

Resolution No.: AC/ 2023

**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 (Information Technology)**



**Program: B. Sc (Information Technology)**

**Program Code: B. Sc. IT**

**Course Code: (BH.USITS)**

**Choice Based Credit System (CBCS)**

**with effect from academic year 2023-24**

**Approved at Board of Studies meeting Resolution number 1,2 BSCIT/TY /2023  
dated 12/11/2022, 11/01/2023**



## PROGRAM OUTCOMES

	<b>PO Description</b>
<b>PO</b>	<b>A student completing Bachelor's Degree in Science program will be able to:</b>
<b>PO-1</b>	Create, select, and apply appropriate current techniques, resources in the core areas of information management, programming, networking, and cyber security, web systems and green technologies.
<b>PO-2</b>	Identify, formulate, use research literature, analyze information technology related problems and design the system or provide the solution for the problem.
<b>PO-3</b>	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Information Technology practice.
<b>PO-4</b>	Understand the impact of the Information Technology solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO-5</b>	Design solutions for system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the societal, and environmental considerations.
<b>PO-6</b>	Function in multidisciplinary teams by working cooperatively, creatively and responsibly as a member of a team.



**PROGRAM SPECIFIC OUTCOMES**

	<b>Description</b>	<b>Mapping</b>
<b>PSO</b>	<b>A student completing a Bachelor's Degree in BSc. Program with the subject of Information Technology will be able to</b>	
<b>PSO-1</b>	think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.	<ul style="list-style-type: none"> <li>● Enterprise JAVA using Spring</li> <li>● Geographical Information Systems</li> <li>● Data Science</li> </ul>
<b>PSO-2</b>	analyze a problem, design, implement the computing requirements, and evaluate computer-based system, process, component, or program to meet desired needs.	<ul style="list-style-type: none"> <li>● Enterprise JAVA using Spring</li> <li>● Geographical Information Systems</li> <li>● Data Science</li> </ul>
<b>PSO-3</b>	manage complex IT projects with consideration of the human, financial and environmental factors	<ul style="list-style-type: none"> <li>● Software Quality Assurance</li> <li>● Security in computing</li> </ul>
<b>PSO-4</b>	adhere to the highest standards of ethics, including relevant industry and organizational codes of conduct	<ul style="list-style-type: none"> <li>● Software Quality Assurance</li> <li>● UI/UX Design for Entrepreneurs</li> </ul>
<b>PSO-5</b>	communicate effectively with a range of audiences both technical and non-technical.	<ul style="list-style-type: none"> <li>● Next Generation Technologies</li> <li>● Security in computing</li> </ul>
<b>PSO-6</b>	develop an aptitude to engage in continuing professional development	<ul style="list-style-type: none"> <li>● Internet of Things</li> <li>● Security in computing</li> <li>● Cyber Law</li> <li>● UI/UX Design for Entrepreneurs</li> </ul>



**RATIONALE FOR SYLLABUS REVISION**

Existing Syllabus		Revised Syllabus		Rationale
Course titles	Semester	Course titles	Semester	
Python Programming	3	Core Java	3	After learning Imperative programming skills in first year , GUI development using java is introduced in semester 3 .
Data Structures	3	Data Structures using Python	3	Python Programming is taught in semester 2 of revised syllabus. Focus is on Implementation of data structures using python language
Computer Networks	3	Computer Networks	3	Additional concept are introduced in Session and application layer of OSI framework
Database Management Systems	3	Operating System	3	This course was earlier in semester 1. It's shifted to semester 3. At semester Learners find difficulty in learning and understanding. Continuity is maintained by having Linux System administration in semester 4



Applied Mathematics	3	Computer Oriented Statistical Techniques	3	<p>Applied Mathematics is shifted to semester 1.</p> <p>After learning Mathematics at 10 +2 level , the gap of relearning Mathematics concepts after one year is eliminated by shifting Course from semester 3 to semester 1.</p> <p>Numerical and statistical methods is taught in semester 2 .</p> <p>Further learners shall be learning techniques in semester 3 using R software</p>
Core Java	4	Business Intelligence	4	<p>Semester 4 main focus is given on Implementation techniques.</p> <p>Fundamentals of Digital Marketing using Web Analytics is new course introduced .</p> <p>Other courses are from semester 5,6 which will be taught in semester 4</p> <p>Semester 5 and 6 main focus is given on upcoming technologies.</p>
Introduction to Embedded Systems	4	Advanced Web Programming	4	
Computer Oriented Statistical Techniques	4	Fundamentals of Digital Marketing using Web Analytics	4	
Software Engineering	4	Linux Administration	4	
Computer Graphics and Animation	4	Software Engineering and Management Practices	4	
Software Project Management	5	Software Quality Assurance	5	



Internet of Things	5	Internet Of Things	5	The courses are introduced as per industry trend recommendation.
Advanced Web Programming	5	Data Science	5	
Linux System Administration	5	Next Generation Technologies	5	
Enterprise Java	5	Enterprise JAVA and Spring	5	
Software Quality Assurance	6	UI/UX Design for Entrepreneurs	6	
Security in Computing	6	Security in Computing	6	
Business Intelligence	6	Data Center Technologies	6	
Principles of Geographic Information Systems	6	Principles of Geographic Information Systems	6	
Cyber Laws	6	Cyber Law	6	



## DETAILED SYLLABUS

### PREAMBLE

Keeping an eye on the industry and to modernize the curriculum, the Board of Studies members of Information technology department has initiated syllabus to include industry-oriented syllabus.

The main objective of this program is to inculcate among the students, the technical as well as the theoretical knowledge about information technology and its applications in different domain area.

The syllabus aims to focus on enabling the students to familiarize with upcoming technologies, enhance and strengthen the fundamental knowledge in Information Technology Applications, Mathematics, and Statistics.

This programme 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.

On completion of the program students should be able to,

- Use a range of programming languages and tools to develop computer programs and systems that are effective solutions to problems. dents employable and impart industry oriented training.
- to think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.
- to apply their knowledge and skills to be employed and excel in IT professional careers and/or to continue their education in IT and/or related postgraduate programmes.
- to adhere to the highest standards of ethics, including relevant industry and organizational codes of conduct.
- to communicate effectively with a range of audiences both technical and non-technical.
- to develop an aptitude to engage in continuing professional development.



**PROGRAM OUTLINE**  
for  
**BSc. Information Technology**

Sem ester	Core course 16 CREDIT(T+P) =2+2 /COURSE	Ability enhancemen t course CREDIT 2	Skill enhanceme nt course CREDIT 2	Discipline specific elective* CREDIT 2	Generi c electiv e CRED IT02	TOT AL CRE DITS
I	Imperative Programming BH. USITS101	Communication Skills BH. USITS105	-	-	-	20
I	Digital Electronics BH. USITS102		-	-	-	
I	Microprocessor & Microcontroller BH. USITS103		-	-	-	
I	Applied Mathematics BH. USITS104		-	-	-	
II	Python Programming BH. USITS201	Green Computing BH. USITS205	-	-	-	20
II	Database Management System BH. USITS202		-	-	-	
II	Web Programming BH. USITS203		-	-	-	
II	Numerical & Statistical Methods BH. USITS204		-	-	-	
III	Computer Oriented Statistical Techniques BH. USITS302	-	Core Java BH. USITS301	-	-	20
III	Computer Networks BH. USITS303	-		-	-	
III	Data Structures using Python BH. USITS304	-		-	-	
III	Operating System BH. USITS305	-		-	-	





<b>IV</b>	Advanced Web Programming BH. USITS402	-	Fundamentals of Digital Marketing using Web Analytics BH. USITS401	-	-	20
<b>IV</b>	Business Intelligence BH. USITS403	-		-	-	
<b>IV</b>	Linux Administration BH. USITS404	-		-	-	
<b>IV</b>	Software Engineering and Management Practices BH. USITS405	-		-	-	
<b>V</b>	Internet Of Things BH.USITS502	-	Software Quality Assurance BH.USITS501	Enterprise JAVA and Spring BH.USITS504	-	20
<b>V</b>	Data Science BH.USITS503	-	-	Next Generation Technologies BH.USITS505	-	
<b>V</b>	-	-	-	Micro-Service Architecture BH.USITS506	-	
<b>VI</b>	Principles of Geographic Information Systems BH. USITS602	-	UI/UX Design for Entrepreneurs BH. USITS601	Data Center Technologies BH. USITS604	-	20
<b>VI</b>	Security in Computing BH. USITS603	-	-	Cyber Law BH. USITS605	-	
<b>VI</b>	-	-	-	Enterprise Networking BH. USITS606	-	



### TYBSc. Information Technology Semester V & VI Revised Course Titles & Credits

YEAR	SEMESTER	COURSE TYPE	COURSE CODE	COURSE TITLE	CREDITS
T.Y.B. Sc IT	V	Skill Enhancement Course	BH. USITS501	Software Quality Assurance	02
T.Y.B. Sc IT	V	Core Course	BH. USITS502	Internet Of Things	02
T.Y.B. Sc IT	V	Core Course	BH. USITS503	Data Science	02
T.Y.B. Sc IT	V	Elective Course	BH. USITS504	Enterprise JAVA and Spring	02
T.Y.B. Sc IT	V	Elective Course	BH. USITS505	Next Generation Technologies	02
T.Y.B. Sc IT	V	Elective Course	BH. USITS506	Micro-Service Architecture	02
T.Y.B. Sc IT	V	Skill Enhancement Course Practical	BH. USITS5P1	Project Dissertation	02
T.Y.B. Sc IT	V	Core Course Practical	BH. USITS5P2	Internet Of Things Practicals	02
T.Y.B. Sc IT	V	Core Course Practical	BH. USITS5P3	Data Science Practicals	02
T.Y.B. Sc IT	V	Elective Course Practical	BH. USITS5P4	Enterprise JAVA with Spring Practicals	02
T.Y.B. Sc IT	V	Elective Course Practical	BH. USITS5P5	Next Generation Technologies Practicals	02
T.Y.B. Sc IT	V	Elective Course Practical	BH. USITS5P6	Micro-Service Architecture Practicals	02
T.Y.B. Sc IT	VI	Skill Enhancement Course	BH. USITS601	UI/UX Design for Entrepreneurs	02
T.Y.B. Sc IT	VI	Core Course	BH. USITS602	Principles of Geographic Information Systems	02



