



BHAVAN'S AUTONOMOUS COLLEGE, SYLLABUS FOR TYBSC(CS) 2023-2024.

Approved at Board of Studies meeting

Resolution No: point no:3

Bharatiya Vidya Bhavan's

M. M. College of Arts, N.M. Institute of Science, H.R.J. College of Commerce.

(Bhavan's College) Autonomous

(Affiliated to University of Mumbai)



Syllabus for: T. Y. B. Sc. (Computer Science)

Program: B. Sc. (Computer Science)

Program Code: B. Sc. CS

Course Code: (BH.USCS)

Choice Based Credit System (CBCS)

With effect from academic year 2023-24



PREAMBLE

The goal of the B.Sc. program in Computer Science is to provide students the foundations of various career opportunities in the field of Information and Communication Technology (ICT). This program emphasizes acquisition of knowledge and understanding of the system, various programming languages and tools required for effective computation-based problem solving. The main objective of this program is to inculcate among the students, the technical as well as the theoretical knowledge about the computers and its various applications in different fields. This program is designed in such a way that students can have a detailed knowledge of subjects as well as the knowledge of information technology related applications. Throughout this program the students will go through the Information and Communication Technology (ICT) scenario, its scope, career and the essentials of the ICT world.

The Bachelor of Computer Science program will equip the students with the necessary knowledge and skills for the existing and emerging challenges that a career in computing and software technology will entail. In addition, it prepares graduates to show high quality of independent thought, flexibility and maturity based on a sound technical knowledge of the field.



BHAVAN'S COLLEGE, ANDHERI WEST

T.Y.B.Sc. COMPUTER SCIENCE
Credit Based System and Grading System

SYLLABUS FOR AUTONOMY

Semester – V (THEORY)				
Course Code	Course Type	Course Title	Credits	Lectures/Week
BH. USCS501	Core Subject	Artificial Intelligence	2	3
BH. USCS502	Core Subject	Blockchain Technology	2	3
BH. USCS503	Core Subject	Information and Network Security	2	3
BH. USCS504	Core Subject	Web Services	2	3
BH. USCS505	Core Subject	Game Programming	2	3
SEMESTER - V (PRACTICAL)				
Course Code	Course Type	Course Title	Credits	Lectures/Week
BH. USCSP501	Core Subject Practical	Practical of BH.USCS501	1	3
BH. USCSP502	Core Subject Practical	Practical of BH.USCS502	1	3
BH. USCSP503	Core Subject Practical	Practical of BH.USCS503	1	3
BH. USCSP504	Core Subject Practical	Practical of BH.USCS504	1	3
BH. USCSP505	Core Subject Practical	Practical of BH.USCS505	1	3
BH. USCSP506	Core Subject Practical	Project Implementation	1	3



BHAVAN'S AUTONOMOUS COLLEGE, SYLLABUS FOR TYBSC(CS) 2023-2024.

Semester – VI (THEORY)				
Course Code	Course Type	Course Title	Credits	Lectures/ Week
BH.USCS601	Core Subject	Cloud Computing	2	3
BH.USCS602	Core Subject	Design and implementation of Modern Compilers	2	3
BH.USCS603	Core Subject	Information Retrieval	2	3
BH.USCS604	Core Subject	Data Science	2	3
BH.USCS605	Core Subject	Ethical Hacking	2	3

SEMESTER - VI (PRACTICAL)				
Course Code	Course Type	Course Title	Credits	Lectures /Week
BH.USCSP601	Core Subject Practical	Practical of BH.USCS601	1	3
BH.USCSP602	Core Subject Practical	Practical of BH.USCS602	1	3
BH.USCSP603	Core Subject Practical	Practical of BH.USCS603	1	3
BH.USCSP604	Core Subject Practical	Practical of BH.USCS604	1	3
BH.USCSP605	Core Subject Practical	Practical of BH.USCS605	1	3
BH.USCSP606	Core Subject Practical	Project Implementation	1	3



PROGRAM OUTCOMES

A student completing Bachelor's Degree in Science programme will be able to:

PO1.	Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more other disciplines that form a part of an undergraduate program of study. This program helps students in building a solid foundation for further higher studies and research.
PO2.	Critical Thinking & Competency in Skills: Take informed actions after identifying the assumptions that frame our thinking and actions. Critically evaluate practices, policies and theories by following scientific approach to knowledge development. Obtain proficiency in analytical reasoning, critical understanding, analysis and synthesis in order to solve theoretical and practical problems. This can orient students towards applications of their subject in other disciplines and, can also be utilized in modelling and solving real life problems.
PO3.	Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; communicate with others using appropriate media; confidently share one's views and express herself/ himself; demonstrate the ability to listen carefully; and present complex information in a clear and concise manner to different groups.
PO4.	Social Interaction: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause. Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO5.	Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
PO6.	Interdisciplinary and Research Skills: A sense of inquiry and capability for asking relevant/ appropriate questions, Ability to recognize cause- and- effect relationships, define problems, formulate hypotheses, interpret and draw conclusions from data, ability to plan, execute and report the results of an experiment or investigation which will enable them to apply one's learning to real life situations.
PO7.	Proficiency in Employments: This program will help students to enhance their employability for Government jobs, related to science, data analysis jobs, and jobs in various other public and private enterprises.



