**Kurukshetra University, Kurukshetra**

**(Established by the State Legislature Act XII of 1956)**

**(‘A+’ Grade, NAAC Accredited)**

|| योगस्थ:कुरुकर्माणि ||

समबुद्धिवयोगयुक्तहोकरकर्मकरो

(Perform Actions while Stead fasting in the State of Yoga)



Syllabus of Bachelor of Computer Applications (Cloud Technology and Information Security) (BCA-CTIS)2nd Year

to be implemented w.e.f. 2022-23

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| **BCA- CTIS-301: OBJECT ORIENTED PROGRAMMING USING JAVA** |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** The aim of the course is to provide knowledge of JAVA as a High level language as one of the programming tool and generating logical development using programming. Making student to learn about OOPS and linking JAVA as a powerful OOPs language. Also making student aware of property of JAVA as Platform independent. |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-301.1 demonstrate the basic programming constructs of Java and OOPs to develop Java programs.BCA-CTIS-301.2 learn and develop various controls and branching of logics under various cases using language control structures.BCA-CTIS-301.3 exemplify the usage to implement polymorphism and Inheritance in java programs.BCA-CTIS-301.4 acquire knowledge of Packages, Interfaces, Exceptions and Multithreading in building efficient applications. |
| **UNIT – I**Key Attributes of Object-Oriented Programming, Introduction to Java, History and Features of Java, Java Virtual Machine (JVM), JDK, Java Runtime Environment; Basic Elements: Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Data types, Operators, Assignments; Input/output in Java: Basics, I/O Classes, Reading Console Input. |
| **UNIT – II**Control Structures in Java: Decision and Loop Control Statements.Class and Object in Java: Class Fundamentals, Creation of Objects, Defining Methods, Argument Passing Mechanism, Constructors, Abstract Class, Static Members. Array in Java: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array. |
| **UNIT – III**String: String Fundamentals, Operations on Array and String, String Constructors, Creating Strings using String Class and StringBuffer Class. Polymorphism in Java: Basic Concept, Types, Overriding vs Overloading, Inheritance: Benefits of Inheritance, Types of Inheritance, Interface: Implementing Interface, extending Interface; package: creating a package.  |
| **UNIT –IV**Exception handling: catching multiple exception, throw/throws keyword, finally keyword, user defined exception, Introduction toMultithreading, Thread Lifecycle. Introduction to Applet, Types of Applet, Applet Lifecycle. |
| **Text Books:**1. E Balaguruswamy,Programming with java, Tata McGraw-Hill.
2. Patrick Naughton and Herbert Schlitz, JAVA-2 Complete Reference, TMH.
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| **Reference Books:**1. Ivor Horton, Beginning JAVA 2, WROX Publications, New Delhi.
2. Paul Deital & Harvey Deital, Java: How to Program, Pearson Education.
3. Horstmann, John Wiley, Computing Concepts with Java 2 Essentials.
4. Decker & Hirshfield, Programming Java, Vikas Publication.
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| **BCA- CTIS-302: FUNDAMENTALS OF STORAGE AND DATA CENTRES** |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** This course is designed to deliver the relevant knowledge about storage technology and its environment along with data protection. This course also aims to provide an overview of Data Center and their requirement. |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-302.1 understand the basics of storage technology and its environment.BCA-CTIS-302.2 learnhow to protect the data using storage mechanisms.BCA-CTIS-302.3 learn the basic of data center and their architecture.BCA-CTIS-302.4understand the need of data centers from different perspectives. |
| **UNIT – I**Introduction to Storage Technology Information storage, evolution of storage technology and architecture, data center infrastructure, key challenges in managing information, information lifecycle. Storage system environments: components of storage system environment, Disk Drive components, Disk Drive Performance, fundamental laws governing disk performance, logical components of the host, application requirements and disk performance. |
| **UNIT – II**Data Protection: RAID: Implementation of RAID, RAID array components, RAID levels, RAID comparison, RAID Impact on disk performance, host spares. Intelligent Storage System: Components of an Intelligent Storage System, Intelligent Storage array, concepts in Practice: EMC CLARIION and Symmetric. |
| **UNIT – III**Overview of Data Centers: Data Centers Defined, Data Center Goals, Data Center Facilities, Roles of Data Centers in the Enterprise, Roles of Data Centers in the Service Provider Environment, Application Architecture Models. The Client/Server Model and Its Evolution, The n-Tier Model, Multitier Architecture Application Environment, Data Center Architecture.  |
| **UNIT –IV**Data Center Requirements: Data Center Prerequisites, Required Physical Area for Equipment and Unoccupied Space, Required Power to Run All the Devices, Required Cooling and HVAC, Required Weight, Required Network Bandwidth, Budget Constraints, Selecting a Geographic Location, Safe from Natural Hazards, Safe from Man-Made Disasters, Availability of Local Technical Talent, Abundant and Inexpensive Utilities Such as Power and Water, Selecting an Existing Building (Retrofitting), tier standard |