T.Y.B. Sc IT	VI	Core Course	BH. USITS603	Security in Computing	02
T.Y.B. Sc IT	VI	Elective Course	BH. USITS604	Data Center Technologies	02
T.Y.B. Sc IT	VI	Elective Course	BH. USITS605	Cyber Law	02
T.Y.B. Sc IT	VI	Elective Course	BH. USITS606	Enterprise Networking	02
T.Y.B. Sc IT	VI	Skill Enhancement Course Practical	BH. USITS6P1	UI/UX Design for Entrepreneurs Practical	02
T.Y.B. Sc IT	VI	Core Course Practical	BH. USITS6P2	Principles of Geographic Information Systems Practical	02
T.Y.B. Sc IT	VI	Core Course Practical	BH. USITS6P3	Security in Computing Practical	02
T.Y.B. Sc IT	VI	Core Course Practical	BH. USITS6P4	Data Center Technologies Practical	02
T.Y.B. Sc IT	VI	Core Course Practical	BH. USITS6P5	Project Implementation	02
T.Y.B. Sc IT	VI	Core Course Practical	BH. USITS6P6	Advanced Networking Practical	02



**DETAILED SYLLABUS**

**SEMESTER V**

<b>Programme: B. Sc. IT</b>				<b>Semester: V</b>	
<b>Course: Software Quality Assurance</b>				<b>Course Code: BH.USITS501</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>(Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
<b>4</b>	<b>4</b>	<b>-</b>	<b>2+2</b>	<b>40</b>	<b>60</b>
<p><b>COURSE OBJECTIVES:</b></p> <ol style="list-style-type: none"> <li>1. Manage the selection and initiation of individual projects and of portfolios of projects in the enterprise.</li> <li>2. Conduct project planning activities that accurately forecast project costs, timelines, and quality.</li> <li>3. Implement processes for successful resource, communication, and risk and change management.</li> <li>4. Conduct project closure activities and obtain formal project acceptance.</li> </ol>					
<p><b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able</p> <ol style="list-style-type: none"> <li>1. To introduce how software management is different from ordinary project management.</li> <li>2. To Understand effective project execution and control techniques that result in successful projects</li> <li>3. To gain a strong working knowledge of ethics and professional responsibility.</li> <li>4. To Implement effective organizational leadership and change skills for managing projects, project teams, and stakeholders.</li> </ol>					
<b>Detailed Syllabus: (per session plan)</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	<b>Introduction to Quality[Lectures 4]:</b> Historical Perspective of Quality, What is Quality? , Core Components of Quality, Quality View, Financial				<b>12</b>



	<p>Aspect of Quality, Customers, Suppliers and Processes, <b>Quality Principles of Total Quality Management [Lectures 4]</b>;; Quality Management Through Statistical Process Control, Quality Management Through Cultural Changes, Continual (Continuous) Improvement Cycle, Quality in Different Areas, Benchmarking and Metrics, Problem Solving Techniques, Problem Solving Software Tools.</p> <p><b>Software Quality[Lectures 4]</b>: Introduction, Constraints of Software Product Quality Assessment, Customer is a King, Quality and Productivity Relationship, Requirements of a Product, Organisation Culture, Characteristics of Software, Software Development Process, Types of Products, Schemes of Criticality Definitions, Problematic Areas of Software Development Life Cycle, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, Important Aspects of Quality Management.</p>	
2	<p><b>Fundamentals of testing [Lectures 4]</b>: Introduction, Necessity of testing, what is testing? Fundamental test process, the psychology of testing, Historical Perspective of Testing, Definitions of Testing, Approaches to Testing, Testing During Development Life Cycle, Requirement Traceability Matrix, Essentials of Software Testing, Workbench, Important Features of Testing Process, Misconceptions About Testing,</p> <p><b>Principles of Software Testing [Lectures 4]</b>: Salient Features of Good Testing, Test Policy, Test Strategy, Test Planning, Testing Process and Number of Defects Found in Testing, Test Team Efficiency, Mutation Testing, Challenges in Testing, Test Team Approach, Process Problems Faced by Testing, Cost Aspect of Testing, Establishing Testing Policy, Methods, Structured Approach to Testing, Categories of Defect, Defect, Error, or Mistake in Software, Developing Test Strategy,</p> <p><b>Developing Testing Methodologies [Lectures 4]</b>: Attitude Towards Testing , Test Methodologies/Approaches, People Challenges in Software Testing, Raising Management Awareness for Testing, Skills Required by Tester, Testing throughout the software life cycle, Software development models, Unit Testing, Boundary Value Testing, Equivalence Class Testing, Decision Table?Based Testing, Path Testing, Data Flow Testing</p>	12
3	<p><b>Software Verification and Validation[Lectures 4]</b>: Introduction, Verification, Verification Workbench, Methods of Verification, Types of reviews on the basis od Stage Phase, Entities involved in verification, Reviews in testing lifecycle,</p> <p><b>Coverage in Verification [Lectures 2]</b>: Concerns of Verification,</p> <p><b>Validation [Lectures 4]</b>: Validation Workbench, Levels of Validation, Coverage in Validation, Acceptance Testing</p> <p><b>V-test Model[Lectures 2]</b>: Introduction, V-model for software, VV Model, Critical Roles and Responsibilities.</p>	12
4	<p><b>Levels of Testing[Lectures 4]</b>: Proposal Testing, Requirement Testing, Design Testing, Code Review, Unit Testing, Module Testing, Integration</p>	12



	<p>Testing, Big-Bang Testing, Sandwich Testing, Critical Path First, Sub System Testing, System Testing, Testing Stages.</p> <p><b>Special Tests[Lectures 4]:</b> GUI testing, Compatibility Testing, Security Testing, Performance Testing, Volume Testing, Stress Testing, Recovery Testing, Installation Testing, Requirement Testing, Regression Testing, Smoke Testing, Adhoc Testing, Parallel Testing, Decision Table Testing, Documentation Testing, Training testing, Rapid Testing,</p> <p><b>Control flow graph [Lectures 4]:</b> Generating tests on the basis of Combinatorial Designs , State Graph, Risk Associated with New Technologies, Process maturity level of Technology, Object Oriented Application Testing, Testing of Internal Controls, COTS Testing, Client Server Testing, Web Application Testing, Mobile Application Testing, eBusiness eCommerce Testing, Agile Development Testing, Data Warehousing Testing.</p>	
	<b>Total</b>	<b>48</b>
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Software Testing and Continuous Quality Improvement, William E. Lewis ,CRC Press ,Edition 2020.</li> <li>2. Software Testing: Principles, Techniques and Tools,M. G. Limaye, TMH 2021</li> <li>3. Foundations of Software Testing , Dorothy Graham, Erik van Veenendaal, Isabel Evans,Rex Black,Cengage Learning-Latest Edition.</li> <li>4. Software Testing: A Craftsman’s Approach, Paul C. Jorgenson, CRC Edition 2020 Press</li> </ol>		
<p><b>Details of Continuous Internal Assessment(CIA):</b>                  (CIA-1):20 Marks                  (CIA-2) 20 Marks : Case Study on Software Quality</p>		



<b>Programme: B. Sc. IT</b>				<b>Semester: V</b>	
<b>Course: Internet of Things</b>				<b>Course Code: BH.USITS502</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
<b>4</b>	<b>2 ( 2 batches) =4</b>	<b>---</b>	<b>2+2</b>	<b>40</b>	<b>60</b>
<b>COURSE OBJECTIVES:</b>					
<ol style="list-style-type: none"> <li>1. To understand principles of connected devices.</li> <li>2. To learn the model-driven and design-driven approaches for developing applications of IOT.</li> <li>3. To think about the manufacturing of printed circuit boards.</li> <li>4. To learn different techniques for writing embedded code.</li> </ol>					
<b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able to					
<ol style="list-style-type: none"> <li>1. Conceptually develop software and hardware for automation</li> <li>2. Develop the embedded devices.</li> <li>3. Prototype embedded devices.</li> <li>4. Design different business model.</li> </ol>					
<b>Detailed Syllabus: (per session plan)</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	<p><b>The Internet of Things[Lectures 2]:</b> An Overview : The Flavour of the Internet of Things, The “Internet” of “Things”, The Technology of the Internet of Things, Enchanted Objects.</p> <p><b>Design Principles for Connected Devices[Lectures 6]:</b> Calm and Ambient Technology, Magic as Metaphor, Web Thinking for Connected Devices, Small Pieces, Loosely Joined, First-Class Citizens On The Internet, Graceful Degradation, Affordances.</p> <p><b>Internet Principles[Lectures 4]:</b> Internet Communications: An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS, Static IP Address Assignment.</p>				<b>12</b>



<b>2</b>	<p><b>Thinking About Prototyping[Lectures 2]:</b> Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Changing Embedded Platform,</p> <p><b>Physical Prototypes and Mass Personalization [Lectures 4]:</b>, Climbing into the Cloud, Open Source versus Closed Source, Closed Source for Mass Market Projects, Tapping into the Community.</p> <p><b>Prototyping Embedded Devices[Lectures 6]:</b> Electronics, Sensors, Actuators, Scaling Up the Electronics, Embedded Computing Basics, Microcontrollers, System-on-Chips, Developing on the Raspberry Pi, Arduino, Developing on the Arduino, Some Notes on the Hardware, Openness.</p>	12
<b>3</b>	<p><b>Prototyping the Physical Design[Lectures 4]:</b> Preparation, Sketch, Iterate, and Explore, Nondigital Methods, Laser Cutting, Choosing a Laser Cutter, Software, Hinges and Joints, 3D Printing, Types of 3D Printing, Software, CNC Milling, Repurposing/Recycling.</p> <p><b>Prototyping Online Components[Lectures 6]:</b> Getting Started with an API, Mashing Up APIs, Scraping, Legalities, Writing a New API, Clockodillo, Security, Implementing the API, Using Curl to Test, Polling, Comet, Other Protocols.</p> <p><b>Techniques for Writing Embedded Code[Lectures 2]:</b> Memory Management, Types of Memory, Making the Most of Your RAM, Performance and Battery Life, Libraries, Debugging.</p>	12
<b>4</b>	<p><b>Business Models[Lectures 6]:</b> A Short History of Business Models, Space and Time, From Craft to Mass Production, The Long Tail of the Internet, Learning from History, The Business Model Canvas, Funding an Internet of Things Startup, Hobby Projects and Open Source, Venture Capital, Government Funding, Crowdfunding, Lean Startups.</p> <p><b>Moving to Manufacture[Lectures 3]:</b> What Are You Producing? Designing Kits, Designing Printed circuit boards, Software Choices, The Design Process, Manufacturing Printed Circuit Boards, Etching Boards, Milling Boards.</p> <p><b>Ethics[Lectures 3]:</b> Characterizing the Internet of Things, Privacy, Control, Disrupting Control, Crowdsourcing.</p>	12
	<b>Total</b>	<b>48</b>

**Reference Books:**

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley 2021.
2. Internet of Things-Architecture and Design, Raj Kamal, McGraw Hill 2020.
3. Getting Started with the Internet of Things, Cuno Pfisher, O'Really 2021.
4. Getting Started with Raspberry Pi, Matt Richardson and Shawn Wallace, SPD 2020.