PROGRAM SPECIFIC OUTCOME

PSO	Description
	A student completing Bachelor's Degree in Computer Science program will be able to:
PSO-1	Foundation of mathematical concepts: obtain the Ability to apply mathematical methodologies to solve computation tasks, model real world problems using appropriate data structure and suitable algorithms. Foundations of Software development: Obtain the Ability to understand the structure and development methodologies of software systems. Possess professional skills of software design process.
PSO-2	Applications of Computing and Research Ability: obtain the Ability to use knowledge in various domains to identify research gaps and hence to provide solution to new ideas and innovation Problem analysis: Identify, formulate, review research literature, and analyze complex technical problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and computer sciences
PSO-3	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. Project management and finance: Demonstrate knowledge and understanding of the development and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PSO-4	Design/development of solutions: Design solutions for complex technical problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.



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PSO-5	<p>Conduct investigations of complex problems:</p> <p>Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.</p> <p>Ethics:</p> <p>Apply ethical principles and commit to professional ethics and responsibilities and norms of the software development practice</p>
PSO-6	<p>Modern tool usage:</p> <p>Create, select, and apply appropriate techniques, resources, and modern technical methods and IT tools including prediction and modeling with an understanding of the limitations.</p> <p>Communication:</p> <p>Communicate effectively on complex technical activities with the development community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.</p>



DETAILED SYLLABUS

SEMESTER V

Artificial Intelligence

Program: B.Sc.(CS)			Semester: V		
Course: Artificial Intelligence			Course Code: BH.USCS501		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. Strong Knowledge of Mathematics and good Analytical skills
2. Knowledge of Programming concepts.
3. Basic knowledge of Statistics and modelling.

Course Objectives: The learner should be able -

- A. To provide comprehensive techniques that helps in transform the world of machines and surpass human capability
- B. To introduce the learner to this machinery world of intelligence with programming concepts

Course Outcomes: After successfully completing the course, the learner-

- A. Learner should get a clear understanding of AI and different search algorithms used for solving problems.
- B. The learner should also get acquainted with different algorithms and models used in machine learning.

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Unit	Description	Periods
1	Introduction to AI	15 L
2	Learning from Examples	15 L
3	Learning probabilistic models	15 L
	Total	45 L



Detailed Syllabus		
Unit	Detailed Description	Lecture/ Period
I	What Is AI: Foundations, History and State of the Art of AI. Intelligent Agents: Agents and Environments, Nature of Environments, Structure of Agents. Problem Solving by searching: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.	15 Lectures
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 Lectures
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 Lectures
	Total	45 Lectures
<u>Text Book:</u> 1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 4th Edition, Pearson, 2010. https://zoo.cs.yale.edu/classes/cs470/materials/aima2010.pdf [Uploaded by Yale University]		
<u>Reference Books:</u> 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		
<u>Self-Study topics:</u> 1. Comparative study between various searching and sorting algorithms. 2. Differentiate between processing of various learning algorithm. 3. Case study on AI based systems already running in a market.		



List of Topics for the practicals for Artificial Intelligence:

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.

Details of Conduct of Practical Examination (Evaluation Scheme):

40 -Marks practical work
05 -Marks Viva
05 -Marks Journal



Block Chain Technology

Program: B.Sc.(CS)			Semester: V		
Course: Block Chain Technology			Course Code: BH.USCS502		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. About transaction in banks and basics of blockchain.

Course Objectives:

- A. To understand how Blockchain systems works.
- B. To securely interact with blockchain.
- C. To design, build, and deploy smart contracts and distributed applications.

Course Outcomes: After successfully completing the course

- A. Understand cryptographic building blocks and reason about their security that enables to assess blockchain applications in a structured manner.
- B. Understand and implement consensus mechanism in blockchain technology.
- C. Understand the applications and limitations of Blockchain technology.