| **Text Books:**1. G. Somasundaram, A. Shrivastava, EMC Corporation : Information Storage and Management, 1st Edition, wiley publishing, 2009
2. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
 |
| **Reference Books:**1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011
2. Meeta Gupta : Storage Area Network Fundamentals, 2 nd Edition, Pearson Education Limited, 2002
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| **BCA- CTIS-304: COMPUTER ORGANIZATION AND ARCHITECTURE** |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** This course is designed to deliver the relevant knowledge about computer organization and architecture. This course is an essential for understanding the working of computer in detail. |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-304.1 have a thorough understanding of the basic structure and operation of a digital computer.BCA-CTIS-304.2 learn the different ways of communicating with I/O devices and standard I/O interfaces.BCA-CTIS-304.3 understand basics of Computer ArchitectureBCA-CTIS-304.4understand the Pipeline processing along with RISC and CISC architectures |
| **UNIT – I**Boolean Algebra and Logic Gates Basic definition, Axiomatic Definition, Basic theorem and Properties of Boolean algebra, Minterms and Maxterms, Logic Operations, Digital logic gates, IC digital logic families.Simplification of Boolean functions: Different types map method, product of sum simplification, NAND or NOR implementation, Don’t care condition, Tabulation method, Adder, Subtractor, Code Conversion, Universal Gate |
| **UNIT – II**Sequential Logic: Flip-flops, Triggering of Flip-flops, Analysis of clocked sequential circuits, State reduction and Assignment, Flip-flop excitation, Design of counters, Design with state equations.Overview Of Register Transfer And Microoperations: Register Transfer Language, Register transfer, Bus and Memory transfer, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit. |
| **UNIT – III**Basic Computer Organization and Design: Instruction codes, Computer registers, Computer instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input-output and interrupt, Design of Basic computer, Design of Accumulator Unit.Programming the Basic Computer: Introduction, Machine Language, Assembly Language, the Assembler, Program loops, Programming Arithmetic and logic operations, Subroutines, I-O Programming. |
| **UNIT –IV**Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction format, Addressing Modes, Data transfer and manipulation, Program Control, Reduced Instruction Set Computer (RISC).Pipeline Processing: Parallel Processing Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline |
| **Text Books:**1. Computer System Architecture: By M. Morris Mano.
2. Structured Computer Organization: By Tanenbaum.
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| **Reference Books:**1. Computer Organization: By Stallings.
2. Computer Architecture and Organization: By Hayes.
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| **BCA-CTIS-305: Principles of Virtualization** |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:**Virtualization is the single most effective way to reduce IT expenses while boosting efficiency and agility in organizations. This unit explores the implementation and usage of VMWare Virtualization, its installation process and the working of Windows Server Hyper-V. |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-305.1 understand the basics of virtualizationBCA-CTIS-305.2 learn about the system configuration for virtualizationBCA-CTIS-305.3 deploy and manage remote applications and web servicesBCA-CTIS-305.4 learn the various software for virtualization |
| **UNIT-I****Basics of Virtualization:** Understanding Virtualization, Need of Virtualization and Virtualization Technologies: Server Virtualization, Storage Virtualization, I/O Virtualization, Network Virtualization, Client Virtualization, Application virtualization, Desktop virtualization, Understanding Virtualization Uses: Studying Server Consolidation, Development and Test Environments, Helping with Disaster Recovery |
| **UNIT-II****System Configuration for Virtualization:** Configure the BIOS to support hardware virtualization; Install and configure Windows Virtual PC: installing Windows Virtual PC on various platforms (32-bit, 64-bit), creating and managing virtual hard disks, configuring virtual machine resources including network resources, preparing host machines; create, deploy, and maintain images. |
| **UNIT-III****Deploying and Managing Remote Applications & Web Access:** Prepare and manage Remote Applications: Configuring Application Sharing, package applications for deployment by using RemoteApp, installing and configuring the RD Session, Host Role Service on the server. Access published applications: configuring Remote Desktop Web Access, configuring role-based application provisioning, and configuring Remote Desktop client connections. Configure client settings to access virtualized desktops: configuring client settings |
| **Unit – IV****Virtualization Software & Tools:** Brief of Virtualization Software, VMware: Introduction to vSphere, ESXi, vCentre Server and vSphere Client. Creating Virtual Machine. Introduction to Hyper-V Role. Create Virtual Machines. Create Hyper-V Virtual Networking, Use Virtual Machine Snapshots. Monitor the performance of a Hyper-V Server, Citrix XENDesktop Fundamentals**.** |
| **Text Books:**1. Virtualization with Microsoft Virtual Server 2005, TwanGrotenhuis, RogierDittner, Aaron Tiensivu, KenMajors, Geoffrey Green, DavidRule, Andy Jones, Matthijs tenSeldam, Syngress Publications,2006