**Details of Continuous Internal Assessment:**

**(CIA-1):20 Marks**

**(CIA-2) 20 Marks :Prototyping IOT Components**

**Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.**

**PRACTICALS : Practical BH.USITS5P2**

Unit No.	Description
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1	Starting Raspbian OS, Familiarising with Raspberry Pi Components and interface, Connecting to ethernet, Monitor, USB
2	Displaying different LED patterns with Raspberry Pi.
3	Displaying Time over 4-Digit 7-Segment Display using Raspberry Pi
4	Controlling Raspberry Pi with Whatsapp (Telegram)
5	Visitor Monitoring with Raspberry Pi & Pi Camera
6	Interfacing Raspberry Pi with RFID
7	Raspberry Pi GPS Module Interfacing
8	Raspberry Pi based Oscilloscope
9	Fingerprint Sensor interfacing with Raspberry Pi
10	IoT based Web Controlled Home Automation using Raspberry Pi



<b>Programme: BSc.IT</b>				<b>Semester: V</b>	
<b>Course: Data Science</b>				<b>Course Code: BH.USITS503</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
4	4	-	2+2	40	60
<b>COURSE OBJECTIVES:</b> <ol style="list-style-type: none"> <li>1. To gain knowledge of Data science.</li> <li>2. To Understand Machine learning Algorithm.</li> <li>3. To Learn Re-inforcement learning techniques</li> <li>4. To Understand Unsupervised Learning</li> </ol>					
<b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able to <ol style="list-style-type: none"> <li>1. Understand basic concept and need of machine learning.</li> <li>2. Apply machine learning algorithms to solve the given problem.</li> <li>3. Implement various reinforcement learning techniques.</li> <li>4. Apply Dimensionality reduction techniques.</li> </ol>					
<b>Detailed Syllabus: (per session plan)</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
1	<b>Introduction to Machine Learning[Lectures 2]:</b> Need of machine learning, machine learning vs AI, machine learning vs Deep learning <b>Learning types[Lectures 4] :</b> Supervised Learning, Unsupervised learning, Reinforcement learning, What makes Machine Learning tick purpose or objectives, variety of algorithms- learning style, similarity style, Applications of machine learning. <b>General Steps or Process of Machine Learning [Lectures 4]-</b> SourceX -> Feature Extraction -> Feature Correlation -> Feature TransformX-> Train Model-> Ensemble-> Evaluate Capacity, Overfitting and Underfitting. <b>Hyperparameters and Validation Sets[Lectures 2]:</b> Estimators, Bias and Variance, likelihood, Stochastic Gradient Descent.				12
2	<b>Supervised Learning[Lectures 4]:</b> Hypothesis testing, Training versus Testing, Gradient Descent, Over fitting & Regularization , <b>Regression[Lectures 4]:</b> Regression fundamentals, Linear Regression, Polynomial regression, Regularization technique (LASSO), <b>Classification[Lectures 4]:</b> Classification fundamentals, Logistic Regression, Decision trees,-CART,-Random Forest, Naïve Bayes , Support VectorMachine,TimeSeries,				12
3	<b>Unsupervised Learning Clustering basics[Lectures 4]:</b> K-means clustering, K-Nearest Neighbor , Association Rule Learning ,				12



	<b>Hierarchical Dimensionality Reduction[Lectures 4]:</b> Feature Engineering, <b>Feature Selection methods[Lectures 4]</b> -Filters; Wrappers, Embedded, PCA, SVD, -tSNE	
<b>4</b>	<b>Reinforcement Learning [Lectures 4]:</b> Markov Decision, Monte Carlo Prediction, <b>Case Study (next best offer, dynamic pricing)[Lectures 4]:</b> <b>Machine Learning Applications[Lectures 4]:</b> across Industries Healthcare, Retail, Financial Services, Hospitality	12
	<b>Total</b>	<b>48</b>

**Reference Books:**

1. Shai Shalev-Shwartz and Shai Ben-David," Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, Latest Edition,2020
- 2.Mehryar Mohri Afshin , Rostamizadeh ,Ameet Talwalkar," Foundation of Machine Learning", The MIT Press, Latest Edition, 2020
- 3.Gareth James, Daniela Witten, Trevor Hastie Robert Tibshirani," An Introduction to Statistical Learning", Springer, Latest Edition
4. Andrew Ng, Machine Learning Yearning, Deeplearning.ai, Draft v0.5.
5. Dr Dinesh Kumar," Machine-learning-using-python", WileyIndia, Latest Edition
6. Online software product documentation, Python, R-software documentation.

**Details of Continuous Internal Assessment(CIA):**
**(CIA-1):20 Marks**
**(CIA-2) 20 Marks : Mini Project on Data Science**
**Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.**
**PRACTICALS : Data Science practical BH.USITS5P3**

Unit No.	Description
<b>1</b>	Python/R data types and objects, reading and writing data, Python/R Packages
<b>2</b>	Python/R flow control Control structures, scoping rules, dates and times, data manipulation in Python/R
<b>3</b>	Functions and Modules Loop functions, debugging tools, Mathematical Functions, Data Processing and handling
<b>4</b>	Apply Linear regression
	Apply Logistic regression
<b>6</b>	Apply decision tree for given problems
<b>7</b>	Apply Random Forest for given problems
<b>8</b>	Apply Naïve Bayes for given problems
<b>9</b>	Apply K means clustering for given problem
<b>10</b>	Apply PCA for given problem



<b>Programme: BSc.IT</b>				<b>Semester: V</b>	
<b>Course: Enterprise JAVA and Spring</b>				<b>Course Code: BH.USITS504</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
<b>4</b>	<b>4</b>	<b>-</b>	<b>2+2</b>	<b>40</b>	<b>60</b>
<b>Pre-requisites: - Basic Knowledge of Core JAVA</b>					
<b>COURSE OBJECTIVES:</b>					
<ol style="list-style-type: none"> <li>1. To Learn the use of Enterprise Applications.</li> <li>2. Implement different web API</li> <li>3. Understanding Enterprise Java Beans Technology.</li> <li>4. Learn Hibernate and Spring with IDE.</li> </ol>					
<b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able to					
<ol style="list-style-type: none"> <li>1. Implement advance concept and framework for web development.</li> <li>2. Implement Java Server Pages</li> <li>3. Mapping of Object Relational Model</li> <li>4. develop application using Spring and hibernate with IDE</li> </ol>					
<b>Detailed Syllabus: (per session plan)</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	<b>JavaEE Architecture[Lectures 2]</b>  <b>Introduction to Java Servlets[Lectures 6]:</b> Server and Containers, Servlet API and Lifecycle, A Simple Welcome Servlet ,Working with Servlets: Getting Started, Using Annotations Instead of Deployment Descriptor. <b>Working with Databases[Lectures 4]:</b> What Is JDBC? JDBC Architecture, Accessing Database, The Servlet GUI and Database Example.				<b>12</b>



<p><b>2</b></p>	<p><b>Request Dispatcher[Lectures 2]:</b> Resquestdispatcher Interface, Methods of Requestdispatcher.</p> <p><b>COOKIES[Lectures 2]:</b> Kinds of Cookies, Where Cookies Are Used? Creating Cookies Using Servlet.</p> <p><b>SESSION[Lectures 2]:</b> What Are Sessions? Lifecycle of Http Session.Working with Files and Non-Blocking I/O,</p> <p><b>Introduction To Java Server Pages[Lectures 4]:</b> Why use Java Server Pages? Disadvantages Of JSP, JSP v\s Servlets, Life Cycle of a JSP Page, how does a JSP function? How does JSP execute? About Java Server Pages Getting Started with Java Server Pages, Action Elements,</p> <p><b>Java Server Pages Standard Tag Libraries[Lectures 2]:</b> How JSTL Fixes JSP Scriptlet's Shortcomings? Tag Libraries.</p>	<p>12</p>
<p><b>3</b></p>	<p><b>Introduction To Enterprise Javabeans[Lectures 4]:</b> Enterprise Bean Architecture, Benefits of Enterprise Bean, Types of Enterprise Bean, Accessing Enterprise Beans, Enterprise Bean Application,</p> <p><b>Packaging Enterprise Beans[Lectures 2]:</b>Working with session bean, message driven bean. Interceptors, Java Naming and Directory Interface</p> <p><b>Persistence, Object/Relational Mapping And JPA[Lectures 3]:</b> What is Persistence? Persistence in Java, Current Persistence Standards in Java, why another Persistence Standards? Object/Relational Mapping,</p> <p><b>Introduction to Java Persistence API[Lectures 3]:</b> The Java Persistence API, JPA, ORM, Database and the Application, Architecture of JPA, How JPA Works? JPA Specifications. Writing JPA Application</p>	<p>12</p>
<p><b>4</b></p>	<p><b>Introduction to Hibernate[Lectures 3]:</b> What is Hibernate? Why Hibernate? Hibernate, Database and The Application,</p> <p><b>Components of Hibernate[Lectures 3]:</b> Architecture of Hibernate, How Hibernate Works? Writing Hibernate Application</p> <p><b>Introduction to Spring[Lectures 3]:</b> Basics of Spring, Spring with IDE, Dependency Injection.</p> <p>Spring with ORM[Lectures 3]: Writing Spring Application.</p>	<p>12</p>
<p><b>Total</b></p>		<p><b>48</b></p>



**Reference Books:**

1. Java EE 7 For Beginners ,Sharanam Shah, SPD First ,Vaishali Shah(Latest Edition).
2. Java EE 8 Cookbook: Build reliable applications with the most robust and mature technology for enterprise development , Elder Moraes ,Packt First (Latest Edition.
3. Advanced Java Programming, Uttam Kumar Roy, Oxford Press , 2020.
4. Online software documentation,Github.

