deal with Security and QoS issues.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Web services basics**	What Are Web Services? Types of Web Services Distributed computing infrastructure, overview of XML, SOAP, Building Web Services with JAX-WS, Registering and Discovering Web Services, Service Oriented Architecture, Web Services Development Life Cycle, Developing and consuming simple Web Services across platform	**15**
II	**The REST Architectural style**	Introducing HTTP, The core architectural elements of a RESTful system, Description and discovery of RESTful web services, Java tools and frameworks for building RESTful web services, JSON message format and tools and frameworks around JSON, Build RESTful web services with JAX-RS APIs, The Description and Discovery of RESTful Web Services, Design guidelines for building RESTful web services, Secure RESTful web services	**15**
III	**Developing Service-Oriented Applications with WCF**	What Is Windows Communication Foundation, Fundamental Windows Communication Foundation Concepts, Windows Communication Foundation Architecture, WCF and .NET Framework Client Profile, Basic WCF Programming, WCF Feature Details. Web Service QoS	**15**

Learning Resources recommended:

Textbook(s):

1. Web Services: Principles and Technology, Michael P. Papazoglou, Pearson Education Limited, 2008
2. RESTful Java Web Services, Jobinesh Purushothaman, PACKT Publishing,2nd Edition, 2015
3. Developing Service-Oriented Applications with WCF, Microsoft, 2017 https://docs.microsoft.com/en-us/dotnet/framework/wcf/index

Additional Reference(s):

1. Leonard Richardson and Sam Ruby, RESTful Web Services, O'Reilly, 2007
2. The Java EE 6Tutorial, Oracle, 2013

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of 4**0 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Web Services**
Course Code (refer to student handbook)	**USCSP502**
Class	TYBSc
Semester	V
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Curriculum:
Lecture/ week : 3

Practical shall be implemented using Netbeans and Visual Studio Minimum 8 practical to be implemented as a journal work	
Sr. No.	**Practical Title**
1.	Write a program to implement to create a simple web service that converts the temperature from Fahrenheit to Celsius and vice a versa.
2.	Write a program to implement the operation can receive request and will return a response in two ways. a) One - Way operation b) Request –Response
3.	Write a program to implement business UDDI Registry entry.
4.	Develop client which consumes web services developed in different platform.
5.	Write a JAX-WS web service to perform the following operations. Define a Servlet / JSP that consumes the web service.
6.	Define a web service method that returns the contents of a database in a JSON string. The contents should be displayed in a tabular format.
7.	Define a RESTful web service that accepts the details to be stored in a database and performs CRUD operation
8.	Implement a typical service and a typical client using WCF.
9.	Use WCF to create a basic ASP.NET Asynchronous JavaScript and XML (AJAX) service.
10.	Demonstrates using the binding attribute of an endpoint element in WCF.

Evaluation Pattern

A. Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B. Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Game Programming**
Course Code (refer to student handbook)	**USCS507**
Class	TYBSc
Semester	V
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	-
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	-

Nomenclature: Game Programming

Course Outcomes:

- To study Graphics and gaming concepts.
- To study modern techniques of game designing to implement on windows.
- To understand different game engines and getting knowledge about Unity (Game Engine).
- To understand concepts of AR, VR and MR.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I (Mathematics for Computer Graphics, DirectX Kickstart)	**Cartesian Coordinate system**	The Cartesian XY-plane, Function Graphs, Geometric Shapes, Polygonal Shapes, Areas of Shapes, Theorem of Pythagoras in 2D, Coordinates, Theorem of Pythagoras in 3D, 3D Polygons, Euler's Rule	**15**
	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	
	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	
	DirectX	Understanding GPU and GPU architectures. How they are different from CPU Architectures? Understanding how to solve by GPU?	
	Introduction To	COM, Textures and Resources Formats, The swap chain and Page flipping, Depth Buffering, Texture	

II (DirectX Pipeline and Programming)	**DirectX 11**	Resource Views, Multisampling Theory and MS in Direct3D, Feature Levels	**15**
	Direct3D 11 Rendering Pipeline	Overview, Input Assembler Stage (IA), Vertex Shader Stage (VS), The Tessellation Stage (TS), Geometry Shader Stage (GS), Pixel Shader Stage (PS), Output merger Stage (OM) Understanding Meshes or Objects, Texturing, Lighting, Blending.	
	Interpolation and Character Animation, Trigonometry	The Trigonometric Ratios, Inverse Trigonometric Ratios, Trigonometric Relationships, The Sine Rule, The Cosine Rule, Compound Angles, Perimeter Relationships	
	Interpolation	Linear Interpolant, Non-Linear Interpolation, Trigonometric Interpolation, Cubic Interpolation, Interpolating Vectors, Interpolating Quaternions	
	Curves	Circle, Bezier, B-Splines	
	Analytic Geometry	Review of Geometry, 2D Analytic Geometry, Intersection Points, Point in Triangle, and Intersection of circle with straight line.	
III	**Introduction to Rendering Engines**	Understanding the current market Rendering Engines. Understanding AR, VR and MR.Depth Mappers, Mobile Phones, Smart Glasses, HMD's	**15**
	Unity Engine, Multi-platform publishing, VR + AR	Introduction and working in Unity, 2D, Graphics, Physics, Scripting, Animation, Timeline, Multiplayer and Networking, UI, Navigation and Pathfinding, XR, Publishing	
	Scripting	Scripting Overview, Scripting Tools and Event Overview	
	XR	VR, AR, MR, Conceptual Differences. SDK, Devices	