2. Virtualization--the completecornerstone guide tovirtualization best practices, Ivanka Menken, Gerard Blokdijk,Lightning Source Incorporated,2008
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| **Reference Books:** 1. Virtualization: From the Desktop to the Enterprise, Chris Wolf, Erick M. Halter, EBook, 2005
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| **BCA-CTIS-307: Software Engineering** |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** The aim of the course is to provide knowledge of Software Engineering as a paradigm in Computer Science. This course will enable students to be the computer engineer or system analysts for an enterprise.  |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-307.1. Understand concept of Software Engineering and types of System.BCA-CTIS-307.2. Plan the software project for an Enterprise.BCA-CTIS-307.3. Analyze the requirement of a client to design a software.BCA-CTIS-307.4. Design software using structured and object-oriented approach.  |
| **UNIT-I**System Concept: Definition of Software Engineering, Goals and Principles of Software Engineering, Software Crisis, Factors Responsible for Software Crisis, Software Engineering Vs. Traditional Engineering, Software Processes & Characteristics, Elements of system, Physical and Abstract System, Open and Closed System, Man-Made Information Systems. System Development Life Cycle, Waterfall, Prototype, Evolutionary and Spiral Models, Various Phases of System Development.  |
| **UNIT-II**System Analyst: Definition, Qualification, Multifaceted Role of System Analyst, Analyst/ User interface.System Planning: Introduction, Bases for Planning in System Analysis, Dimensions of Planning. Software Cost Estimation, Cost and Benefit Categories, Procedure for Cost/ Benefit Determination, COCOMO Model. Project Scheduling, Team Structures, Software Configuration Management, Software Quality and Quality Assurance, Risk Management.  |
| **UNIT-III**Software Requirements Analysis and Specifications (SRS): Meaning, Structured Analysis: Data Flow Diagram, Guidelines for Developing DFDs, Context Diagram, and Feasibility study: System Performance Definition, Statement of Constraints, Identification of Specific System Objectives, Description Of Outputs, Feasibility Consideration, Steps in Feasibility Analysis, System Proposal. Overview of Decision Tree, Structured English, Entity-Relationship Diagrams, Cohesion and Coupling. |
| **Unit – IV**Software Design process: Software Quality Guidelines and Attributes, Design Concepts: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Refactoring, Software Design Principles, Modularity, Structured Design Methodology, Object Oriented Design Concepts and Methodology, Design Verification. Deployment Level Design Elements. |
| **Text Books:**1. Roger S. Pressman, Software Engineering APractioner’s Approach, McGraw Hill Publication.
2. R.E Fairely, Software Engineering Concepts, Tata McGraw Hill Publication.
3. Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publication House.
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| **Reference Books:**1. Ian Sommerville, Software Engineering, International Computer Science Series.
2. Awad M. Elias, System Analysis and Design, Galgotia Publication.
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| **BCA-CTIS-308: Network Security**  |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:**The aim of this course is to facilitate students, gain hands-on experience of identifying and providing solutions for common network security challenges using various security tools and techniques. |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-308.1. understand various characteristics of network security, threats and risks to securing network.BCA-CTIS-308.2. know the network security to identifying common issues and propose and suitable solutions BCA-CTIS-308.3. Relate fundamental concepts of information security with network and connectivity.BCA-CTIS-308.4. make it possible for students to learn important network security protocols and means of achieving effective network security. |
| **Unit- I****Introduction to Network Security:** Perimeter Security – Overview of Network Security, Access Control, Device Security, and Security features on Switches, Firewall, Types of firewall, Access Management, Multifactor Authentication, Wireless LAN (WLAN) Security and Network Admission Control (NAC). |
| **Unit- II****Threats, Vulnerabilities and Attacks:** Threat; Vulnerabilities; Attacks – Application Attack, Network Attack and Mitigating & Deterring Attacks; Network Security – Security through network devices, Security through Network Technologies and Security through Network Design Elements, Administering a Secure Network. |
| **Unit- III****Network Security Management:** Secure Socket Layer (SSL) – Introduction to SSL, Open SSL basics, Problems with SSL, Cryptography, Message Digest Algorithms, Digital Signature and Public Key Infrastructure (PKI); Data Privacy – IPsec VPN, Dynamic Multipoint VPN (DMVPN), Group Encrypted Transport VPN (GET VPN), Secure Sockets Layer VPN (SSL VPN) and Multiprotocol Label Switching VPN (MPLS VPN). |
| **Unit- IV****Network Security Controls:** Network Intrusion Prevention – Overview of Intrusion Prevention System (IPS), Intrusion Detection System (IDS), Deploying IPS and IPS high Availability; host Intrusion Prevention; Anomaly Detection and Mitigation.  |
| **Text Books:**1. Network Security Bible by Eric Cole, Wiley; Second edition (2009).