**Details of Continuous Internal Assessment(CIA):**

**(CIA-1):20 Marks**

**(CIA-2) 20 Marks : Mini Project using JAVA EE**

**Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.**

**PRACTICALS : Enterprise JAVA and Spring practical BH. USITS5P4**

<b>Unit No.</b>	<b>Description</b>
1	Implement Simple Servlet applications.
2	Implement the following Servlet applications with Cookies and Sessions.
3	Implement the Servlet IO and File applications.
4	Implement the JSP applications.
5	Implement the JSTL applications.
6	Implement the EJB Applications.
7	Implement the JPA applications.
8	Implement the JPA applications with ORM and Hibernate.
9	Implement the Hibernate applications.
10	Implement the Spring applications.



<b>Programme: BSc IT</b>				<b>Semester: V</b>	
<b>Course: Next Generation Technologies</b>				<b>Course Code: BH.USITS505</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory + Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Term End Examination (TEE) (Marks: 60)</b>
<b>4</b>	<b>4</b>	<b>-</b>	<b>2+2</b>	<b>40</b>	<b>60</b>
<p><b>COURSE OBJECTIVES:</b></p> <ol style="list-style-type: none"> <li>1. To analyse information related to Big Data, NoSQL and MongoDB.</li> <li>2. To learn MongoDB Data Model.</li> <li>3. To understand MongoDB storage Engine.</li> <li>4. To learn JQuery.</li> </ol>					
<p><b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able to</p> <ol style="list-style-type: none"> <li>1. Discover and analyse information, Big Data challenges and procedures, explain NoSQL history, MongoDB design philosophy and scalability.</li> <li>2. Use MongoDB for simple queries.</li> <li>3. Learn MongoDB storage engine, journaling</li> <li>4. Implement jQuery Events</li> </ol>					
<b>Detailed Syllabus: (per session plan)</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	<p><b>Big Data[Lectures 3]:</b> Facts About Big Data, Big Data Sources, Three Vs of Big Data, Volume, Variety, Velocity, Usage of Big Data, Visibility, Discover and Analyze Information, Segmentation and Customizations, Aiding Decision Making, Innovation,</p> <p><b>Big Data Challenges[Lectures 3]:</b> Policies and Procedures, Access to Data, Technology and Techniques, Legacy Systems and Big Data, Structure of Big Data, Data Storage, Data Processing, Big Data Technologies</p> <p><b>NoSQL[Lectures 2]:</b> SQL, NoSQL, Definition, A Brief History of NoSQL, ACID vs. BASE, CAP Theorem (Brewer's Theorem).</p> <p><b>Introducing MongoDB[Lectures 4]:</b> History, MongoDB Design Philosophy, Speed, Scalability, and Agility, Non-Relational Approach, JSON-Based Document Store, Performance vs. Features, Running the Database Anywhere, SQL Comparison</p>				<b>12</b>



<b>2</b>	<p><b>The MongoDB Data Model[Lectures 6]:</b> The Data Model, JSON and BSON, The Identifier (_id), Capped Collection,</p> <p><b>Polymorphic Schemas[Lectures 4]:</b> Object- Oriented Programming, Schema Evolution,</p> <p><b>Using MongoDB Shell, MongoDB Architecture[Lectures 2]</b></p>	12
<b>3</b>	<p><b>MongoDB Storage Engine[Lectures 2]:</b> Data Storage Engine, Data File (Relevant for MMAPv1), Namespace (.ns File),</p> <p><b>Data File[Lectures 4]:</b>(Relevant for WiredTiger), Reads and Writes, How Data Is Written Using Journaling.</p> <p><b>MongoDB Limitations, MongoDB Best Practices[Lectures 2]:</b> Deployment, Hardware Suggestions from the MongoDB Site, Few Points to be Noted,</p> <p><b>Coding[Lectures 4]:</b> Application Response Time Optimization, Data Safety, Administration, Replication Lag, Sharding, Monitoring</p>	12
<b>4</b>	<p><b>The End of Disk? SSD and In-Memory Databases[Lectures 4]:</b> The End of Disk? Solid State Disk, The Economics of Disk,</p> <p><b>SSD-Enabled Databases[Lectures 4]:</b> In-Memory Databases, TimesTen, Redis, SAP HANA, VoltDB.</p> <p><b>jQuery[Lectures 4]:</b> Introduction, Traversing the DOM, DOM Manipulation with jQuery, JQuery syntax, selectors, events.</p>	12
	<b>Total</b>	<b>48</b>

**Reference Books:**

1. Practical MongoDB, Shakuntala Gupta Edward Navin Sabharwal, Apress, 2020.
2. Beginning jQuery Jack Franklin Russ Ferguson, Apress, Second.
3. Next Generation Databases, Guy Harrison, Apress.
4. Beginning JSON, Ben Smith, Apress .

**Details of Continuous Internal Assessment(CIA):**

**(CIA-1):20 Marks**

**(CIA-2) 20 Marks : Mini project on Next Generation Technologies**

**Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.**

**PRACTICALS : Next Generation Technologies practical BH. USITS5P5**

Unit No.	Description
1	Implement query on MongoDB Basics
2	Implement Simple Queries with MongoDB
3	Implementing Aggregation
4	Implement Replication, Backup and Restore





5	Implement Java and MongoDB
6	Implement PHP and MongoDB
7	Implement Python and MongoDB
8	Implement Programs on Basic jQuery
9	Implement jQuery
10	Implement JQuery Events



<b>Programme: BSc IT</b>				<b>Semester: V</b>	
<b>Course: Micro-Service Architecture</b>				<b>Course Code: BH.USITS506</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory + Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Term End Examination (TEE) (Marks: 60)</b>
<b>4</b>	<b>4</b>	<b>-</b>	<b>2+2</b>	<b>40</b>	<b>60</b>
<b>COURSE OBJECTIVES:</b>					
1. To understand the model-driven and design-driven approaches for developing applications of a microservices system. 2. To analyze the evolution on microservices, concept of microservice with its benefits and how to define a microservice. 3. To understand the design and operation of microservice system. 4. To analyze the ecosystem of microservice applications.					
<b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able to					
1. adopt microservice applications in Practice 2. configure the microservice ecosystem 3. monitor microservice and identify future debugging problems 4. scale microservice applications					
<b>Detailed Syllabus: (per session plan)</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	<b>Microservices[Lecture 2]:</b> Understanding Microservices, Adopting Microservices, The Microservices Way. <b>Microservices Value Proposition[Lecture 4]:</b> Deriving Business Value, defining a Goal-Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach. <b>Designing Microservice Systems[Lecture 4]:</b> The Systems Approach to Microservices, A Microservices Design Process, <b>Establishing a Foundation[Lecture 2]:</b> Goals and Principles, Platforms, Culture.				<b>12</b>
<b>2</b>	<b>Service Design[Lecture 4]:</b> Microservice Boundaries, API design for Microservices, Data and Microservices, <b>Distributed Transactions and Sagas[Lecture 2]:</b> Asynchronous Message-Passing and Microservices, dealing with Dependencies, <b>System Design and Operations[Lecture 3]:</b> Independent Deployability, More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting. <b>Adopting Microservices in Practice[Lecture 3]:</b> Solution Architecture Guidance, Organizational Guidance, Culture Guidance, Tools and Process Guidance, Services Guidance.				<b>12</b>
<b>3</b>	<b>Building Microservices with ASP.NET Core[Lecture 2]:</b> Introduction, Installing .NET Core, Building a Console App, Building ASP.NET Core App. <b>Delivering Continuously[Lecture 4]:</b> Introduction to Docker, Continuous integration with Wercker, Continuous Integration with Circle CI, Deploying to Dicker Hub.				<b>12</b>



	<b>Building Microservice with ASP.NET Core [Lecture 4]:</b> Microservice, Team Service, API First Development, Test First Controller, Creating a CI pipeline, Integration Testing, Running the team service Docker Image. <b>Backing Services [Lecture 2]</b>	
<b>4</b>	<b>Configuring Microservice Ecosystems[Lecture 4]:</b> Using Environment Variables with Docker, Using Spring Cloud Config Server, Configuring Microservices with etcd, <b>Securing Applications and Microservices[Lecture 4]:</b> Security in the Cloud, Securing ASP.NET Core Web Apps, Securing ASP.NET Core Microservices. <b>Building Real-Time Apps and Services[Lecture 3]:</b> Real-Time Applications Defined, Websockets in the Cloud, Using a Cloud Messaging Provider, Building the Proximity Monitor. <b>Putting It All Together[Lecture 3]:</b> Identifying and Fixing Anti-Patterns, Continuing the Debate over Composite Microservices, The Future.	12
	<b>Total</b>	<b>48</b>
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Microservice Architecture: <i>Aligning Principles, Practices, and Culture</i> , Irakli Nadareishvili, Ronnie Mitra, Matt McLarty, and Mike</li> <li>2. Building Microservices with ASP.NET Core, Kevin Hoffman.</li> <li>3. Building Microservices: Designing Fine-Grained Systems, sam newman.</li> </ol>		
<b>Details of Continuous Internal Assessment(CIA):</b>		
<b>(CIA-1):20 Marks</b>		
<b>(CIA-2) 20 Marks : Case Study on Micro Service Architecture</b>		
<b>Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.</b>		
<b>PRACTICALS : Micro-Service Architecture practical BH. USITS5P6</b>		
<b>Unit No.</b>	<b>Description</b>	
1	Building APT.NET Core MVC Application	
2	Building ASP.NET Core REST API.	
3	Working with Docker, Docker Commands, Docker Images and Containers	
4	Installing software packages on Docker, Working with Docker Volumes and Networks.	
5	Working with Docker Swarm	
6	Working with Circle CI for continuous integration.	
7	Creating Microservice with ASP.NET Core.	
8	Working with Kubernetes.	
9	Creating Backing Service with ASP.NET Core.	
10	Building real-time Microservice with ASP.NET Core.	
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Microservice Architecture: <i>Aligning Principles, Practices, and Culture</i> , Irakli Nadareishvili, Ronnie Mitra, Matt McLarty, and Mike</li> <li>2. Building Microservices with ASP.NET Core, Kevin Hoffman.</li> <li>3. Building Microservices: Designing Fine-Grained Systems, sam newman.</li> </ol>		



### MODALITY OF ASSESSMENT- SEMESTER V

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	Internal Class Test with Objective type questions and Short Notes (CIA-I)	20
2	CIA-II	20
	TOTAL	40

CIA II can include:

1. Research paper review
2. Case study
3. Small project
4. Literature review on recent technologies in IT
5. Preparation of research poster for application of IT

B) External Examination- 60%- 60 Marks Semester End Theory Examination: 60 marks (for offline Mode)

Duration - The examinations shall be of 2 hours duration. Paper Pattern:

1. There shall be **04** question of 15 marks each.
2. All questions shall be compulsory with internal choice within questions.
3. The unitized questions may have subjective and objective type of questions.