Learning Resources recommended:

Text Book(s):

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 Cengage Learning, Delmar Cengage Learning,2011
3) Introduction To 3D Game Programming With Directx® 11,Frank D Luna, Mercury Learning and Information,2012.
4) https://docs.unity3d.com/Manual/index.html - Free

Additional Reference(s):

1) Computer Graphics, C Version, Donald Hern and Pauline Baker, Pearson Education, 2nd Edition, 1997
2) HLSL Development Cookbook, Doron Feinstein, PACKT Publishing,2013

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modularobject-orienteddynamiclearning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of 4**0 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Game Programming**
Course Code (refer to student handbook)	**USCSP504**
Class	TYBSc
Semester	V
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Nomenclature: Game Programming

Course Outcomes:

- To study Graphics and gaming concepts.
- To study modern techniques of game designing to implement on windows.
- To understand different game engines and getting knowledge about Unity (Game Engine).
- To understand concepts of AR, VR and MR.

Curriculum:

Lecture/ week : 3

Practical shall be implemented using Unity and DirectX Minimum 8 practical to be implemented as a journal work	
Sr. No.	**Practical Title**
1.	Setup DirectX 11, Window Framework and Initialize Direct3D Device
2.	Buffers, Shaders and HLSL (Draw a triangle using Direct3D 11)
3.	Texturing (Texture the Triangle using Direct 3D 11)
4.	Lightning (Programmable Diffuse Lightning using Direct3D 11)
5.	Specular Lightning (Programmable Spot Lightning using Direct3D 11)
6.	Loading models into DirectX 11 and rendering.
7.	https://unity3d.com/learn/tutorials/s/2d-ufo-tutorial
8.	https://unity3d.com/learn/tutorials/s/space-shooter-tutorial
9.	https://unity3d.com/learn/tutorials/s/roll-ball-tutorial
10.	https://unity3d.com/learn/tutorials/topics/vr/introduction?playlist=22946

Evaluation Pattern

A. Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B. Semester End Examination: 30 Marks **Duration: 1 hrs**

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

I. Project(USCSP503)

The evaluation of the project will include a viva voce, which will assess the project based on the following parameters:

- **Documentation – 10 Marks:** The completeness, accuracy, and professionalism of the project documentation, including the project report and supporting materials, will be considered.
- **Quality of the Project – 10 Marks:** The overall quality of the project, including its design, implementation, and user experience, will be evaluated.
- **Working of the Project – 10 Marks**: The functionality and performance of the project will be assessed to determine how well it meets the specified requirements and objectives.
- **Project Presentation – 10 Marks:** The clarity, organization, and effectiveness of the project presentation will be evaluated.
- **Viva – 10 Marks:** The viva voce session will provide an opportunity for the student to demonstrate their knowledge and understanding of the project, as well as to answer questions and engage in a discussion with the evaluators.

Please refer to Project implementation Guidelines

Revised Syllabus of Courses of B.Sc. Computer Science Programme at Semester VI
Implementation Year 2023-2024

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Wireless Sensor Networks and Mobile Communication**
Course Code (refer to student handbook)	**USCS601**
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	----
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	----

Nomenclature: Wireless Sensor Networks and Mobile Communication

Course Outcomes:

- After completion of this course, learner should be able to list various applications of wireless sensor networks, describe the concepts, protocols, design, implementation and use of wireless sensor networks.
- Also implement and evaluate new ideas for solving wireless sensor network design issues.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Introduction**	Introduction to Sensor Networks, unique constraints and challenges. Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc NETworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks.	**15**
	Sensor Node Hardware and Network Architecture	Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC. Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.	
II	**Medium Access Control Protocols**	Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC Case Study.	

	Routing Protocols	Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless	**15**
	Transport Control Protocols	Sensor Networks, Routing Strategies in Wireless Sensor Networks. Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols.	
III	**Introduction, Wireless Transmission and Medium Access Control**	Applications, A short history of wireless communication.	**15**
	Wireless Transmission:	Frequency for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems.	
	Telecommunication , Satellite and Broadcast Systems: GSM	Mobile services, System architecture, Radio interface, Protocols, Localization And Calling, Handover, security, New data services; DECT: System architecture, Protocol architecture; ETRA, UMTS and IMT- 2000. Satellite Systems: History, Applications, Basics: GEO, LEO, MEO; Routing, Localization, Handover.	