2. Network Security: Private Communication in a Public World by Charlie Kaufman, Radia Perlman, Mike Speciner, Pearson Education; Second edition (15 September 2016).
3. Network Security and Administration by Adesh K. Pandey, S.K. Kataria& Sons; (2013).
4. Network Security: A Beginners Guide by Eric Maiwald, McGraw Hill Education; Third edition.
 |
| **Reference Books:**1. NETWORK SECURITY. PRINCIPLES AND PRACTICE. FIFTH EDITION. William Stallings. Prentice Hall.
2. Cryptography and Network Security Principles and Practices, Fourth Edition. By William Stallings. Publisher: Prentice Hall.
3. Network Security Assessment: Know Your Network by Chris McNab, Shroff/O'Reilly; Third edition.
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| **BCA-CTIS-310 (I): PERSONALITY DEVELOPMENT** |
| Type: Skill Enhancement Elective (SEC)Course Credits: 02Contact Hours: 02 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 40External Pass Marks: 16 (i.e. 40%)Internal Maximum Marks: 10Total Max. Marks: 50Total Pass Marks: 20 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** The objective of this course is to groom overall personality of the students in general with special focus on the placement of students. |
| **Course Outcomes:** At the end of this course students will be able to:BCA-CTIS-310(I).1 appreciate the concept of personal groomingBCA-CTIS-310(I).2 learn about dealing with colleagues at workplaceBCA-CTIS-310(I).3 prepare themselves for group discussions and presentations.BCA-CTIS-310(I).4 get themselves ready for the interviews. |
| **UNIT – I****Personality & Personal Grooming** – A Brief Introduction Personality and self-concept, Element of Personality, Determinants of Personality, Causes of deranged Personality, Personality Analysis Grooming, Personal hygiene, Social, Business and Dining Etiquettes, Body language use and misuse, Art of good Conversation, Art of Intelligent Listening. |
| **UNIT – II****Interpersonal Skills & Role playing**: Dealing with seniors, colleagues, juniors, customers,suppliers, contract workers, owners etc at work place.Self Esteem: Term self-esteem, Symptoms, Advantages, Do's and Don’ts to develop positive self-esteem, Low self-esteem: Symptoms, Personality having low self-esteem, Positive and negative self-esteem |
| **UNIT – III****Group Discussion & Presentation skills:** Team behavior, how to effectively conduct yourself during GD, do’s and don’ts, clarity of thoughts and its expression Presentation skills & seminar skills |
| **UNIT – IV****Interviews Preparation:** Intent and purpose, selection procedure, types of interviews, Self-planning, writing winning resume, knowledge of company profiles, academics and professional knowledge review, update on current affairs and possible questions, time – keeping, grooming, dress code, document portfolio, frequently asked questions and their appropriate answers, self – introduction, panel addressing, mental frame – work during interviews |
| **Reference Books:**(1) Personal management and Human Resources, by C.S. Venkata Ratanam and B.K. Srivastava, published by Tata McGraw Hill Publishing Ltd. New Delhi (2) Human Behaviour at Work, by: Keith Davis, Tata McGraw Hill Pub. Ltd. N. Delhi (3) Im OK, You re OK, by : Thomas A. Harris, Published By : Pan Books, London and Sydney (4) Pleasure of your Company, by: Ranjana Salgaocar, Published by: Pyramid Publishers, Goa (5) How to get the job you want, by: Arun Agarwal, Published by: Vision Books, New Delhi (6) Get That Job, Rohit Anand & Sanjeev Bikhachandani, Harper Collins |

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| **BCA-CTIS-401: Ethical Hacking**  |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** The aim of this course is to**:*** To introduce the methodologies and framework of ethical hacking for enhancing the security.
* The course Includes-Impacts of Hacking; Types of Hackers; Information Security Models; Planning a Controlled Attack.
* To gain knowledge of the use and availability of tools to support an ethical hack.
* To gain the knowledge of interpreting the results of a controlled attack.
* To understand the role of government, inherent and imposed limitations and metrics for planning of a pre-emptive confided pen-test.