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Unit	Description	Periods
1	Basics of BlockChain	15 L
2	Introduction to Bitcoin	15 L
3	Mechanics and anatomy of bitcoin	15 L
	Total	45 L

Detailed Syllabus

Unit	Detailed Description	Lecture/
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		Period
I	Basics of Blockchain History and Overview, Blockchain vs distributed databases, Role of Blockchain in the landscape of digitalization, Introduction to cryptographic concepts Hashing, public key cryptosystems, private vs public blockchain and use cases, Hash Puzzles, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain transactions, Blockchain block structure.	15 Lectures
II	Introduction to Bitcoin Bitcoin Mining Process, Mining Developments, Task of bitcoin miners, Mining incentives and strategies Mining explained, The bitcoin network, The Overview of Hyperledger, Hyperledger Projects and Architecture, Consensus model for permissioned Blockchains, Consensus and its interaction with architectural layers in bitcoin, Distributed consensus, Proof of work consensus, Architecture of Enterprise level Blockchain applications.	15 Lectures
III	Mechanics of Bitcoin Bitcoin script, Bitcoin block, Bitcoin network, Limitations and improvements in Bitcoin network, how to store and use bitcoins Hot and cold storage, splitting and sharing keys, Payment services, transaction fees, Currency exchange markets. Bitcoin and anonymity - Anonymity basics, how to de-anonymize Bitcoin, Mixing, De-centralized mixing. Alternative coins Altcoins and cryptocurrency ecosystem, Ethereum and smart contracts, alternative mining puzzles. Blockchain with different technology: Applications, Limitations and Use cases of Blockchain - Applications of Blockchain in cyber security, finances, integrity of information, supply chain, government, Limitations of Blockchain, business model challenges, Research aspects of Blockchain - Future of Bitcoin, Blockchain and Big data, Blockchain and Artificial Intelligence.	15 Lectures
	Total	45 Lectures

Text Book:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Latest Edition Princeton University Press.



Reference Books:

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System

Self-Study topics:

- Concept of node.js
- Creating new transaction and testing blockchain.
- Building interactive API model

List of Topics for the practicals:

1. Demo on the working of node.js.
2. Demo on the working of postman.
3. Create new block with data and test the block.
4. Create a new transaction.
5. Hash block and Hash function Genesis block.
6. Proof of work.
7. Genesis block.
8. Building APIs to interact with BC.
9. Block chain end points.
10. Mining block via API.

Details of Conduct of Practical Examination (Evaluation Scheme):

- 40 -Marks practical work
- 05 -Marks Viva
- 05 -Marks Journal



Information and Network Security

Program: B.Sc.(CS)			Semester: V		
Course: Information and Network Security			Course Code: BH.USCS503		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. Basics of cyber security.
2. Some concepts of communication in transactions.

Course Objectives:

- A. To provide students with knowledge of basic concepts of computer security.
- B. To explore more on network security and cryptography.

Course Outcomes: After successfully completing the course, the learner will have:

- A. Understand the principles and practices of cryptographic techniques.
- B. Understand a variety of generic security threats and vulnerabilities.
- C. Understand various protocols for network security to protect against the threats in a network

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Unit	Description	Periods
1	Introduction to INS and its Encryption Techniques.	15 L
2	Key Management, Message Authentication and Hash Functions including Digital Signatures and Authentication.	15 L
3	Security and firewall.	15 L
	Total	45 L



Detailed Syllabus

Unit	Detailed Description	Lecture/ Period
I	<p>Introduction: Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms</p> <p>Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, AES (round details not expected), Multiple Encryption and Triple DES, Block Cipher Modes of Operation, Stream Ciphers</p> <p>Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm</p>	15 Lectures
II	<p>Key Management: Public-Key Cryptosystems, Key Management, Diffie-Hellman Key Exchange</p> <p>Message Authentication and Hash Functions: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and Macs, Secure Hash Algorithm, HMAC</p> <p>Digital Signatures and Authentication: Digital Signatures, Authentication Protocols, Digital Signature Standard Authentication Applications: Kerberos, X.509 Authentication, Public-Key Infrastructure</p>	15 Lectures
III	<p>Electronic Mail Security: Pretty Good Privacy, S/MIME</p> <p>IP Security: Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management</p> <p>Web Security: Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction</p> <p>Intrusion: Intruders, Intrusion Techniques, Intrusion Detection</p> <p>Malicious Software: Viruses and Related Threats, Virus Countermeasures, DDOS</p> <p>Firewalls: Firewall Design Principles, Types of Firewalls</p>	15 Lectures
	Total	45 Lectures



Text Book:

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

Reference Books:

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

Self-Study topics:

1. X.509 Authentication
2. Public-Key Infrastructure
3. Malicious Software

List of Topics for the practicals:

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

Details of Conduct of Practical Examination (Evaluation Scheme):

- 40 -Marks practical work
- 05 -Marks Viva
- 05 -Marks Journal



Web Services

Program: B.Sc.(CS)			Semester: V		
Course: Web Services			Course Code: BH.USCS504		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. Basics knowledge of computing and networking.
2. Basics of software engineering concepts.