Learning Resources recommended:

Textbook(s):

1) Protocols and Architectures for Wireless Sensor Network, Holger Kerl, Andreas Willig, John Wiley and Sons, 2005
2) Wireless Sensor Networks Technology, Protocols, and Applications ,Kazem Sohraby, Daniel Minoli and TaiebZnati, John Wiley & Sons, 2007
3) Mobile communications, Jochen Schiller,2nd Edition, Addison wisely , Pearson Education,2012

Additional Reference(s):

1) Fundamentals of Wireless Sensor Networks, Theory and Practice, Waltenegus Dargie, Christian Poellabauer , Wiley Series on wireless Communication and Mobile Computing, 2011
2) Networking Wireless Sensors, Bhaskar Krishnamachari , Cambridge University Press, 2005

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modularobject-orienteddynamiclearning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded onany **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks(Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Wireless Sensor Networks and Mobile Communication**
Course Code (refer to student handbook)	**USCSP601**
Class	TYBSc
Semester	VI
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Curriculum:

Lecture/ week : 3

Practical shall be implemented using OMNeT++ and CICSO Minimum 8 practical to be implemented as a journal work	
Sr. No.	**Practical Title**
1.	Understanding the Sensor Node Hardware. (For Eg. Sensors, Nodes(Sensor mote), Base Station, Graphical User Interface.)
2.	Exploring and understanding TinyOS computational concepts:- Events, Commands and Task. - nesC model - nesC Components
3.	Understanding TOSSIM for - Mote-mote radio communication - Mote-PC serial communication
4.	Create and simulate a simple adhoc network
5.	Understanding, Reading and Analyzing Routing Table of a network.
6.	Create a basic MANET implementation simulation for Packet animation and Packet Trace.
7.	Implement a Wireless sensor network simulation.
8.	Create MAC protocol simulation implementation for wireless sensor Network.
9.	Simulate Mobile Adhoc Network with Directional Antenna
10.	Create a mobile network using Cell Tower, Central Office Server, Web browser and Web Server. Simulate connection between them.

Evaluation Pattern:

A. Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practicals which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B. Semester End Examination: 30 Marks **Duration: 1 hrs**

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Cloud Computing**
Course Code (refer to student handbook)	**USCS602**
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	---
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	---

Nomenclature: Cloud Computing

Course Outcomes:

- After successful completion of this course, learners should be able to articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing using open source technology.
- Learners should be able to identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
- They should explain the core issues of cloud computing such as security, privacy, and interoperability.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Introduction**	Introduction to Cloud Computing, Characteristics and benefits of Cloud Computing, Basic concepts of Distributed Systems, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing. Elements of Parallel Computing. Elements of Distributed Computing. Technologies for Distributed Computing. Cloud Computing Architecture. The cloud reference model. Infrastructure as a service. Platform as a service. Software as a service. Types of clouds.	**15**
II	**Taxonomy of Virtualization Techniques.**	Characteristics of Virtualized Environments. Taxonomy of Virtualization Techniques. Virtualization and Cloud Computing. Pros and Cons of Virtualization. Virtualization using KVM, Creating virtual machines, oVirt - management tool for virtualization environment. Open challenges of Cloud Computing	**15**
III	**Introduction to OpenStack**	Introduction to OpenStack, OpenStack test-drive, Basic OpenStack operations, OpenStack CLI and APIs, Tenant model operations, Quotas, Private cloud building blocks, Controller deployment, Networking deployment, Block Storage deployment, Compute deployment, deploying and utilizing OpenStack in production environments, Building a production environment, Application orchestration using OpenStack Heat	**15**

Learning Resources recommended:

Textbook(s):

1) Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, Tata McGraw Hill Education Private Limited, 2013
2) OpenStack in Action, V. K. CODY BUMGARDNER, Manning Publications Co,2016

Additional Reference(s)*:*

1) OpenStack Essentials, Dan Radez, PACKT Publishing, 2015
2) OpenStack Operations Guide, Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, O'Reilly Media, Inc., 2014
3) https://www.openstack.org

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Cloud Computing**
Course Code (refer to student handbook)	**USCSP601**
Class	TYBSc
Semester	VI
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	----
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	----

Curriculum:

Lecture/ week : 3

Sr. No.	Practical shall be implemented using Google Cloud Minimum 8 practical to be implemented as a journal work
1.	Study and implementation of Infrastructure as a Service.
2.	Installation and Configuration of virtualization using KVM.
3.	Study and implementation of Infrastructure as a Service
4.	Study and implementation of Storage as a Service
5.	Study and implementation of identity management
6.	Study Cloud Security management
7.	Write a program for web feed.
8.	Study and implementation of Single-Sing-On.
9.	User Management in Cloud.
10.	Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform

Evaluation Pattern

A) Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practicals which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B) Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Cyber Forensics**
Course Code (refer to student handbook)	**USCS603**
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	--
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	--

Nomenclature: Cyber Forensics

Course Outcomes:

- The student will be able to plan and prepare for all stages of an investigation
- The Learner will able to do the detection, initial response and management interaction related cyber problems.
- Also investigate various media to collect evidence, report them in a way that would be acceptable in the court of law.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Computer Forensics**	Introduction to Computer Forensics and standard procedure, Incident Verification and System Identification ,Recovery of Erased and damaged data, Disk Imaging and Preservation, Data Encryption and Compression, Automated Search Techniques, Forensics Software	**15**
	Network Forensic	Introduction to Network Forensics and tracking network traffic, Reviewing Network Logs, Network Forensics Tools, Performing Live Acquisitions, Order of Volatility, Standard Procedure	
	Cell Phone and Mobile Device Forensics	Overview, Acquisition Procedures for Cell Phones and Mobile Devices	
II	**Internet Forensic**	**Introduction** to Internet Forensics, World Wide Web Threats, Hacking and Illegal access, Obscene and Incident transmission, Domain Name Ownership Investigation, Reconstructing past internet activities and events	**15**
	E-mail Forensics	e-mail analysis, e-mail headers and spoofing, Laws against e-mail Crime, **Messenger Forensics:** Yahoo Messenger	
	Social Media Forensics	Social Media Investigations	
	Browser Forensics	Cookie Storage and Analysis, Analyzing Cache and temporary internet files, Web browsing activity	

		reconstruction	
III	**Investigation, Evidence presentation and Legal aspects of Digital Forensics**	Authorization to collect the evidence , Acquisition of Evidence, Authentication of the evidence, Analysis of the evidence, Reporting on the findings, Testimony	**15**
	Introduction to Legal aspects of Digital Forensics	Laws & regulations, Information Technology Act, Giving Evidence in court, Case Study – Cyber Crime cases, Case Study – Cyber Crime cases	

Learning Resources recommended:

Textbook(s):

1. Guide to computer forensics and investigations, Bill Nelson, Amelia Philips and Christopher Steuart, course technology,5th Edition,2015

Additional Reference(s)*:*

2. Incident Response and computer forensics, Kevin Mandia, Chris Prosise, Tata McGrawHill,2nd Edition,2003

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of 4**0 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for TY Computer Science Autonomous from the year 2023-24

Name of the Course	**Cyber Forensics**
Course Code (refer to student handbook)	**USCSP601**
Class	TYBSc
Semester	VI
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	___

Curriculum:

Lecture/ week : 3

Practical shall be implemented using Wire Shark, Sysinternals tool ,FTK imager , FTK autopsy , Browser history examiner , Belkasoft RAM capturer.
Minimum 8 practical to be implemented as a journal work.

Sr. No.	Practical Title
1.	Creating a Forensic Image using FTK Imager/Encase Imager : - Creating Forensic Image - Check Integrity of Data - Analyze Forensic Image
2.	Data Acquisition: - Perform data acquisition using: - USB Write Blocker + Encase Imager - SATA Write Blocker + Encase Imager - Falcon Imaging Device
3.	Forensics Case Study: - Solve the Case study (image file) provide in lab using Encase Investigator or Autopsy
4.	Capturing and analyzing network packets using Wireshark (Fundamentals) : - Identification the live network - Capture Packets - Analyze the captured packets
5.	Analyze the packets provided in lab and solve the questions using Wireshark : - What web server software is used by www.snopes.com? - About what cell phone problem is the client concerned? - According to Zillow, what instrument will Ryan learn to play? - How many web servers are running Apache? - What hosts (IP addresses) think that jokes are more entertaining when they are explained?
6.	Using Sysinternals tools for Network Tracking and Process Monitoring : - Check Sysinternals tools - Monitor Live Processes - Capture RAM - Capture TCP/UDP packets - Monitor Hard Disk

	- Monitor Virtual Memory - Monitor Cache Memory
7.	Recovering and Inspecting deleted files - Check for Deleted Files - Recover the Deleted Files - Analyzing and Inspecting the recovered files - Perform this using recovery option in ENCASE and also Perform manually through command line
8.	Acquisition of Cell phones and Mobile devices
9.	Email Forensics - Mail Service Providers - Email protocols - Recovering emails - Analyzing email header
10.	Web Browser Forensics - Web Browser working - Forensics activities on browser - Cache / Cookies analysis - Last Internet activity

Evaluation Pattern

A. Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B. Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Information Retrieval**
Course Code (refer to student handbook)	**USCS604**
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	---
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	---

Nomenclature: Information Retrieval

Course Outcomes:

- After completion of this course, learners should get an understanding of the field of information retrieval and its relationship to search engines.
- It will give the learner an understanding to apply information retrieval models.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Introduction to Information Retrieval**	Introduction, History of IR, Components of IR, and Issues related to IR, Boolean retrieval, Dictionaries and tolerant retrieval.	**15**
II	**Link Analysis and Specialized Search**	Link Analysis, hubs and authorities, Page Rank and HITS algorithms, Similarity, Hadoop & Map Reduce, Evaluation, Personalized search, Collaborative filtering and content-based recommendation of documents and products, handling "invisible" Web, Snippet generation, Summarization, Question Answering, Cross- Lingual Retrieval.	**15**
III	**Web Search Engine**	Web search overview, web structure, the user, paid placement, search engine optimization/spam, Web size measurement, search engine optimization/spam, Web Search Architectures.	**15**
	XML retrieval	Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric versus data-centric XML retrieval.	

Learning Resources recommended:

Text book(s):

1) Introduction to Information Retrieval, C. Manning, P. Raghavan, and H. Schütze, Cambridge University Press, 2008

2) Modern Information Retrieval: The Concepts and Technology behind Search, Ricardo Baeza -Yates and Berthier Ribeiro – Neto, 2nd Edition, ACM Press Books 2011.

3) Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler and Trevor Strohman, 1st Edition, Pearson, 2009.

Additional Reference(s):

1) Information Retrieval Implementing and Evaluating Search Engines, Stefan Büttcher, Charles L. A. Clarke and Gordon V. Cormack, The MIT Press; Reprint edition (February 12, 2016)

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behaviour	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Information Retrieval**
Course Code (refer to student handbook)	**USCSP602**
Class	TYBSc
Semester	VI
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Curriculum:

Lecture/ week : 3

Practical may be done using software/tools like Python / Java / Hadoop. **Minimum 8 practical to be implemented as a journal work.**	
Sr. No.	**Practical Title**
1.	Write a program to demonstrate bitwise operation.
2.	Implement Page Rank Algorithm.
3.	Implement Dynamic programming algorithm for computing the edit distance between strings s1 and s2. (Hint. Levenshtein Distance)
4.	Write a program to Compute Similarity between two text documents.
5.	Write a map-reduce program to count the number of occurrences of each alphabetic character in the given dataset. The count for each letter should be case-insensitive (i.e., include both upper-case and lower-case versions of the letter; Ignore non-alphabetic characters).
6.	Implement a basic IR system using Lucene.
7.	Write a program for Pre-processing of a Text Document: stop word removal.
8.	Write a program for mining Twitter to identify tweets for a specific period and identify trends and named entities.
9.	Write a program to implement a simple web crawler.
10.	Write a program to parse XML text, generate Web graph and compute topic specific page rank.

Evaluation Pattern

A) Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B) Semester End Examination: 30 Marks **Duration: 1 hrs**

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Digital Image Processing**
Course Code (refer to student handbook)	**USCS605**
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	----
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	---

Nomenclature: Digital Image Processing

Course Outcomes:

- Learner should review the fundamental concepts of a digital image processing system.
- Analyze the images in the frequency domain using various transforms. Evaluate the techniques for image enhancement and image segmentation.
- Apply various compression techniques. They will be familiar with basic image processing techniques for solving real problems.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Introduction to Image-processing System**	Introduction, Image Sampling, Quantization, Resolution, Human Visual Systems, Elements of an Image-processing System, Applications of Digital Image Processing	**15**
	2D Signals and Systems	2D signals, separable sequence, periodic sequence, 2D systems, classification of 2D systems, 2D Digital filter	
	Convolution and Correlation	2D Convolution through graphical method, Convolution through 2D Z—transform, 2D Convolution through matrix analysis, Circular Convolution, Applications of Circular Convolution, 2D Correlation	
	Image Transforms	Need for transform, image transforms, Fourier transform, 2D Discrete Fourier Transform, Properties of 2D DFT, Importance of Phase, Walsh transform, Hadamard transform, Haar transform, Slant transform, Discrete Cosine transform, KL transform	
II	**Image Enhancement**	Image Enhancement in spatial domain, Enhancement trough Point operations, Histogram manipulation, Linear and nonlinear Gray Level Transformation, local or neighborhood operation, Median Filter, Spatial domain High pass filtering, Bit-plane slicing, Image Enhancement in frequency domain, Homomorphic filter, Zooming operation,	**15**

		Image Arithmetic	
	Binary Image processing	Mathematical morphology, Structuring elements, Morphological image processing, Logical operations, Morphological operations, Dilation and Erosion, Distance Transform	
	Colour Image processing	Colour images, Colour Model, Colour image quantization, Histogram of a colour image	
III	**Image Segmentation**	Image segmentation techniques, Region approach, Clustering techniques, Thresholding, Edge-based segmentation, Edge detection, Edge Linking, Hough Transform	**15**
	Image Compression	Need for image compression, Redundancy in images, Image-compression scheme, Fundamentals of Information Theory, Run-length coding, Shannon-Fano coding, Huffman Coding, Arithmetic Coding, Transform-based compression, Image-compression standard	

Learning Resources recommended:

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 The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani and Jerome Friedman, Springer, 2013

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of 4**0 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Digital Image Processing**
Course Code (refer to student handbook)	**USCSP602**
Class	TYBSc
Semester	VI
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Curriculum:

Lecture/ week : 3

Practical need to be performed using Scilab under Linux or Windows. Minimum 8 practical to be implemented as a journal work.	
Sr. No.	**Practical Title**
1.	2D Linear Convolution, Circular Convolution between two 2D matrices.
2.	Circular Convolution expressed as linear convolution plus alias.
3.	Linear Cross correlation of a 2D matrix, Circular correlation between two signals and Linear autocorrelation of a 2D matrix, Linear Cross correlation of a 2D matrix
4.	DFT of 4x4 gray scale image.
5.	Compute discrete cosine transform, Program to perform KL transform for the given 2D matrix.
6.	Brightness enhancement of an image, Contrast Manipulation, image negative.
7.	Perform threshold operation, perform gray level slicing without background.
8.	Image Segmentation.
9.	Image Compression.
10.	Binary Image Processing and Colour Image processing.