Overall Examination & Marks Distribution Pattern Semester V

Course BH. USITS	501		502		503		504		505		Grand Total
	Internal	External	Internal	External	Internal	External	Internal	External	Internal	External	
<b>Theory</b>	40	60	40	60	40	60	40	60	40	60	500
<b>Practical</b>		50		50		50		50		50	250
											750



**Rubrics of evaluation for ESE -SEMESTER V**

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
1	5	5	5	15
2	5	5	5	15
3	5	5	5	15
4	5	5	5	15
Total	20	20	20	60
% Weightage	33.33	33.33	33.33	100 ~

**Rubrics of evaluation for CIA-2 Assignment: Presentation/debate**

Parameters	Max Marks	Excellent/Advanced(4point)	Proficient (3point)	Approaching proficiency(2point)	Beginning scale(1point)
<b>CONTENT</b>	<b>10</b>				
<b>Content: Logic</b>	<b>02</b>				
<b>Content: knowledge</b>	<b>03</b>				
<b>Content: Code Elegance-</b>	<b>03</b>				
<b>Content: Demonstration/ Execution/Testing</b>	<b>02</b>				
<b>Content: Modularity level Specifications</b>	<b>-</b>				
<b>Effective communication skill</b>	<b>10</b>				



**SEMESTER VI**

<b>Programme: BSc.IT</b>				<b>Semester : VI</b>	
<b>Course: UI/UX Design for Entrepreneurs</b>				<b>Course Code: BH.USITS601</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme(Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutoriall (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
4	02(02 batches)=04	-	2+2	40	60
<b>Pre-requisites:</b> Understanding of Computer architecture, basic programming language(C).					
<b>COURSE OBJECTIVES:</b>					
<ol style="list-style-type: none"> <li>1. To understand the relationship between UI and UX Design.</li> <li>2. To understand about different working prototype tools.</li> <li>3. To use visual design principles.</li> <li>4. To understand about different working of wireframe</li> </ol>					
<b>COURSE OUTCOME:</b>					
<p>After successful completion of the course, the learner should be able to</p> <ol style="list-style-type: none"> <li>1. Understand iterative user-centered design of graphical user interfaces</li> <li>2. Apply the user Interfaces to different devices and requirements,</li> <li>3. Apply wireframe for UI/UX design</li> <li>4. Create high quality professional documents and artifacts related to the design process.</li> </ol>					
<b>Detailed Syllabus: ( per session plan )</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	<p><b>Introduction to the UI[Lecture 2]:</b> What is User Interface Design (UI) -The Relationship Between UI and UX , Roles in UI/UX,</p> <p>A Brief Historical Overview of Interface Design[Lecture 4]: Interface Conventions,</p> <p><b>Approaches to Screen Based UI[Lecture 2]:</b> Template vs Content,</p> <p><b>Interface Design[Lecture 4]:</b>Formal Elements of Interface Design, Active Elements of Interface Design.</p>				12



<b>2</b>	<p><b>Composing the Elements of Interface Design[Lecture 2]:</b> UI Design Process, Visual Communication design component in Interface Design[Lecture 4]</p> <p><b>Introduction to UX[Lecture 4]:</b> Foundation of UX design, Good and poor design, Understanding Your Users[Lecture 2]</p>	12
<b>3</b>	<p><b>Designing the Experience[Lecture 4]:</b> Elements of user Experience, Visual Design Principles, Functional Layout, Interaction design[Lecture 4]: Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design[Lecture 4]</p>	12
<b>4</b>	<p><b>UI/ UX Design Tools[Lecture 2]:</b> User Study- Interviews, <b>writing personas[Lecture 3]:</b> user and device personas, User Context. <b>Building[Lecture 2]:</b> Low Fidelity Wireframe and High-Fidelity <b>Polished Wireframe Using wireframing Tools[Lecture 2]</b> <b>Creating the working Prototype using Prototyping tools [Lecture 3]:</b> Sharing and Exporting Design .</p>	12
	<b>Total</b>	<b>48</b>
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2020.</li> <li>2. The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education.</li> <li>3. The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz , Wiley Publishing, 2020.</li> <li>4. The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier, 2020</li> </ol>		
<p><b>Details of Continuous Internal Assessment(CIA):</b>  <b>(CIA-1):20 Marks</b>  <b>(CIA-2) 20 Marks :</b> Creating the working Prototype using Prototyping tools</p>		





<b>Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.</b>	
<b>PRACTICALS :<i>UI/UX Design for Entrepreneurs practical</i> BH.USITS6P1</b>	
<b>Sr. No</b>	<b>Description</b>
1	Study the process of creating Graphically User Interface
2	Design the UI using an existing template
3	Study the implementation of GUI to different devices.
4	Develop the complete UI design process
5	Design the UI using any formal elements of Interface Design
6	Design the UI using any active elements of Interface Design
7	Design the UI using any visual communication elements of Interface Design
8	Build Low Fidelity Wireframe Using any wire-framing Tools
9	High-Fidelity Polished Wireframe Using any wire-framing Tools
10	Creating the working Prototype using any Prototyping tools



<b>Programme: BSc.IT</b>				<b>Semester : VI</b>	
<b>Course: Geographical Information System</b>				<b>Course Code: BH.USITS602</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme(Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
<b>4</b>	<b>2 ( 2 batches) = 4</b>	---	<b>2+2</b>	<b>40</b>	<b>60</b>

**Pre-requisites : Basic Programming Concepts.**

**COURSE OBJECTIVES:**

1. To learn Geographic information system(GIS), providing opportunities to analyse data, explore issues, problems solve, and evaluate situation in a geographical and spatial context.
2. To understand spatial patterns and relationship by relating seemingly unrelated data.
3. To understand the stages of spatial data handling.
4. To understand GIS visualisation process.

**COURSE OUTCOMES:** After successful completion of the course, the learner should be able to explore mapped data

1. Relate GIS with remote sensing technologies
2. Analyze spatial data, using GIS analysis tools
3. Develop and manage geodatabases.
4. Create maps, images and apps to communicate spatial data in a meaningful way to others

**Detailed Syllabus: ( per session plan )**

<b>Unit</b>	<b>Description</b>	<b>Periods</b>
<b>1</b>	<p><b>A Gentle Introduction to GIS The nature of GIS[Lecture 2]:</b> Some fundamental observations, Defining GIS, GISystems, GIScience and GIApplications, Spatial data and Geoinformation.</p> <p><b>The real world and representations of it[Lecture 2]:</b> Models and modelling, Maps, Databases, Spatial databases and spatial analysis</p> <p><b>Geographic Information and Spatial Database Models and Representations of the real world Geographic Phenomena[Lecture 3]:</b> Defining geographic phenomena, types of geographic phenomena, Geographic fields, Geographic objects, Boundaries</p> <p><b>Computer Representations of Geographic Information[Lecture 3]:</b> Regular tessellations, irregular tessellations, Vector representations, Topology and Spatial relationships, Scale and Resolution, Representation of Geographic fields, Representation of Geographic objects</p> <p><b>Data Management and Processing Systems Hardware and Software Trends[Lecture 2]:</b> Geographic Information Systems, GIS Software, GIS Architecture and functionality, Spatial Data Infrastructure (SDI)</p>	12



2	<p><b>Stages of Spatial Data handling[Lecture 4]:</b> Spatial data handling and preparation, Spatial Data Storage and maintenance, Spatial Query and Analysis, Spatial Data Presentation.</p> <p><b>GIS and Spatial Databases[Lecture 4]:</b> Linking GIS and DBMS, Spatial database functionality.</p> <p><b>Data Management and Processing Systems Hardware and Software Trends[Lecture 4]</b></p>	12
3	<p><b>Satellite-based Positioning[Lecture 4]:</b> Absolute positioning, Errors in absolute positioning, Relative positioning, Network positioning, code versus phase measurements, Positioning technology</p> <p><b>Data Entry and Preparation</b>  <b>Spatial Data Input[Lecture 2]:</b> Direct spatial data capture, Indirect spatial data capture, Obtaining spatial data elsewhere</p> <p><b>Data Quality[Lecture 4]:</b> Accuracy and Positioning, Positional accuracy, Attribute accuracy, temporal accuracy, Lineage, Completeness, Logical consistency</p> <p><b>Data Preparation[Lecture 2]:</b> Data checks and repairs, Combining data from multiple sources</p>	12
4	<p><b>Spatial Data Analysis</b>  <b>Classification of analytical GIS Capabilities</b>  <b>Retrieval, classification and measurement[Lecture 2]:</b> Measurement, Spatial selection queries, Classification</p> <p><b>Overlay functions[Lecture 2]:</b> Vector overlay operators,Raster overlay operators</p> <p><b>Neighbourhood functions[Lecture 2]:</b> Proximity computations, Computation of diffusion, Flow computation, Raster based surface analysis          Analysis: Network analysis, interpolation, terrain modeling.</p> <p><b>Data Visualization GIS and Maps[Lecture 2]</b></p> <p><b>The Visualization Process Visualization Strategies[Lecture 2]:</b> Present or explore?</p> <p><b>The cartographic toolbox[Lecture 2]:</b> What kind of data do I have? How can I map my data?</p>	12
	<b>Total</b>	<b>48</b>
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. Principles of Geographic Information SystemsAn Introductory Text Book Editors: Otto Huisman and Rolf A.</li> <li>2. Principles of Geographic Information Systems P.A Burrough and R.A.McDonnell</li> <li>3. Fundamentals of Geographic Information Systems Michael N.Demers Wiley Publications</li> </ol>		