Course Objectives:

- A. To understand the details of web services technologies like SOAP, WSDL, and UDDI.
- B. To learn how to implement and deploy web service client and server.
- C. To understand the design principles and application of SOAP and REST based web services.
- D. To design secure web services and QoS of web services.

Course Outcomes: After successfully completing the course, the learner will have

- A. Emphasis on SOAP based web services and associated standards such as WSDL.
- B. Design SOAP based / RESTful / WCF services Deal with Security and QoS issues of Web Services

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Unit	Description	Periods
1	Web services basics	15 L
2	REST Architectural	15 L
3	Developing Service-Oriented Applications with WCF	15 L
	Total	45 L



Detailed Syllabus

Unit	Detailed Description	Lecture/ Period
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 Lectures
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 Lectures
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 Lectures
	Total	45 Lectures

Text Book:

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>

Reference Books:

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

Self-Study topics:

1. Concepts of cloud computing.
2. Distributed infrastructure models.
3. Networking Protocols



List of Topics for the practicals:

- 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.

Details of Conduct of Practical Examination (Evaluation Scheme):

40 -Marks practical work
05 -Marks Viva
05 -Marks Journal



Game Programming

Program: B.Sc.(CS)			Semester: V		
Course: Game Programming			Course Code: BH.USCS505		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. Basic knowledge of Cartesian Coordinate system.
2. Basic knowledge of vectors.

Course Objectives: The learner should be able -

- A. To understand the mathematics behind computer graphics B.
- B. To learn computer Graphics programming using Directx.
- C. To design, use and implement components of unity engine for creating a game.

Course Outcomes: After successfully completing the course, the learner -

- A. Solves sums on various mathematical concepts of computer graphics.
- B. Exhibits the usage of components of Directx in computer graphics programming.
- C. Develops a game using unity engine.

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Unit	Description	Periods
1	Vectors, Transformations, DirectX, Introduction to DirectX 11	15 L
2	Direct3D 11 Rendering Pipeline, Trigonometry, Interpolation, Curves, Analytic Geometry	15 L
3	Introduction to Rendering Engines, Unity Engine, Scripting, XR	15 L
	Total	45 L



Detailed Syllabus		
Unit	Detailed Description	Lecture/Period
I	<p>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</p> <p>Vectors : Vector Manipulation, multiplying a Vector by a Scalar, Vector Addition and Subtraction, Position Vectors, Unit Vectors, Cartesian Vectors, Vector Multiplication, Scalar Product, Example of the Dot Product, The Dot Product in Lighting Calculations, The Dot Product in Back-Face Detection, The Vector Product, The Right-Hand Rule, deriving a Unit Normal Vector for a Triangle Areas, Calculating 2D Areas</p> <p>Transformations: 2D Transformations, Matrices, Homogeneous Coordinates, 3D Transformations, Change of Axes, Direction Cosines, rotating a Point about an Arbitrary Axis, Transforming Vectors, Determinants, Perspective Projection, Interpolation</p> <p>DirectX: Understanding GPU and GPU architectures. How they are different from CPU Architectures? Understanding how to solve by GPU?</p> <p>Introduction To DirectX 11: COM, Textures and Resources Formats, The swap chain and Page flipping, Depth Buffering, Texture Resource Views, Multisampling Theory and MS in Direct3D, Feature Levels</p>	15 Lectures
II	<p>DirectX Pipeline and Programming:</p> <p>Introduction To DirectX 11: COM, Textures and Resources Formats, The swap chain and Page flipping, Depth Buffering, Texture Resource Views, Multisampling Theory and MS in Direct3D, Feature Levels</p> <p>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.</p> <p>Interpolation and Character Animation: Trigonometry: The Trigonometric Ratios, Inverse Trigonometric Ratios, Trigonometric Relationships, The Sine Rule, The Cosine Rule, Compound Angles, Perimeter Relationships</p>	15 Lectures



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	<p>Interpolation: Linear Interpolant, Non-Linear Interpolation, Trigonometric Interpolation, Cubic Interpolation, Interpolating Vectors, Interpolating Quaternions</p> <p>Curves: Circle, Bezier, B-Splines</p> <p>Analytic Geometry: Review of Geometry, 2D Analytic Geometry, Intersection Points, Point in Triangle, and Intersection of circle with straight line.</p>	
III	<p>Introduction to Rendering Engines: Understanding the current market Rendering Engines, Understanding AR, VR and MR, Depth Mappers, Mobile Phones, Smart Glasses, HMD's</p> <p>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.</p> <p>Scripting: Scripting Overview, Scripting Tools and Event Overview</p> <p>XR: VR, AR, MR, Conceptual Differences, SDK, Devices</p>	15 Lectures
	Total	45 Lectures

Text Book:

1. Mathematics for Computer Graphics, John Vince, Springer-Verlag London, 5th Edition, 2017
2. Mathematics for 3D Game Programming and Computer Graphic, Eric Lengyel, Delmar
3. Introduction To 3D Game Programming With Directx® 11, Frank D Luna, Mercury Learning And Information, 2012.
4. <https://docs.unity3d.com/Manual/index.html> - Free

Reference Books:

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

Self-Study topics:

1. Euler's Rule
2. Difference between CPU and GPU
3. Applications of VR, AR and MR
4. Various rendering engines available in market

List of Topics for the practicals:

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. Loading 2d models into DirectX 11 and rendering.