To comprehend the dangers associated with penetration testing. |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-401.1. Explain the importance of ethical hacking in achieving the goals of information security.BCA-CTIS-401.2. Differentiate the processes of vulnerability assessment and ethical hacking from penetration testing.BCA-CTIS-401.3. Comprehend the importance of appropriate countermeasures for managing vulnerabilities.BCA-CTIS-401.4. Justify the need for meticulous documentation in writing reports for consumption of both technical and management audiences.BCA-CTIS-401.5.Articulate the rationale for having an adequate legal framework for dealing with hacking and ethical hacking. |
| **Unit- I****Introduction to Ethical Hacking:** Ethical Hacking concepts and essential terminology. Different phases involved in an exploit by a Hacker. Overview of Attacks and Identification of Exploit Categories. Legal implications of Hacking. Hacking, Law and Punishment, Reverse engineering, Ethical hacking terminology, Exploit, Vulnerability – Zero-day, manual PT, Case Studies. |
| **Unit- II****Ethical Hacking Phases-Scanning & Enumeration:** Essential terms like Hacker, Hacking, Cracker, Ethical Hacker, Threat, Vulnerability, Target of Evaluation, Attacks and Exploits. Elements of Security and how Hacking impacts these elements. Scanning as a part of the pre-attack phase. Use of dialers, port scanners, network mapping, sweeping, vulnerability scanners etc. Usage of Open source tools for scanning. Gaining Access phase of the attack including how the attack occurs. |
| **Unit- III****Penetration Techniques and Tools:** Maintaining access phase where the hacker tries to retain ownership of the system. Techniques & tools used by hackers to maintain access. Covering tracks Phase of the hacking activity including removal of evidence of hacking to avoid forensics & legal action. |
| **Unit- IV****Report Writing and Mitigation:** Introduction to Report Writing & Mitigation, requirements for low level reporting &high level reporting of Penetration testing results, Demonstration of vulnerabilities and Mitigation of issues identified including tracking, Overview of India’s Information Technology Amendment Act 2008 (IT Act 2008 – sections 43, 65 and 66, how to file a complaint of suspected hacking, Case Studies, understanding how hacking is legally dealt with among BRICS countries |
| **Text Books:**1. Gray Hat Hacking The Ethical Hackers Handbook, 3rd Edition Paperback – 1 Jul 2017 by Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, McGraw Hill Education; 3 ed (1 July 2017).
2. CEH v9: Certified Ethical Hacker Version 9 Study Guide by Sean-Philip Oriyano, Sybex; Stg edition (17 June 2016).
3. Hacking for Beginners: Ultimate 7 Hour Hacking Course for Beginners. Learn Wireless Hacking, Basic Security, Penetration Testing by Anthony Reynolds, CreateSpace Independent Publishing Platform (10 April 2017).

**Reference Books:**1. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy by Patrick Engebretson, Syngress; 2 edition (12 September 2013).2. Hacking With Python: The Complete Guide to Ethical Hacking, Basic Security, Botnet Attack,Python hacking and Penetration Testing Kindle Edition by John C. Smalls. |

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| **BCA-CTIS-402: Digital Forensic and Investigation** |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** The aim of this course is to**:*** To deals with the development of tools and software.
* To gather evidences from computers, without corrupting the information contained.
* To understand the process of investigation and cyber law.
* To understand the various forms of cybercrime and its implications and duties of professionals employed at different levels towards analyzing and controlling cybercrime.
* To recover data from storage devices are covered in following chapters. Different forensic techniques and cyber laws are also dealt in detail.
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| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-402.1. Explain the importance of computer forensic in achieving the goals of information securityBCA-CTIS-402.2. Comprehend steps involved in recovering data stored in various devices and various techniques used in windows, linux, network and web application forensics.BCA-CTIS-402.3. Articulate the rationale for having an adequate legal framework when dealing with computer forensics.BCA-CTIS-402.4. Identify and apply current practices for data discovery recovery and acquisition.BCA-CTIS-402.5. Justify the need for meticulous documentation in computer forensics. |
| **UNIT-I****Computer Forensics:** Introduction to Computer Forensics, Forms of Cyber Crime, First Responder Procedure- Non-technical staff, Technical Staff, Forensics Expert and Computer Investigation procedure, Case Studies. |
| **UNIT-II****Storage Devices & Data Recover Methods:** Storage Devices- Magnetic Medium, Non-magnetic medium and Optical Medium, Working of Storage devices-Platter, Head assembly, spindle motor, Data Acquisition, Data deletion and data recovery method and techniques, volatile data analysis, Case Studies. |
| **UNIT-III****Forensics Techniques:** Windows forensic, Linux Forensics, Network forensics – sources of network-based evidence, other basic technical fundamentals, Mobile Forensics – data extraction & analysis, Steganography, Password cracking-Brute force, Cross-drive analysis, Live analysis, deleted files, stochastic forensics, Dictionary attack, Rainbow attack, Email Tacking – Header option of SMTP, POP3, IMAP, examining browsers, Case Studies. |
| **Unit – IV****Cyber Law:** Corporate espionage, digital evidences handling procedure, Chain of custody, Main features of Indian IT Act 2008 (Amendment), Case Studies, Incident specific procedures – virus and worm incidents, Hacker incidents, Social incidents, physical incident, Guidelines for writing forensic report. |
| **Text Books:**1. Computer Forensics: Computer Crime Scene Investigation by John Vacca, Laxmi Publications, 1st; 2015
2. Digital Forensic: The Fascinating World of Digital Evidences by Nilakshi Jain, et.al, Wiley, 1sted; 2016
3. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics by John Sammons, Syngress, 2nded; 2014
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| **Reference Books:**1. Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, Universal Law Publishing - an imprint of LexisNexis; First 2017 edition.