Evaluation Pattern

A) Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B) Semester End Examination: 30 Marks **Duration: 1 hrs**

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Data Science**
Course Code (refer to student handbook)	**USCS606**
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	---
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	---

Nomenclature: Data Science

Course Outcomes: After completion of this course, the students should be able to understand & comprehend the problem; and should be able to define suitable statistical method to be adopted.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Introduction to Data Science**	What is Data? Different kinds of data, Introduction to high level programming language + Integrated Development Environment (IDE), Exploratory Data Analysis (EDA) + Data Visualization, Different types of data sources,	**15**
	Data Management	Data Collection, Data cleaning/extraction, Data analysis & Modeling	
II	**Data Curation**	Query languages and Operations to specify and transform data, Structured/schema based systems as users and acquirers of data Semi-structured systems as users and acquirers of data, Unstructured systems in the acquisition and structuring of data, Security and ethical considerations in relation to authenticating and authorizing access to data on remote systems, Software development tools, Large scale data systems, Amazon Web Services (AWS)	**15**
III	**Statistical Modelling and Machine Learning:**	Introduction to model selection: Regularization, bias/variance tradeoff e.g. parsimony, AIC, BIC, Cross validation, Ridge regressions and penalized regression e.g. LASSO	**15**
	Data transformations:	Dimension reduction, Feature extraction, Smoothing and aggregating	
	Supervised Learning:	Regression, linear models, Regression trees, Time-series Analysis, Forecasting, Classification: classification trees, Logistic regression, separating hyperplanes, k-NN	
	Unsupervised Learning:	Principal Components Analysis (PCA), k-means clustering, Hierarchical clustering, Ensemble methods	

Learning Resources recommended:

Textbook(s):

1) Doing Data Science, Rachel Schutt and Cathy O'Neil, O'Reilly,2013
2) Mastering Machine Learning with R, Cory Lesmeister, PACKT Publication,2015

Additional Reference(s):

1) Hands-On Programming with R, Garrett Grolemund,1st Edition, 2014
   An Introduction to Statistical Learning, James, G., Witten, D., Hastie, T., Tibshirani, R.,Springer,2015

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of **40 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Data Science**
Course Code (refer to student handbook)	**USCSP602**
Class	TYBSc
Semester	VI
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	___

Curriculum:

Lecture/ week : 3

Practical shall be performed using R Minimum 8 practical to be implemented as a journal work.	
Sr. No.	**Practical Title**
1.	Practical of Data collection, Data curation and management for Unstructured data (NoSQL)
2.	Practical of Data collection, Data curation and management for Large-scale Data system (such as MongoDB)
3.	Practical of Principal Component Analysis
4.	Practical of Clustering
5.	Practical of Time-series forecasting
6.	Practical of Simple/Multiple Linear Regression
7.	Practical of Logistics Regression
8.	Practical of Hypothesis testing
9.	Practical of Analysis of Variance
10.	Practical of Decision Tree

A) Internal Examination: 20 Marks

Sr No	**Criterion**	**Marks**
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B) Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Ethical Hacking**
Course Code (refer to student handbook)	**USCS607**
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Theory
Type (applicable to NEP only)	__
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	__

Nomenclature: Ethical Hacking

Course Outcomes:

- Learner will know to identify security vulnerabilities and weaknesses in the target applications.
- They will also know to test and exploit systems using various tools and understand the impact of hacking in real time machines.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Information Security : Attacks and Vulnerabilities Introduction to information security**	Asset, Access Control, CIA, Authentication, Authorization, Risk, Threat, Vulnerability, Attack, Attack Surface, Malware, Security-Functionality-Ease of Use Triangle	**15**
	Types of malware	Worms, viruses, Trojans, Spyware, Rootkits	
	Types of vulnerabilities	OWASP Top 10 : cross-site scripting (XSS), cross site request forgery (CSRF/XSRF), SQL injection, input parameter manipulation, broken authentication, sensitive information disclosure, XML External Entities, Broken access control, Security Misconfiguration, Using components with known vulnerabilities, Insufficient Logging and monitoring, OWASP Mobile Top 10, CVE Database	
	Types of attacks and their common prevention mechanisms	Keystroke Logging, Denial of Service (DoS /DDoS), Waterhole attack, brute force, phishing and fake WAP, Eavesdropping, Man-in-the-middle, Session Hijacking, Clickjacking, Cookie Theft, URL Obfuscation, buffer overflow, DNS poisoning, ARP poisoning, Identity Theft, IoT Attacks, BOTs and BOTNETs	
	Case-studies	Recent attacks – Yahoo, Adult Friend Finder, eBay, Equifax, WannaCry , Target Stores, Uber, JP Morgan	