<b>Details of Continuous Internal Assessment(CIA):</b>	
<b>(CIA-1):20 Marks</b>	
<b>(CIA-2) 20 Marks : Design a Model using Geographic Information System</b>	
<b>Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.</b>	
<b>PRACTICALS (Section 1):<i>Geographic information system practical</i> BH.USITS6P4</b>	
<b>Unit No.</b>	<b>Description</b>
1	Familiarizing Quantum GIS: Installation of QGIS, datasets for both Vector and Raster data, Maps. Creating and Managing Vector Data: a) Adding vector layers, b) setting properties, c) formatting d) calculating line lengths and statistics
2	Exploring and Managing Raster data: a) Adding raster layers, r b) aster styling and analysis. c) raster mosaicking and clipping
3	a) Making a Map, b) Working with Attributes, c) Importing Spreadsheets or CSV files.
4	a) Working with attributes b) terrain Data and hill shading
5	Working with Projections and WMS Data
6	a)Georeferencing Topo Sheets and Scanned Maps b)Georeferencing Aerial Imagery c) Digitizing Map Data
7	Managing Data Tables and Saptial data Sets:  a) Table joins b) spatial joins c) points in polygon analysis  d) performing spatial queries.
8	Advanced GIS Operations: a) Nearest Neighbor Analysis.  b)Sampling Raster Data using Points or Polygons.  c) Interpolating Point Data.
9	Validating Map data



<b>Programme: BSc.IT</b>				<b>Semester: VI</b>	
<b>Course: Security in Computing</b>				<b>Course Code: BH.USITS603</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
4	2 (2 batches) = 4	---	2+2	40	60

**Pre-requisites: Basic Programming Concepts.**

**COURSE OBJECTIVES:**

1. To learn information security, design and principles.
2. To understand and configure routers using various authentication techniques.
3. To learn firewall overview, wireless network security.
4. To learn intrusion detection and prevention system.

**COURSE OUTCOMES:** After successful completion of the course, the learner should be able to

1. configure routers using various authentication techniques like AAA, OSPF MD5, NTP, support SSH conditions, log messages to Syslog server
2. configure, apply and verify ACL and extended numbered ACL
3. implement network device security.
4. apply intrusion detection and prevention technique.

**Detailed Syllabus: (per session plan)**

<b>Unit</b>	<b>Description</b>	<b>Periods</b>
<b>1</b>	<p><b>Information Security Overview[Lecture 2]:</b> The Importance of Information Protection, The Evolution of Information Security,</p> <p>Justifying Security Investment[Lecture 2]: Security Methodology, How to Build a Security Program, The Impossible Job, The Weakest Link,</p> <p>Strategy and Tactics [Lecture 2]: Business Processes vs. Technical Controls.</p> <p><b>Risk Analysis[Lecture 2]:</b> Threat Definition, Types of Attacks, Risk Analysis.</p> <p><b>Secure Design Principles[Lecture 4]:</b> The CIA Triad and Other Models, Defense Models, Zones of Trust, Best Practices for Network Defense.</p>	12



<b>2</b>	<p><b>Authentication and Authorization[Lecture 4]:</b> Authentication, Authorization <b>Encryption:</b> A Brief History of Encryption, Symmetric-Key Cryptography, Public Key Cryptography, Public Key Infrastructure.</p> <p><b>Storage Security[Lecture 4]:</b> Storage Security Evolution, Modern Storage Security, Risk Remediation, Best Practices.</p> <p><b>Database Security[Lecture 4]:</b> General Database Security Concepts, Understanding Database Security Layers, Understanding Database- Level Security, Using Application Security, Database Backup and Recovery, Keeping Your Servers Up to Date.</p>	12
<b>3</b>	<p><b>Secure Network Design[Lecture 2]:</b> Introduction to Secure Network Design, Performance, Availability, Security.</p> <p><b>Network Device Security[Lecture 2]:</b> Switch and Router Basics, Network Hardening.</p> <p><b>Firewalls[Lecture 4]:</b> Overview, The Evolution of Firewalls, Core Firewall Functions, Additional Firewall Capabilities, Firewall Design.</p> <p><b>Wireless Network Security[Lecture 4]:</b> Radio Frequency Security Basics, Data- Link Layer Wireless Security Features, Flaws, and Threats, Wireless Vulnerabilities and Mitigations, Wireless Network Hardening Practices and Recommendations, Wireless Intrusion Detection and Prevention, Wireless Network Positioning and Secure Gateways.</p>	12
<b>4</b>	<p><b>Intrusion Detection and Prevention Systems[Lecture 4]:</b> IDS Concepts, IDS Types and Detection Models, IDS Features, IDS Deployment Considerations, Security Information and Event Management (SIEM).</p> <p><b>Voice over IP (VoIP) and PBX Security[Lecture 4]:</b> Background, VoIP Components, VoIP Vulnerabilities and Countermeasures, PBX, TEM: Telecom Expense Management.</p> <p><b>Operating System Security Models[Lecture 2]:</b> Operating System Models, Classic Security Models, Reference Monitor, Trustworthy Computing, International Standards for Operating System Security.</p> <p>Virtual Machines and Cloud Computing, Secure Application Design.</p> <p>Physical Security, Securing Assets[Lecture 2]: Locks and Entry Controls, Physical Intrusion Detection.</p>	12
	<b>Total</b>	<b>48</b>

**Reference Books:**

1. The Complete Reference: Information Security, Mark Rhodes- Ousley McGraw- Hill 2 2nd 2020
2. Essential Cybersecurity Science, Josiah Dykstra, O'Reilly, Fifth, 2019.
3. Principles of Computer Security: CompTIA Security+ and Beyond, Wm.Arthur Conklin, Greg White, McGraw Hill, Second 2020.



<b>Details of Continuous Internal Assessment(CIA):</b> (CIA-1):20 Marks (CIA-2) 20 Marks : Case study on security	
<b>Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.</b>	
<b>PRACTICALS : Security in Computing practical BH. USITS6P3</b>	
Unit No.	Description
1	<b>Configure Routers</b> a) OSPF MD5 authentication. b) NTP . c) to log messages to the syslog server. d) to support SSH connections.
2	<b>Configure AAA Authentication</b> a) Configure a local user account on Router and configure authenticate on the console and vty lines using local AAA b) Verify local AAA authentication from the Router console and the PC-A client
3	Configuring Extended ACLs
4	Configure IP ACLs to Mitigate Attacks and IPV6 ACLs
5	Configuring a Zone-Based Policy Firewall
6	Configure IOS Intrusion Prevention System (IPS) Using the CLI
7	Layer 2 Security
8	Layer 2 VLAN Security
9	Configure and Verify a Site-to-Site IPsec VPN Using CLI
10	Configuring ASA Basic Settings and Firewall Using CLI



<b>Programme: BSc. Information Technology</b>				<b>Semester : VI</b>	
<b>Course: Data Center Technologies</b>				<b>Course Code: BH. USITS604</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme(Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
<b>04</b>	<b>04</b>		<b>02+02</b>	<b>40</b>	<b>60</b>
<b>COURSE OBJECTIVES:</b>					
<ol style="list-style-type: none"> <li>1. To understand various data center concepts.</li> <li>2. To apply network virtualization.</li> <li>3. To understand storage virtualization.</li> <li>4. To familiarize how virtualization and cloud computing can be implemented in data center technologies.</li> </ol>					
<b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able to					
<ol style="list-style-type: none"> <li>1. Apply the virtualization in network technologies.</li> <li>2. Use the virtualization in storage technologies.</li> <li>3. Apply the virtualization in storage technologies.</li> <li>4. Use the virtualization in server technologies.</li> </ol>					
<b>Detailed Syllabus: ( per session plan )</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	<b>What is Virtualization[Lecture 4]:</b> Virtualization history and definitions, Data Center network evolution[Lecture 4] Beginning of network virtualization[Lecture 4]				12
<b>2</b>	Virtualization in network Technologies[Lecture 6] An Army of One ACE virtual context[Lecture 6]				12
<b>3</b>	Virtualization in storage Technologies[Lecture 4] Storage Evolution[Lecture 4], Island in the SAN[Lecture 4]				12
<b>4</b>	Virtualization in server Technologies[Lecture 3] Server Evolution[Lecture 3] changing personalities[Lecture 3] <b>End to End virtualization[Lecture 3]:</b> The virtual data center and cloud computing.				12
	<b>Total</b>				<b>48</b>
<b>Reference Books:</b>					
1. Data center Virtualization Fundamentals, Gustavo Alessandro Andrade Santana, Cisco press,2020.					
<b>Details of Continuous Internal Assessment(CIA):</b>					
<b>(CIA-1):20 Marks</b>					
<b>(CIA-2) 20 Marks :</b>					





**Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.**

**PRACTICALS : Data Center Technologies Practical BH. USITS6P4**

<b>Unit No.</b>	<b>Description</b>
<b>1.</b>	Configuring ESXi Hosts
<b>2.</b>	Deploying and Configuring a Virtual Machine
<b>3.</b>	Working with vCenter Server
<b>4.</b>	Navigating the vSphere Clients
<b>5.</b>	Creating Folders in vCenter Server Appliance
<b>6.</b>	Using Standard Switches
<b>7.</b>	Accessing iSCSI Storage
<b>8.</b>	Using Templates and Clones
<b>9.</b>	Modifying Virtual Machines