Network Forensics:Tracking Hackers Throu by Davidoff, Pearson India, 1sted; 2013 |

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| **BCA-CTIS-404: Server Administration** |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** * The objective of this course is to make students feel too provides a network foundation from which you can centrally manage settings on your computers that are based on the Windows® operating system, and upon which you can run the most popular business applications. Students will learn various aspects of managerial writing including report writing.
* This unit explores the method to install, upgrade, and deploy the Windows Server. Also, the learners will have the functional knowledge of configuring core network services and the active directory of Windows Server.
* This unit provides the knowledge and skills necessary to plan and implement a Windows Server 2012 and Windows Server 2012 R2 environment.
* It covers the most important job tasks for Server Administrators who are responsible for the planning, operations, and day-to-day maintenance of Windows Server 2012 and Windows Server 2012 R2 servers in the enterprise.
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| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-402.1. install and configure windows server 2012BCA-CTIS-402.2. secure files and disksBCA-CTIS-402.3. configure files and permissionsBCA-CTIS-402.4. configure DNS zones and records. |
| **Unit I****Installing and Configuring Windows Server 2012:** Introduction, Selecting a Windows Server 2012 Edition, Supporting Server Roles and Features, Server Licensing, Installing Windows Server 2012: System Requirement, Performing a Clean Installation, Working with Installation Partitions, Server Core Defaults, Server Core Capabilities, Completing Post-Installation Tasks, Converting Between GUI and Server Core, Upgrade paths, Installing Windows Server Migration Tools, Configuring NIC Teaming, Configuring local storage, Configuring WDS to install OS through networking.  |
| **UNIT – II****Securing Files and Disks:** How to Securing Files, Encryption files with EFS, Configuring EFS, Using the Cipher Command, Sharing Files Protected with EFS with others, Configuring EFS with Group Policies, Configuring EFS Recovery Agent, Managing EFS Certificates, Encrypting Files with BitLocker, Configuring BitLocker Encryption, configuring BitLocker to Go, Configuring BitLocker Policies, Managing BitLocker Certificates.  |
| **UNIT – III****Configuring File and Share Access Permissions:** Designing a File-Sharing Strategy, Arranging Shares, Controlling Access, Mapping Drives, Creating Folder Shares, Assigning Permissions, Understanding the windows Permission Architecture and Basic, Advanced Permissions, Allowing and Denying Permissions, Inheriting Permissions, Understanding Effective Access, Setting Share Permissions, Understanding NTFS Authorization, Assigning Basic NTFS Permissions, Understanding Resource Ownership, Combining Share and NTFS Permissions, Installing File Server Resource Manager, Using, creating, changing Quotas, Managing Files with File Screening, Creating File Groups, creating a File Screen, creating a File Screen Exception, Creating a File Screen Template. Storage Reports Management. |
| **UNIT – IV****Configuring DNS Zones and Records :** Understanding DNS, Understanding DNS Names and Zones, Understanding the Address Resolution Mechanism, configuring and Managing DNS Zones, Installing DNS, Configuring Primary and Secondary Zones, Configuring Active Directory-Integrated Zones, configuring Zone Delegation, configuring Stub Zones, configuring Caching-Only Servers, Configuring Forwarding and Conditional Forwarding, Configuring DNS Record types, creating and Configuring DNS Resource Records, Start of Authority(SOA) Records, Name Server(NS) Records, Host(A and AAAA) Records, Canonical Name(CNAME) Records, Pointer(PTR) Records. |
| **Text Books:**1. Windows Server 2012: A Handbook for Professionals by Aditya Raj (Author)
2. Administering Windows Server 2012 (Certification Guide) by Orin Thomas
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| **Reference Books:**1. Administering Widows Server 2012 by Patrick Regan
2. Mastering Windows Server 2012 R2 by Mark Minasi, Kevin Greene, Christian Booth, and Robert Butler
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| **BCA-CTIS-405: Containerization using Dockers** |
| Type: Core Course (CC)Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:*** Introducing Docker Architecture and its components.