		Chase, Bad Rabbit	
II	**Ethical Hacking – I (Introduction and pre-attack)**	Black Hat vs. Gray Hat vs. White Hat (Ethical) hacking, Why is Ethical hacking needed?, How is Ethical hacking different from security auditing and digital forensics?, Signing NDA, Compliance and Regulatory concerns, Black box vs. White box vs. Black box, Vulnerability assessment and Penetration Testing.	**15**
	Approach : Planning	Threat Modeling, set up security verification standards, Set up security testing plan – When, which systems/apps, understanding functionality, black/gray/white, authenticated vs. unauthenticated, internal vs. external PT, Information gathering, Perform Manual and automated (Tools: WebInspect/Qualys, Nessus, Proxies, Metasploit) VA and PT, How WebInspect/Qualys tools work: Crawling/Spidering, requests forging, pattern matching to known vulnerability database and Analyzing results, Preparing report, Fixing security gaps following the report	
	Enterprise strategy	Repeated PT, approval by security testing team, Continuous Application Security Testing, **Phases:**Reconnaissance/foot-printing/Enumeration, **Phases**: Scanning, Sniffing	
III	**Phases : Gaining and Maintaining Access** :	**Phases : Gaining and Maintaining Access** : **Systems hacking** – Windows and Linux – Metasploit and Kali Linux, Keylogging, Buffer Overflows, Privilege Escalation, Network hacking - ARP Poisoning, Password Cracking, WEP Vulnerabilities, MAC Spoofing, MAC Flooding, IPSpoofing, SYN Flooding, Smurf attack, **Applications hacking** : SMTP/Email-based attacks, VOIP vulnerabilities, Directory traversal, Input Manipulation, Brute force attack, Unsecured login mechanisms, SQL injection, XSS, Mobile apps security, **Malware analysis** : Netcat Trojan, wrapping definition, reverse engineering **Phases :** Covering your tracks : Steganography, Event Logs alteration **Additional Security Mechanisms** : IDS/IPS, Honeypots and evasion techniques, Secure Code Reviews (Fortify tool, OWASP Secure Coding Guidelines)	**15**

Learning Resources recommended:

Textbook(s):

1) Certified Ethical Hacker Study Guide v9, Sean-Philip Oriyano, Sybex; Study Guide Edition,2016
2) CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2007
3) Certified Ethical Hacker: Michael Gregg, Pearson Education,1st Edition, 2013
4) Certified Ethical Hacker: Matt Walker, TMH,2011
5) http://www.pentest-standard.org/index.php/PTES_Technical_Guidelines
6) https://www.owasp.org/index.php/Category:OWASP_Top_Ten_2017_Project
7) https://www.owasp.org/index.php/Mobile_Top_10_2016-Top_10

8) https://www.owasp.org/index.php/OWASP_Testing_Guide_v4_Table_of_Contents
9) https://www.owasp.org/index.php/OWASP_Secure_Coding_Practices_-_Quick_Reference_ Guide
10) https://cve.mitre.org/
11) https://access.redhat.com/blogs/766093/posts/2914051
12) http://resources.infosecinstitute.com/applications-threat-modeling/#gref
http://www.vulnerabilityassessment.co.uk/Penetration%20Test.html

Evaluation Pattern

A. Internal Evaluation: 40 marks

Method	Marks
Mid-Term Class Test ● It should be conducted using any **learning management system** such as **Moodle**(Modular object-oriented dynamic learning environment) ● The test should have **20 MCQ's** which should be solved in a time duration of 4**0 minutes.**	20
Assignment/ Case study/ Presentations ● Assignment / Case Study Report / Presentation can be uploaded on any **learning management system**.	10
Attendance	05
Behavior	05

B. Semester End Evaluation: 60 marks (Paper Pattern) Duration: 2 hrs

Question No	Unit	Options	Marks
Q1	Unit 1	Any 3 out of 6	15
Q2	Unit 2	Any 3 out of 6	15
Q3	Unit 3	Any 3 out of 6	15
Q4	Unit 1,2,3	Objective Based	15

Syllabus for T.Y.B.Sc. Computer Science Implementation Year 2023-24

Name of the Course	**Ethical Hacking**
Course Code (refer to student handbook)	**USCSP604**
Class	TYBSc
Semester	VI
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	—
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	—

Curriculum:

Lecture/ week : 3

Practical shall be performed using **CrypTool , Ubuntu , NMap scanner , XAMP server , Wireshark , Cain and Abel , python.** **Minimum 8 practical to be implemented as a journal work.**	
Sr. No.	**Practical Title**
1.	Use Google and Whois for Reconnaissance.
2.	Use CrypTool to encrypt and decrypt passwords using RC4 algorithm.
3.	Run and analyze the output of following commands in Linux – ifconfig, ping, netstat, traceroute.
4.	Use NMap scanner to perform port scanning of various forms – ACK, SYN, FIN, NULL, XMAS.
5.	Simulate persistent cross-site scripting attack.
6.	Use Wireshark (Sniffer) to capture network traffic and analyze.
7.	Use Cain and Abel for cracking Windows account password using Dictionary attack and to decode wireless network passwords.
8	Perform ARP Poisoning in Windows.
9.	Use Nemesy to launch DoS attack.
10.	Perform SQL injection attack.
11.	Create a simple keylogger using python.