<b>Programme: BSc.IT</b>				<b>Semester : VI</b>	
<b>Course: Cyber law</b>				<b>Course Code: BH.USIT605</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme(Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
<b>4</b>	<b>2</b>	<b>-</b>	<b>2+2</b>	<b>40</b>	<b>60</b>
<b>Pre-requisites:</b>					
<b>COURSE OBJECTIVES:</b>					
<ol style="list-style-type: none"> <li>1. To understand the legal frameworks</li> <li>2. To helps the student, understand different cyber crimes</li> <li>3. To provide an overview on Intellectual Property, copy rights, patents rights etc.</li> <li>4. To give rapid changes in technology and the corresponding changes in crime and the law</li> </ol>					
<b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able to					
<ol style="list-style-type: none"> <li>1. Identify and analyse statutory, regulatory, constitutional and organizational laws that effect the information technology professional.</li> <li>2. Locate and apply case law and common law to current legal dilemmas in the technology field.</li> <li>3. Understand cybercrime and ethical practices.</li> <li>4. Understand ecommerce taxation.</li> </ol>					
<b>Detailed Syllabus: ( per session plan )</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>
<b>1</b>	<p><b>Power of Arrest Without Warrant Under the IT Act, 2000[Lecture 4]:</b> A Critique, Crimes of this Millennium, Section 80 of the IT Act, 2000 – A Weapon or a Farce? Forgetting the Line Between Cognizable and Non- Cognizable Offences, Necessity of Arrest without Warrant from Any Place, Public or Otherwise, Check and Balances Against Arbitrary Arrests, Arrest for “About to Commit” an Offence Under the IT Act: A Tribute to Draco, Arrest, But NO Punishment!</p> <p><b>Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000[Lecture 4]:</b> Concept of “Cyber Crime “ and the IT Act , 2000, Hacking, Teenage Web Vandals, Cyber Fraud and Cyber Cheating,</p> <p><b>Virus on the Internet[Lecture 4]:</b> Defamation, Harassment and E-mail Abuse, Cyber Pornography, Other IT Act Offences, Monetary Penalties, Adjudication and Appeals Under IT Act , 2000.</p>				<b>12</b>
<b>2</b>	<p><b>Contracts in the Infotech World[Lecture 4]:</b> Contracts in the Infotech World, Click-Wrap and Shrink-Wrap</p> <p><b>Contract[Lecture 2]:</b> Status under the Indian Contract Act, 1872, Contract Formation Under the Indian Contract Act, 1872.</p>				<b>12</b>



	<p><b>Jurisdiction in the Cyber World[Lecture 4]:</b> Questioning the Jurisdiction and Validity of the Present Law of Jurisdiction, Civil Law of Jurisdiction in India, Cause of Action, Jurisdiction and the Information Technology Act,2000, Foreign Judgements in India, Place of Cause of Action in Contractual and IPR Disputes, Exclusion Clauses in Contracts, Abuse of Exclusion Clauses, Objection of Lack of Jurisdiction, Misuse of the Law of Jurisdiction.</p>	
3	<p><b>Battling Cyber Squatters and Copyright Protection in the Cyber World[Lecture 4]:</b> Concept of Domain Name and Reply to Cyber Squatters, Meta- Tagging, Legislative and Other Innovative Moves Against Cyber Squatting, The Battle Between Freedom and Control on the Internet.</p> <p><b>Works in Which Copyright Subsists and meaning of Copyright[Lecture 4]:</b> Copyright Ownership and Assignment, License of Copyright, Copyright Terms and Respect for Foreign Works, Copyright Infringement, Remedies and Offences,</p> <p><b>Copyright Protection of Content on the Internet[Lecture 4]:</b> Copyright Notice, Disclaimer and Acknowledgement, Downloading for Viewing Content on the Internet, Hyper-Linking and Framing.</p>	12
4.	<p><b>E-Commerce Taxation: Real Problems in the Virtual World[Lecture 2]:</b> A Tug of War on the Concept of ‘Permanent Establishment’, Finding the PE in Cross Border E-Commerce, The United Nations Model Tax Treaty.</p> <p><b>The Law of Double Taxation[Lecture 4]:</b> Avoidance Agreements and Taxable Jurisdiction Over Non-Residents, Under the Income Tax Act, 1961, Tax Agents of Non-Residents under the Income Tax Act,1961</p> <p><b>The Relevance to E-Commerce[Lecture 2]:</b> Source versus Residence and Classification between Business Income and Royalty. Digital Signature, Certifying Authorities and E-Governance, The Indian Evidence Act of 1872 v.</p> <p><b>Information Technology Act, 2000[Lecture 4]:</b> Protection of Cyber Consumers in India, Amendments in Indian IT Act 2000</p>	12
	<b>Total</b>	<b>48</b>
<p><b>Reference Books:</b></p> <p>1. Cyber Law Simplified , Vivek Sood, TMH Education 2021</p> <p>2. Cybersecurity Law Jeff Kosseff Wiley 2020.</p>		
<p><b>Details of Continuous Internal Assessment(CIA):</b></p> <p>(CIA-1):20 Marks</p> <p>(CIA-2) 20 Marks : Case Study</p>		
<p><b>Any other information : Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.</b></p>		



<b>Programme: BSc.IT</b>				<b>Semester : VI</b>	
<b>Course: Enterprise Networking</b>				<b>Course Code: BH.USITS606</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme(Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Internal Continuous Assessment (ICA) (Marks - 40)</b>	<b>Semester End Examination (SEE) (Marks: 60)</b>
<b>4</b>	<b>2</b>	<b>-</b>	<b>2+2</b>	<b>40</b>	<b>60</b>
<b>Pre-requisites:</b>					
<p><b>COURSE OBJECTIVES:</b></p> <ol style="list-style-type: none"> <li>1. To understand the foundation of business networking</li> <li>2. To understand various tools &amp; techniques of business networking as well as their applicability in business situations.</li> <li>3. To Learn different WAN technologies.</li> <li>4. To analyse internet protocol version 4.</li> </ol>					
<p><b>COURSE OUTCOMES:</b> After successful completion of the course, the learner should be able to</p> <ol style="list-style-type: none"> <li>1. Understand the concepts of Enterprise Networking.</li> <li>2. Understand the LAN Design.</li> <li>3. Understand Wireless Technologies and the Enterprise Edge.</li> <li>4. Implement different IPv6 routing protocols.</li> </ol>					
<b>Detailed Syllabus: ( per session plan )</b>					
<b>Unit</b>	<b>Description</b>				<b>Periods</b>