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6. Loading 3d models into DirectX 11 and rendering
7. Implement 2d ufo tutorial
8. Implement space shooter tutorial
9. Implement roll a ball tutorial
10. Project - Create your own game

Details of Conduct of Practical Examination (Evaluation Scheme):

- 40 -Marks practical work
- 05 -Marks Viva
- 05 -Marks Journal



DETAILED SYLLABUS

SEMESTER VI

Cloud Computing

Program: B.Sc.(CS)			Semester: VI		
Course: Cloud Computing			Course Code: BH.USCS601		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. Computing concepts and knowledge on cloud.
2. Flexibility to adapt different technology.

Course Objectives:

- A. To expose the learners to frontier areas of Cloud Computing.
- B. To provide learners with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture, implantations and applications.

Course Outcomes: After successfully completing the course

- A. Learner should be able to identify the architecture and infrastructure of cloud computing.
- B. Learner should be able to articulate the main concepts and the possible applications for state-of-the-art cloud computing, using open-source technology.

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Unit	Description	Periods
1	Introduction to Cloud Computing	15 L
2	Characteristics of Virtualized Environments	15 L
3	Introduction to OpenStack	15 L
	Total	45 L



Detailed Syllabus		
Unit	Detailed Description	Lecture/ Period
I	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 Lectures
II	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 Lectures
III	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 Heats.	15 Lectures
	Total	45 Lectures
<u>Text Book:</u> <ol style="list-style-type: none">1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, Tata McGraw Hill Education Private Limited, 20132. OpenStack in Action, V. K. CODY BUMGARDNER, Manning Publications Co, 2016		
<u>Reference Books:</u> <ol style="list-style-type: none">1. OpenStack Essentials, Dan Radez, PACKT Publishing, 20152. OpenStack Operations Guide, Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, O'Reilly Media, Inc., 20143. https://www.openstack.org		
<u>Self-Study topics:</u> <ol style="list-style-type: none">1. Concepts of cloud and its working.2. Concepts of software platforms on different infrastructure.3. Concepts of virtualization.		
<u>List of Topics for the practicals:</u> <ol style="list-style-type: none">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		



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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-Sign-On.
9. User Management in Cloud.
10. Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform

Details of Conduct of Practical Examination (Evaluation Scheme):

- 40 -Marks practical work
- 05 -Marks Viva
- 05 -Marks Journal



Design and implementation of Modern Compilers

Program: B.Sc.(CS)		Semester: VI		
Course: Design and implementation of Modern Compilers.		Course Code: BH.USCS602		
Teaching Scheme		Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)
3	3	1	2+1	(Marks: 40)

Pre-requisites:

1. Hands on experience with basic logical programming
2. Basic knowledge of Finite Automata
3. Conversion of Regular expression to Finite Automata

Course Objectives:

- A. To appreciate and design the model of compiler construction.
- B. To understand syntax and semantic analysis
- C. To have exposure regarding loop optimization and data analysis

Course Outcomes: After successfully completing the course

- A. Comprehends basic concepts of a compiler
- B. Performs different types of checking on a given syntax
- C. Implements loop optimization techniques

INDEX

Unit	Description	Periods
1	Introduction to Compilers	15 L
2	Advanced syntax analysis and basic semantic analysis	15 L
3	Dataflow analysis and loop optimization	15 L
	Total	45 L

Detailed Syllabus



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Unit	Detailed Description	Lecture/Period
I	Introduction to Compilers , The structure of a compiler, A simple approach to the design of lexical analyzers, Regular expressions, Finite automata, From regular expressions to finite automata, Minimizing the number of states of a DFA, Context-free grammars, Derivations and Parse trees, Parsers, Shift-reduce parsing, Operator- precedence parsing, Top- down parsing, Predictive parsers.	15 Lectures
II	Advanced syntax analysis and basic semantic analysis Syntax-directed translation schemes, Implementation of syntax-directed translators, Initial introduction to the ongoing Tiger compiler, bindings for the Tiger compiler, typechecking expressions, type-checking declarations, activation records, stack frames, frames in the Tiger compiler, translation to intermediate code, intermediate representation trees, translation into trees, declarations, basic blocks and traces, taming conditional branches, liveness analysis, solution of dataflow equations, liveness in the Tiger compiler, interference graph construction.	15 Lectures
III	Dataflow analysis and loop optimization The principle sources of optimization, Loop optimization: The DAG representation of basic blocks, Dominators, Reducible flow graphs, Depth- first search, Loop-invariant computations, Induction variable elimination, Some other loop optimizations. Dataflow Analysis: intermediate representation for flow analysis, various dataflow analyses, transformations using dataflow analysis, speeding up dataflow analysis, alias analysis.	15 Lectures
	Total	45 Lectures