* Working with Docker containers.
* Building Docker images by utilising the Docker file.
* Build applications and services using Docker.
* Implementing Docker Networking
* Using Docker APIs and Engine APIs
* Orchestrating Docker containers and discovering Docker services
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| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-405.1 Develop Containerized applications and implement continuous integration using Docker.BCA-CTIS-405.2 Manage images and containers using Docker API.BCA-CTIS-405.3 Create their own images and build the repository.BCA-CTIS-405.4 Implement Docker Orchestration and Service discovery features. |
| **UNIT-I**Getting Started with Docker: Introduction to Dockers, Containers vs Virtual Machines, Docker Architecture, Docker Components, and Installing Docker, Working with Docker Containers, Introduction to Swarm mode and Micro services. Docker Image Layers, Listing Docker Images, Pulling Images, Searching Images, Building Docker Images – Using Commands, Using Docker File, pushing image to the Docker Hub, Deleting an Image, Running Docker Registry. |
| **UNIT-II**Containerized Applications: Docker to build and test a web application, Docker for Continuous Integration, Managing Multi-configuration job, Building services with Docker – Application, Application Server and Multi-container application stack, managing containers without SSH. |
| **UNIT-III**Docker Networking and Docker APIs: Introduction to Docker Networking, None Network, Bridge Network, Host Network, Overlay Network, Container Networks with Docker Compose. The Docker APIs, Engine API, Managing images and containers with API, Authenticating the Docker Engine API. |
| **Unit – IV**Docker Orchestration and Service Discovery: Docker Compose, Consul, Service Discovery and Docker, Docker Swarm, Orchestration alternatives and components – Fleet and etcd, Kubernetes, Apache Mesos, Helios, Centurion. |
| **Text Books:**1.The Docker Book: Containerization is the new virtualization, James Turnbull, Docker Inc., |
| **Reference Books:** 1. Docker in Action Agility, Reliability, and Security, Gene Kim, Patrick Debois, John Willis, Jez, IT Revolution Press, First Edition, October.
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| **BCA-CTIS-407: Internet of Things** |
| Type: Core Course (CC)Course Credits: 03Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It’s becoming the Internet of Things (IoT). The course enables student to understand the basics of Internet of things and protocols. It introduces some of the application areas where Internet of Things can be applied. Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things. |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-407.1 understand the basics of Internet of thingsBCA-CTIS-407.2 learn about IoT protocolsBCA-CTIS-407.3 know about the architecture of IoTBCA-CTIS-407.4 understand the concepts of Web of Things and some of the application areas where Internet of Things can be applied |
| **UNIT-I**Introductory Concepts: What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues. |
| **UNIT-II**IOT PROTOCOLS: Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security |
| **UNIT-III**IOT ARCHITECTURE - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction. |
| **Unit – IV**WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. |
| **Text Books:**1. Internet of Things, APractioner’s Approach, McGraw Hill Publication.
2. R.E Fairely, IOT Concepts, Tata McGraw Hill Publication.
3. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press,2012.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applicationsand Protocols”, Wiley, 2012.
 |
| **Reference Books:**1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-On-Approach)”,1st Edition, VPT, 2014
2. CunoPfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1- 4493-9357-1
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| **BCA-CTIS-408:Designing Enterprise Network** |
| Type: Core Course (CC)Course Credits: 03Contact Hours: 03 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 60External Pass Marks: 24 (i.e. 40%)Internal Maximum Marks: 15Total Max. Marks: 75Total Pass Marks: 30 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:**This course takes students through the second level of Networking concepts like where main focus is on understanding the principles of routing and functioning of different routing protocols. |
| **Course Outcomes:** At the end of this course students will be able to BCA-CTIS-408.1 understand the basic concepts of networking like OSI layers, TCP/ IP models and concept of sub netting, BCA-CTIS-408.2 learn advanced topics like TCP and UDP operations, IPv4 and IPv6 technologies. BCA-CTIS-408.3 appreciate in-depth functioning of Routing protocols, specifically Advanced Routing. BCA-CTIS-408.4 learn to identify different types of WAN networks and understand their workings.  |
| **UNIT-I**Networking Fundamentals: The TCP/IP and OSI Networking Models, Fundamentals of Ethernet LANs, Fundamentals of WANs, Fundamentals of IPv4 Addressing and Routing, Fundamentals of TCP/IP Transport and Applications, Ethernet LANs and Switches: Building Ethernet LANs with Switches, Cisco LAN Switches, Configuring Ethernet Switching |
| **UNIT-II**IP Version 4 Addressing and Subnetting: Perspectives on IPv4 Subnetting, Analyzing Class full IPv4 Networks, Analyzing Subnet Masks, Analyzing Existing Subnets, Implementing IP Version 4: Operating Cisco Routers, Configuring IPv4 Addresses and Routes, Implementing Ethernet Virtual LANs, Troubleshooting Ethernet LANs, Spanning Tree Protocol Concepts, Troubleshooting LAN Switching. |
| **UNIT-III**LAN Routing: Configure IPv4 Routing, Configure and Verify Host Connectivity, Advanced IPv4 Addressing Concepts, Describe the boot process of Cisco IOS routers; Operation status of a serial interface; Manage Cisco IOS files; Routing and Routing Protocols; OSPF (multi-area); EIGRP (single AS); Passive Interface  |
| **Unit – IV**IPv4 Services and IP Version 6: Basic IPv4 Access Control Lists, Advanced IPv4 ACLs and Device Security, Network Address Translation, Recognize high availability (FHRP); Describe SNMP v2 and v3, IPV6 addressing |
| **Text Books:**1. Network Analysis, Architecture, and Design 3rd Edition, Morgan Kaufman, James D.
2. Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare.
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| **Reference Books:** 1. Network Warrior, SECOND EDITION, by Gary A. Donahue
2. CCNA Routing and Switching 200-120 Official Cert Guide Library by Wendell Odom
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| **BCA-CTIS-410 (I): LOGICAL REASONING AND THINKING** |
| Type: Skill Enhancement Course (SEC)Course Credits: 02Contact Hours: 02 hours/week.Examination Duration: 3 HoursMode: LectureExternal Maximum Marks: 40External Pass Marks: 16 (i.e. 40%)Internal Maximum Marks: 10Total Max. Marks: 50Total Pass Marks: 20 (i.e. 40%) | **Instructions To Paper Setter For End Semester Exam:** Examiner will be required to set NINE questions in all. Question No.1 will consist of objective type / short-answer type questions covering the entire syllabus. In addition to Question no. 1, the examiner is required to set EIGHT more questions selecting TWO from each UNIT. Student will be required to attempt FIVE questions in all. Question No.1 will be compulsory. In addition to compulsory question, student will have to attempt FOUR more questions selecting ONE question from each UNIT. All questions will carry equal marks. |
| **Course Objectives:** It is the objective of the course to introduce to the students, concepts like Reasoning and thinking which are very important for any individual in every aspect and walk of life and assists them in taking the right decisions, approach every problem with diligence and perform action accordingly. |
| **Course Outcomes:** At the end of this course, the student will be able to:BCA-CTIS-410 (I).1 understand various Verbal ability activities and conceptsBCA-CTIS-410(I).2 participate in solving questions related tological aptitudeBCA-CTIS-410(I).3 learn the various concepts of logical reasoningBCA-CTIS-410(I).4 learn various types of graphical representation of data. |
| **UNIT – I**Verbal ability**:**Synonyms, Antonyms and One word substitutesSeries: Types of series, Alphabet series, Alpha numeric series, Examples on continues pattern series.Classification: Choosing the odd word, Choosing the odd numeral, Choosing the odd letter group. |
| **UNIT – II**Basic quantitative aptitude:Speed, Time and Distance, Time and Work, Linear Equations, Progressions (Sequences & Series), Permutation and Combination, Probability, Functions, Set Theory, Number Systems, LCM and HCF, Percentages, Collection and Scrutiny of data: Primary data, questionnaire and schedule; secondary data, their major sources including some government publications. |
| **UNIT – III**Logical Reasoning:Calendars, Clocks, Cubes, Venn Diagrams, Binary Logic, Seating Arrangement, Logical Sequence, Logical Matching, Logical Connectives, Syllogism, Blood Relations; concept of a statistical population and sample from a population; qualitative and quantitative data |
| **UNIT – IV**Presentation of Data: Construction of tables with one or more factors of classification; Diagrammatic and Graphical representation of non-frequency data; Frequency distribution, cumulative frequency distribution and their graphical representation - histogram, Column Graphs, Bar Graphs, Line Charts, Pie Chart, Data Interpretation – Introduction and approaches |
| **Text Books:**1.Richard I Levin, David S. Rubin: Statistics for Management, Pearson Prentice Hall Education Inc. Ltd, NewDelhi, 5th Ed. 20072. Dr.R.S Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand and Company Publications |
| **Reference Books:**1.Sharma J.K., Business Statistics, Pearson Education India, 2010.2.Anderson; David R, Dennis J. Sweeney and Thomas A. Williams, Quantitative Methods for Business, Prentice-Hall, West Publishing Company, 1996.**3.**CAT Complete course, UPKAR publications |