<p><b>1</b></p>	<p><b>General Network Design[Lecture 2]:</b> Network Design Methodology, Architectures for the Enterprise, Borderless Networks Architecture, Collaboration and Video Architecture, Data Center and Virtualization Architecture,</p> <p><b>Design Lifecycle[Lecture 2]:</b> Plan, Build, Manage Plan Phase Build Phase Manage Phase Prepare, Plan, Design, Implement, Operate, and Optimize Phases Prepare Phase Plan Phase Design Phase Implement Phase Operate Phase Optimize Phase Summary of PPDIOO Phases Project Deliverables</p> <p><b>Design Methodology[Lecture 2]:</b> Identifying Customer Design Requirements Characterizing the Existing Network Steps in Gathering Information Network Audit Tools Network Checklist Designing the Network Topology and Solutions Top-Down Approach Pilot and Prototype Tests Design Document</p> <p><b>Network Design Models[Lecture 2]:</b> Hierarchical Network Models Benefits of the Hierarchical Model, Hierarchical Network Design, Core Layer, Distribution Layer, Access Layer, Hierarchical Model Examples, Hub- and-Spoke, Design Collapsed Core,</p> <p><b>Design Enterprise Architecture Model[Lecture 2]:</b> Enterprise Campus Module, Enterprise Edge Area, E- Commerce Module, Internet Connectivity Module, VPN/Remote Access, Enterprise WAN, Service Provider Edge Module, Remote Modules, Enterprise Branch Module, Enterprise Data Center Module,</p> <p><b>Enterprise Teleworker Module[Lecture 2]:</b> High Availability Network Services, Workstation-to-Router Redundancy and LAN, High Availability Protocols, ARP Explicit Configuration, RDP, RIP, HSRP, VRRP, GLBP, Server Redundancy, Route Redundancy, Load Balancing, Increasing Availability, Link Media Redundancy</p>	<p>12</p>
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<p>2</p>	<p><b>Enterprise LAN Design[Lecture 2]:</b> LAN Media, Ethernet Design Rules, 100Mbps Fast Ethernet Design Rules, Gigabit Ethernet Design Rules, 1000BASE-LX Long-Wavelength Gigabit Ethernet, 1000BASE-SX Short-Wavelength Gigabit Ethernet, 1000BASE-CX Gigabit Ethernet over Coaxial Cable, 1000BASE-T Gigabit Ethernet over UTP 86, 10 Gigabit Ethernet Design Rules, 10GE Media Types, EtherChannel,</p> <p><b>Comparison of Campus Media[Lecture 2]:</b> LAN Hardware, Repeaters, Hubs, Bridges, Switches, Routers, Layer 3 Switches, Campus LAN Design and Best Practices Best Practices for Hierarchical Layers, Access Layer Best Practices, Distribution Layer Best Practices, Core Layer Best Practices, STP Design Considerations, STP Toolkit, PortFast, UplinkFast, BackboneFast, Loop Guard, Root Guard, BPDU Guard, BPDU Filter, VLAN and Trunk Considerations, Unidirectional Link Detection (UDLD) Protocol,</p> <p><b>Large-Building LANs[Lecture 2]:</b> Enterprise Campus LANs, Edge Distribution, Medium-Size LANs, Small and Remote Site LANs, Server Farm Module, Server Connectivity Options, Enterprise Data Center Infrastructure, Campus LAN QoS Considerations, Multicast Traffic Considerations, CGMP, IGMP Snooping.</p> <p><b>Data Center Design[Lecture 2]:</b> Enterprise DC Architecture, Data Center Foundation Components, Data Center Topology Components, Data Center Network Programmability, SDN, Controllers, APIs, ACI, Challenges in the DC, Data Center Facility Aspects, Data Center Space, Data Center Power, Data Center Cooling, Data Center Heat, Data Center Cabling, Enterprise DC Infrastructure,</p> <p><b>Data Center Storage[Lecture 2]:</b> Data Center Reference Architecture, Defining the DC Access Layer, Defining the DC Aggregation Layer, Defining the DC Core Layer, Security in the DC, Fabric Extenders, Virtualization Overview, Challenges, Defining Virtualization and Benefits, Virtualization Risks, Types of Virtualization, Virtualization Technologies, VSS, VRF, vPC, Device Contexts, Server Virtualization, Server Scaling, Virtual Switching,</p> <p><b>Network Virtualization Design Considerations[Lecture 2]:</b> Access Control, Path Isolation, Services Edge, Data Center Interconnect, DCI Use Cases, DCI Transport Options, DCI L2 Considerations, Load Balancing in the DC, Application Load Balancing, Network Load Balancing.</p>	<p>12</p>
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3	<p><b>Wireless LAN Design[Lecture 3]:</b> Wireless LAN Technologies, WLAN Standards, ISM and UNII Frequencies, Summary of WLAN Standards, Service Set Identifier, WLAN Layer 2 Access Method, WLAN Security, Unauthorized Access, WLAN Security Design Approach, IEEE 802.1X-2001 Port-Based Authentication, Dynamic WEP Keys and LEAP, Controlling WLAN Access to Servers, WLAN Authentication, Authentication Options, WLAN Controller Components, WLC Interface Types, AP Controller Equipment Scaling, Roaming and Mobility Groups, Intracontroller Roaming, Layer 2</p> <p>Inter-controller Roaming, Layer 3 Intercontroller Roaming, Mobility Groups, WLAN Design, Controller Redundancy Design: Deterministic vs. Dynamic, N+1 WLC Redundancy, N+N WLC Redundancy, N+N+1 WLC Redundancy, Radio Management and Radio Groups, RF Groups, RF Site Survey, Using EoIP Tunnels for Guest Services, Wireless Mesh for Outdoor Wireless, Mesh Design Recommendations, Campus Design Considerations, Power over Ethernet (PoE), Wireless and Quality of Service (QoS), Branch Design Considerations, Local MAC, REAP, Hybrid REAP, Branch Office Controller Options.</p> <p><b>WAN Technologies and the Enterprise Edge[Lecture 3]:</b> WAN and Enterprise Edge Overview, Definition of WAN, WAN Edge Module, Enterprise Edge Modules, WAN Transport Technologies, ISDN, ISDN BRI Service, ISDN PRI Service, Digital Subscriber Line, Cable, Wireless, Frame Relay, Time-Division Multiplexing, Metro Ethernet,SONET/SDH, Multiprotocol Label Switching (MPLS), Dark Fiber, Dense Wavelength-Division Multiplexing, Ordering WAN Technology and Contracts, WAN and Edge Design Methodologies, Response Time, Throughput, Reliability, Bandwidth Considerations, WAN Link Categories, Optimizing Bandwidth Using QoS, Queuing,</p> <p><b>Traffic Shaping and Policing[Lecture 3]:</b> Classification, Congestion Management, Priority Queuing, Custom Queuing, Weighted Fair Queuing, Class-Based Weighted Fair Queuing, Low-Latency Queuing, Traffic Shaping and Policing, Link Efficiency, Window Size, DMZ Connectivity, Segmenting DMZs, DMZ Services, Internet Connectivity, Centralized Internet (Branch) vs. Direct Internet (Branch), High Availability for the Internet Edge, VPN Network Design.</p> <p><b>WAN Design [Lecture 3]:</b></p> <p>Traditional WAN Technologies Hub-and-Spoke Topology Full-Mesh Topology Partial-Mesh Topology Point-to-Point Topology</p>	12
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	<p>Remote Site Connectivity Enterprise VPN vs. Service Provider VPN Enterprise Managed VPN:</p> <p>IPsec, IPsec Direct Encapsulation Generic Routing Encapsulation IPsec DMVPN IPsec Virtual Tunnel Interface Design GETVPN Service</p> <p>Provider-Managed Offerings ,Metro Ethernet Service Provider VPNs: L2 vs. L3 ,Virtual Private Wire Services VPWS L2 VPN Considerations,</p> <p>Virtual Private LAN Services VPLS L2 VPN Considerations ,MPLS, MPLS Layer 3 Design Overview MPLS L3 VPN Considerations ,VPN</p> <p>Benefits WAN Backup Design WAN Backup over the Internet Enterprise WAN Architecture Cisco Enterprise MAN/W AN Enterprise W AN/MAN Architecture Comparison ,</p> <p>Enterprise WAN Components Comparing Hardware and Software Enterprise Branch Architecture</p> <p>Branch Design Branch Connectivity Redundancy for Branches Single WAN Carrier vs. Dual WAN Carriers Single MPLS Carrier Site ,</p> <p>Dual MPLS Carriers Hybrid WAN: L3 VPN with IPsec VPN ,Internet for</p> <p>Branches Flat Layer 2 vs. Collapsed Core ,Enterprise Branch Profiles Small Branch Design Medium Branch Design Large Branch Design Enterprise Teleworker Design ,ISRs for Teleworkers</p>	
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<b>4.</b>	<p><b>Internet Protocol Version 4 Design[Lecture 4]:</b> IPv4 Header ToS IPv4 Fragmentation IPv4 Addressing ,IPv4 Address Classes Class A Addresses Class B Addresses ,Class C Addresses Class D Addresses Class E Addresses ,IPv4 Address Types IPv4 Private Addresses NAT ,IPv4 Address Subnets Mask Nomenclature IP Address Subnet Design</p> <p>Example Determining the Network Portion of an IP Address Variable-Length Subnet Masks, Loopback Addresses IP Telephony Networks ,IPv4 Addressing Design Goal of IPv4 Address Design , Plan for Future Use of IPv4 Addresses , Performing Route Summarization , Plan for a Hierarchical IP Address Network , Private and Public IP Address and NAT Guidelines , Steps for Creating an IPv4 Address Plan</p> <p><b>Case Study[Lecture 4]:</b> IP Address Subnet Allocation , Address Assignment and Name Resolution , Recommended Practices of IP Address Assignment , BOOTP DHCP DNS , Internet Protocol Version 6 Design, IPv6 Header IPv6 Address Representation IPv4-Compatible IPv6 Addresses IPv6 Prefix Representation IPv6 Address Scope Types and Address Allocations IPv6 Address Allocations IPv6 Unicast Address Global Unicast Addresses Link-Local Addresses , Unique Local IPv6 Address Global Aggregatable IPv6 Address ,</p> <p>IPv4-Compatible IPv6 Address IPv6 Anycast Addresses , IPv6 Multicast Addresses IPv6 Mechanisms ICMPv6 , IPv6 Neighbor Discovery Protocol IPv6 Name Resolution , Path MTU Discovery IPv6 Address-Assignment Strategies , Manual Configuration SLAAC of Link-Local Address , SLAAC of Globally Unique IPv6 Address DHCPv6 , DHCPv6 Lite IPv6 Security IPv6 Routing Protocols</p> <p><b>RIPng OSPFv3 [Lecture 4]:</b> BGP4 Multiprotocol Extensions (MP-BGP) for IPv6 , IPv6 Addressing Design , Planning for Addressing with IPv6 , Route Summarization with IPv6 IPv6 Private Addressing IPv6 for the Enterprise IPv6 Address Allocation , Partly Linked IPv4 Address into IPv6, Whole IPv4 Address Linked into IPv6</p> <p>IPv6 Addresses Allocated Per Location and/or Type , IPv4-to-IPv6 Transition Mechanisms and Deployment Models , Dual-Stack Mechanism IPv6 over IPv4 Tunnels , Protocol Translation, Managing Securities</p>	12
	<b>Total</b>	<b>48</b>
<p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. CCDA200-310Official Cert Guide, <b>Cisco Press</b></li> <li>2. Network Warrior,Gary A Donabue,<b>O Reilly</b>, 2nd 2021</li> </ol>		
<p><b>Details of Continuous Internal Assessment(CIA):</b>  <b>(CIA-1):20 Marks</b>  <b>(CIA-2) 20 Marks : Case Study on Advanced Networking</b></p>		
<p><b>PRACTICALS : Enterprise Networking Practical BH.USITS6P6</b></p>		
<b>Unit No.</b>	<b>Description</b>	
<b>1</b>	Configuring OSPF -I	



<b>2.</b>	Configuring OSPF - II
<b>3.</b>	Redistribution and Administrative Distances
<b>4.</b>	BGP
<b>5.</b>	IPv6
<b>6.</b>	VLANs and EtherChannel
<b>7.</b>	Spanning Tree Protocol
<b>8.</b>	VLAN and Spanning Tree
<b>9.</b>	Internal VLAN Routing
<b>10.</b>	Configure NAT Services



### MODALITY OF ASSESSMENT- SEMESTER VI

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	Internal Class Test with Objective type questions and Short Notes (CIA-I)	20
2	CIA-II	20
	TOTAL	40

CIA II can include:

- Research paper review
- Case study
- Small project
- Literature review on recent technologies in IT
- Preparation of research poster for application of IT

B) External Examination- 60%- 60 Marks Semester End Theory Examination: 60 marks (for offline Mode)

Duration - The examinations shall be of 2 hours duration. Paper Pattern:

1. There shall be **04** question of 15 marks each.
2. All questions shall be compulsory with internal choice within questions.
3. The unitized questions may have subjective and objective type of questions.



**Overall Examination & Marks Distribution Pattern Semester VI**

Course BH. USITS	601		602		603		604		605		Grand Total
	Internal	External	Internal	External	Internal	External	Internal	External	Internal	External	
<b>Theory</b>	40	60	40	60	40	60	40	60	40	60	500
<b>Practical</b>		50		50		50		50		50	250
											750



**Rubrics of evaluation for ESE SEMESTER VI**

Unit	Knowledge	Understanding	Analysis & critical thinking	Total marks/unit
1	5	5	5	15
2	5	5	5	15
3	5	5	5	15
4	5	5	5	15
Total	20	20	20	60
% Weightage	33.33	33.33	33.33	100 ~

**Rubrics of evaluation for CIA-2 Assignment: Presentation/debate**

Parameters	Max Marks	Excellent/Advanced(4point)	Proficient (3point)	Approaching proficiency(2point)	Beginning scale(1point)
<b>CONTENT</b>	<b>10</b>				
<b>Content: Logic</b>	<b>02</b>				
<b>Content: knowledge</b>	<b>03</b>				
<b>Content: Code Elegance-</b>	<b>03</b>				
<b>Content: Demonstration/ Execution/Testing</b>	<b>02</b>				
<b>Content: Modularity level Specifications</b>	<b>-</b>				
<b>Effective communication skill</b>	<b>10</b>				