Text Book:

1. Compilers: Principles, Techniques and Tools 2 nd edition, Alfred V. Aho , Monica S. Lam ,
2. Ravi Sethi
Java, Second
3. Edition, Andrew Appel and Jens Palsberg, Cambridge University Press (2004)

Reference Books:

1. Principles of Compiler Design, Alfred Aho and Jeffrey D. Ullman, Addison Wesley(1997).
2. Compiler design in C, Allen Holub, Prentice Hall (1990).

Self-Study topics:

1. Structure of a compiler
2. Minimizing the number of states of a DFA
3. Context-free grammars



List of Topics for the practicals:

1. Write a program to validate decision making statement (validation of if else)
2. Write a program to validate looping statement (validation of for, while, do...while)
3. Write a program to validate DFA
4. Write a program to implement 3-Address Code
5. Write a program to implement Triple
6. Write a program to implement Quadruple
7. Write a program to implement Infix to Postfix
8. Write a program to implement Postfix to Infix
9. Write a program to convert the given Right Linear Grammar to Left Linear Grammar form.
10. Generation of machine code



Information Retrieval

Program: B.Sc.(CS)			Semester: VI		
Course: Information Retrieval			Course Code: BH.USCS603		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. Basics of algorithms, data structures and databases
2. Good knowledge of mathematics

Course Objectives:

- A. To provide an overview of the important issues in classical and web information retrieval
- B. To give an up-to- date treatment of all aspects of the design and implementation of systems
- C. To focus on gathering, indexing, and searching documents and of methods for evaluating systems.

Course Outcomes: After successfully completing the course

- A. Understands the field of information retrieval and its relationship to search engines
- B. Understands the design and implementation of systems
- C. Applies information retrieval models.

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Unit	Description	Periods
1	Introduction to Information Retrieval	15 L
2	Link Analysis and Specialized Search	15 L
3	Web Search Engine and XML retrieval	15 L
	Total	45 L



Detailed Syllabus		
Unit	Detailed Description	Lecture/Period
I	Introduction to Information Retrieval: Introduction, History of IR, Components of IR, and Issues related to IR, Boolean retrieval, Dictionaries and tolerant retrieval	15 Lectures
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 Lectures
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. 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.	15 Lectures
	Total	45 Lectures
<u>Text Book:</u> <ol style="list-style-type: none">1. Introduction to Information Retrieval, C. Manning, P. Raghavan, and H. Schütze, Cambridge University Press, 20082. Modern Information Retrieval: The Concepts and Technology behind Search, Ricardo Baeza -Yates and Berthier Ribeiro – Neto, 2 nd Edition, ACM Press Books 2011.3. Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler and Trevor Strohman, 1st Edition, Pearson, 2009.		
<u>Reference Books:</u> <ol style="list-style-type: none">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)		
<u>Self-Study topics:</u> <ol style="list-style-type: none">1. As per instructor’s guide		
<u>List of Topics for the practicals:</u> <ol style="list-style-type: none">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.,		



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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 simple web crawler.

10. Write a program to parse XML text, generate Web graph and compute topic specific page rank.

Details of Conduct of Practical Examination (Evaluation Scheme):

40 -Marks practical work

05 -Marks Viva

05 -Marks Journal



Data Science

Program: B.Sc.(CS)			Semester: VI		
Course: Data Science			Course Code: BH.USC604		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. Concepts of statistics and basics of programming knowledge.

Course Objectives:

- A. Understanding basic data science concepts.
- B. Making aware of how to address advanced statistical situations, Modeling and Machine Learning.
- C. Learning to detect and diagnose common data issues.

Course Outcomes: After successfully completing the course

- A. Students shall be able to understand & comprehend the problem.
- B. Students shall be able to define suitable statistical method to be adopted.