Learning Resources recommended:

Textbook(s):

1) Certified Ethical Hacker Study Guide v9, Sean-Philip Oriyano, Sybex; Study Guide Edition,2016
2) CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2007

Additional Reference(s):

1) Certified Ethical Hacker: Michael Gregg, Pearson Education,1st Edition, 2013
2) Certified Ethical Hacker: Matt Walker, TMH,2011
3) http://www.pentest-standard.org/index.php/PTES_Technical_Guidelines
4) https://www.owasp.org/index.php/Category:OWASP_Top_Ten_2017_Project

5) https://www.owasp.org/index.php/Mobile_Top_10_2016-Top_10
6) https://www.owasp.org/index.php/OWASP_Testing_Guide_v4_Table_of_Contents
7) https://www.owasp.org/index.php/OWASP_Secure_Coding_Practices_-_Quick_Reference_ Guide
8) https://cve.mitre.org/
9) https://access.redhat.com/blogs/766093/posts/2914051
10) http://resources.infosecinstitute.com/applications-threat-modeling/#gref
11) http://www.vulnerabilityassessment.co.uk/Penetration%20Test.html

Evaluation Pattern

A) Internal Examination: 20 Marks

Sr No	Criterion	Marks
1	Journals containing minimum 8 practical's which are timely completed with desired output	10
2	Attendance & Practical Performance	10

B) Semester End Examination: 30 Marks Duration: 1 hrs

Sr No	Criterion	Marks
1	One Practical Question **OR** Combination of Practical Questions **OR** Combination of Practical Question and Theory Question	25
2	Viva	05

II. Project(USCSP603)

The evaluation of the project will include a viva voce, which will assess the project based on the following parameters:

- **Documentation – 10 Marks:** The completeness, accuracy, and professionalism of the project documentation, including the project report and supporting materials, will be considered.
- **Quality of the Project – 10 Marks:** The overall quality of the project, including its design, implementation, and user experience, will be evaluated.
- **Working of the Project – 10 Marks**: The functionality and performance of the project will be assessed to determine how well it meets the specified requirements and objectives.
- **Project Presentation – 10 Marks:** The clarity, organization, and effectiveness of the project presentation will be evaluated.
- **Viva – 10 Marks:** The viva voce session will provide an opportunity for the student to demonstrate their knowledge and understanding of the project, as well as to answer questions and engage in a discussion with the evaluators.

Project Guidelines

Aim:

The Project Work as part of B.Sc. Computer Science program provides students with practical experience in applying their knowledge and skills to real-world projects, emphasizing hands-on experience in industry- standard project practices. It focuses on project development, implementation, and deployment using computer science principles and techniques. Students will work individually or in teams to design, develop, and present a substantial software project, gaining exposure to real-life project scenarios. It also covers project planning, requirements gathering, software design, coding, testing, debugging, documentation, and project management, following industry best practices. Through these projects, students will enhance their problem-solving abilities, gain proficiency in software development methodologies, and strengthen their practical skills in computer science.

Objectives:

- Apply interdisciplinary knowledge to effectively solve real-life problems using acquired skills and concepts.
- Gain hands-on experience in the software development life cycle, encompassing requirements analysis, design, implementation, testing, and deployment.
- Familiarize with global IT industry standards, ethics, and professional practices to thrive in a professional environment.
- Develop teamwork and project management skills through structured collaboration, effective communication, and task delegation.
- Produce professional technical documentation aligning with industry practices, ensuring clarity, accuracy, and usability.
- Acquire time management, resource allocation, and personnel coordination skills for efficient project execution.

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 member

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

Project Report:

The Certified Copy of Hard Bound Project Report must adhere to the following guidelines:

- No of Copies: Team Size + 1 (College / Department Copy)
- The project report should include the following
    - Title Page *(Sample attached in Appendix)*
    - Certificate *(Sample attached in Appendix)*
    - Table of Contents
    - Acknowledgement
    - Original Copy of approved Project Proposal
    - Self-attested copy of Plagiarism Report from any open source tool.
    - Chapters / Sections depending upon the type of project
    - List of Tables and/or List of Figures
    - References (IEEE / Springer format)

- Use of LaTeX for documentation purposes should be preferred.
- The text of the report should be set in 12 pt, Times New Roman font, and single-spaced.
- Chapter headings should be centered, written in 20 pt, Times New Roman font, bold, and in all caps.
- These guidelines ensure a standardized format for the project report, promoting clarity and readability.

Appendix

SAMPLE TITLE PAGE FORMAT

A PROJECT REPORT

on

<PROJECT NAME>

In partial fulfillment of

B.Sc. in Computer Science

By

Mr. XYZ

Through

Gogate Jogalekar College
(Autonomous),
Ratnagiri

In

Sem V / VI October / March 202- – 202-

SAMPLE CERTIFICATE FORMAT

<<College Name>>,

Department of Computer Science

<<College Logo>>

CERTIFICATE

This is to certify that Mr./Ms._____of **T.Y.B.Sc. (Sem V/VI)** class bearing examination seat no_____has satisfactorily carried out Project on _____,as laid by the Board of Studies of Computer Science for the year **202-** . Hi boanafied work was completed under the guidance of Mr./Mrs. XYZ.

Signature of Guide **Examiner** **Head**
Department Computer Science

Date:

Place:

The Chairperson,
BoS of Computer Science