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Unit	Description	Periods
1	Introduction to data science and data management .	15 L
2	Data Curation.	15 L
3	Statistical Modelling and Machine Learning.	15 L
	Total	45 L



Detailed Syllabus

Unit	Detailed Description	Lecture/ Period
I	<p>Introduction to Data Science: What is Data? Different kinds of data, 15L Introduction to high level programming language + Integrated Development Environment (IDE), Exploratory Data Analysis (EDA) + Data Visualization, Different types of data sources,</p> <p>Data Management: Data Collection, Data cleaning/extraction, Data analysis & Modeling.</p>	15 Lectures
II	<p>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)</p>	15 Lectures
III	<p>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</p> <p>Data transformations: Dimension reduction, Feature extraction, Smoothing and aggregating</p> <p>Supervised Learning: Regression, linear models, Regression trees, Time-series Analysis, Forecasting, Classification: classification trees, Logistic regression, separating hyperplanes, k-NN</p> <p>Unsupervised Learning: Principal Components Analysis (PCA), k-means clustering, Hierarchical clustering, Ensemble methods</p>	
	Total	45 Lectures
<p><u>Text Book:</u></p> <ol style="list-style-type: none">1. Doing Data Science, Rachel Schutt and Cathy O'Neil, O'Reilly,20132. Mastering Machine Learning with R, Cory Lesmeister, PACKT Publication,2015		
<p><u>Reference Books:</u></p> <ol style="list-style-type: none">1. Hands-On Programming with R, Garrett Golemund,1st Edition, 20142. An Introduction to Statistical Learning, James, G., Witten, D., Hastie, T., Tibshirani, R.,Springer,2015		
<p><u>Self-Study topics:</u></p> <ol style="list-style-type: none">1. As per instructor's guide		



List of Topics for the practicals:

(Practical may be done using software/tools like Python / Java / Hadoop)

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

Details of Conduct of Practical Examination (Evaluation Scheme):

40 -Marks practical work
05 -Marks Viva
05 -Marks Journal



Ethical Hacking

Program: B.Sc.(CS)			Semester: VI		
Course: Computer Networks			Course Code: BH.USCS605		
Teaching Scheme			Evaluation Scheme (Theory)		
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)
3	3	1	2+1	(Marks: 40)	(Marks: 60)

Pre-requisites:

1. An understanding of the TCP/IP protocol and the its layer model

Course Objectives:

- A. To understand the ethics, legality, methodologies and techniques of hacking.
- A. To test and exploit systems using various tools
- B. To understand the impact of hacking in real time machines

Course Outcomes: After successfully completing the course

- A.
- A. Identifies security vulnerabilities and weaknesses in the target applications.
- B. Is able to test and exploit systems using various tools
- C. understands the impact of hacking in real time machines

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Unit	Description	Periods
1	Information Security, Types of malware and vulnerabilities	15 L
2	Ethical Hacking	15 L
3	Ethical Hacking- Enterprise Security	15 L
	Total	45 L

Detailed Syllabus



Unit	Detailed Description	Lecture/ Period
I	<p>Information Security : Attacks and Vulnerabilities</p> <p>Introduction to information security : Asset, Access Control, CIA, Authentication, Authorization, Risk, Threat, Vulnerability, Attack, Attack Surface, Malware, Security-Functionality-Ease of Use Triangle.</p> <p>Types of malware: Worms, viruses, Trojans, Spyware, Rootkits.</p> <p>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 .</p> <p>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.</p> <p>Case-studies : Recent attacks – Yahoo, Adult Friend Finder, eBay, Equifax, WannaCry, Target Stores, Uber, JP Morgan Chase, Bad Rabbit.</p>	15 Lectures
II	<p>Ethical Hacking – I (Introduction and pre-attack)</p> <p>Introduction: 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 15L concerns, Black box vs. White box vs. Black box, Vulnerability assessment and Penetration Testing.</p> <p>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</p> <p>Enterprise strategy : Repeated PT, approval by security testing</p>	15 Lectures



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	team, Continuous Application Security Testing, Phases: Reconnaissance/foot-printing/Enumeration, Phases: Scanning, Sniffing	
III	<p>Ethical Hacking :Enterprise Security 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,</p> <p>Applications hacking : SMTP/Email-based attacks, VOIP vulnerabilities, Directory traversal, Input Manipulation, Brute force attack, Unsecured login mechanisms, SQL injection, XSS, Mobile apps security,</p> <p>Malware analysis : Netcat Trojan, wrapping definition, reverse engineering</p> <p>Phases : Covering your tracks : Steganography, Event Logs alteration</p> <p>Additional Security Mechanisms : IDS/IPS, Honeypots and evasion techniques, Secure Code Reviews (Fortify tool, OWASP Secure Coding Guidelines).</p>	15 Lectures
	Total	45 Lectures

Text Book:

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

Reference Books:

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>

Self-Study topics:

- 1.As per instructor's guide



List of Topics for the practicals:

1. Use Google and Whois for Reconnaissance.
2. Perform the following:
 - a. Use CrypTool to encrypt and decrypt passwords using RC4 Algorithm.
 - b. Use MD5 Calculator to calculate hash of a text.
3. Perform the following:
 - a. Demonstrate Steganography.
 - b. Run and analyze the output of the following commands in Linux – ifconfig, ping, netstat, Traceroute.
4. Use NMap scanner to perform port scanning of various forms – regular scan, aggressive scan, full open scan, half open scan, ping scan, XMAS scan.
5. Perform Phishing through Kali Linux.
6. Create a simple keylogger using Python.
7. Perform the following:
 - a. Use Wireshark (Sniffer) to capture and analyze network traffic.
 - b. Create a custom password list using Crunch in Kali Linux.
8. Simulate non-persistent cross-site scripting attack.
9. Perform SQL injection attack.
10. Use Metasploit to exploit Kali Linux.

Details of Conduct of Practical Examination (Evaluation Scheme):

- 40 -Marks practical work
- 05 -Marks Viva
- 05 -Marks Journal



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CIA-2 for Semester V

Paper	601	602	603	604	605
Topics					

CIA-2 for Semester VI

Paper	601	602	603	604	605
Topics					



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Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment - 40% - 40 Marks

SR. NO	EVALUATION TYPE	MARKS
1	CONTINUOUS INTERNAL ASSESSMENT-I (CIA-I): Internal Class Test with Objective types questions MCQs.	20
2	CONTINUOUS INTERNAL ASSESSMENT-II (CIA-II): Case study, Mini project, Group activity etc.	20
	TOTAL	40

B) External Examination- 60%- 60 Marks

Semester End Theory Examination: 60 marks

1. Duration: These examinations shall be of 2 hours duration.
2. Passing criteria: Students have to acquire a minimum of 40% marks in each course.
3. **Paper Pattern:**
 - A. There shall be **four** questions each of **15** marks. On each unit there will be **seven/eight** questions.
 - B. All questions shall be compulsory with internal choice within some questions. Each Question may be subdivided into sub questions as a, b, c, d & e, etc & the allocation of Marks` depends on the weightage of the topic

In case if exams are conducted online then the following examination pattern will be followed.



Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

SR. NO	EVALUATION TYPE	MARKS
1	CONTINUOUS INTERNAL ASSESSMENT-I (CIA-I): Internal Class Test with Objective types questions MCQs. Online platforms such as Google Classroom, Google Form, zoom, google meet etc. can be used.	20
2	CONTINUOUS INTERNAL ASSESSMENT-II (CIA-II): Case study, Mini project, Group activity Online platforms such as Google Classroom, zoom, google meet etc. can be used.	20
	TOTAL	40

B) External Examination- 60%- 60 Marks Semester

End Theory Examination: 60 marks

1. **Duration:** These examinations shall be of **90mins** duration.
2. **Passing criteria:** Students have to acquire a minimum of 40% marks in each course.
3. **Paper Pattern:** All MCQ questions.



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Pattern of MCQ question paper should be as follows:

Unit I -14 one mark and 3 two mark questions	20 Marks
Unit II -13 one mark and 3 two mark questions	19 Marks
Unit III - 13 one mark and 4 two mark questions	21 Marks
TOTAL	60 Marks

Practical Examination Pattern:

External Examination- 50 marks

1. **Duration:** These examinations shall be of **2 hours** duration.
2. **Passing criteria:** Students have to acquire a minimum of 40% marks in each course. Minimum 75% practical from each core/allied course are required to be completed and written in the journal.
3. **Certified E-Journal is compulsory for appearing at the time of Practical Exam.**
4. **Examination pattern:**
 - a. Practical work and Viva: 40 marks
 - b. Journal: 10 marks



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Overall Examination & Marks Distribution Pattern

Semester V

COURSE	THEORY:	BH.USCS501,502,503,504,505	
	PRACTICALS:	BH.USCS501,502,503,504,505,506	
	Internal	External	Total
Theory	40	60	700
Practicals	-	50	300
Total			1000

Semester VI

COURSE	THEORY:	BH.USCS 601,602,603,604,605	
	PRACTICALS:	BH.USCSP 601,602,603,604,605,606	
	Internal	External	Total
Theory	40	60	700
Practicals	-	50	300
Total			1000



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Rubrics of evaluation for ESE:

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
from all units	05	05	05	15
1	05	05	05	15
2	05	05	05	15
3	05	05	05	15
Total	20	20	24	60
% Weightage	33.33	33.33	33.34	100



Rubrics of evaluation for CIA-2 Assignment: Case Study, Research Paper, Analysis of various algorithms

Parameters	Max Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Poor	0-20% very poor
CONTENT						
Content: Isolation of topic	02					
Content: Objective	03					
Content: Study of Case	08					
Content: Module Usage	02					
Limitations	02					
Best Features & Future Enhancements	03					
Total	20					

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