

VI

SEMESTER

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

| | | | | | |
|--------------------------------|----------------|---------------|------------------------|------------------|------------|
| 1.+ Subject Code: | TCS 601 | Course Title: | Compiler Design | | |
| 2. Contact Hours: | L: 3 | T: 0 | P: 0 | | |
| 3. Examination Duration (Hrs): | Theory | | 3 | Practical | |
| 4. Relative Weight: | CIE | 25 | MSE | 25 | ESE |
| 5. Credits: | 3 | | | | |
| 6. Semester: | VI | | | | |
| 7. Category of Course: | DSC | | | | |

8. Pre-requisite: Finite Automata and Formal Languages (TCS 402), Data Structures with C (TCS 302)

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| 9. Course Outcome: | After completion of the course the students will be able to: |
| | CO1 Understand the various phases and fundamental principles of compiler design like lexical, syntactical, semantic analysis, code generation and optimization. |
| | CO2 Compare and contrast various parsing techniques such as SLR, CLR, and LALR etc. |
| | CO3 Use annotated tree to design the semantic rules for different aspects of programming language. |
| | CO4 Implement lexical analyser and parser by using modern tools like Flex and Bison. |
| | CO5 Examine patterns, tokens & regular expressions for solving a problem in the field of data mining. |
| | CO6 Design a compiler for concise programming language. |

10. Details of the Course:

| SL. NO. | Contents | Contact Hours |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1 | Unit 1: Introduction, Lexical analysis: Compilers; Analysis of Source Program; The Phases of a Compiler; Cousins of the Compiler; The grouping of phases; Compiler- Construction tools Lexical analysis: The Role of Lexical Analyser; Input Buffering; Specifications of Tokens; Recognition of Tokens. | 9 |
| 2 | Unit 2: Syntax Analysis – 1: The Role of the Parser; Context-free | 9 |

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| | Grammars; Writing a Grammar; Top-down Parsing; Bottom-up Parsing. Operator-Precedence Parsing; LR Parsers; Using ambiguous grammars; Parser Generators | |
| 3 | <p>Unit 3:</p> <p>Syntax-Directed Translation: Syntax-Directed definitions; Constructions of Syntax Trees; Bottom-up evaluation of S-attributed definitions; L-attributed definitions; Top-down translation.</p> <p>Run-Time Environments: Source Language Issues; Storage Organization; Storage-allocation strategies, Storage-allocation in C; Parameter passing</p> | 9 |
| 4 | <p>Unit 4:</p> <p>Intermediate Code Generation: Intermediate Languages; Declarations; Assignment statements; Boolean Expressions; Case statements; Back patching; Procedure calls.</p> <p>Code Generation: Issues in the design of Code Generator; The Target Machine; Run-time Storage Management; Basic blocks and Flow graphs; Next-use information; A Simple Code Generator; Register allocation and assignment; The dag representation of basic blocks; Generating code from DAGs.</p> | 9 |
| 5 | <p>Unit 5:</p> <p>Code Optimization, Compiler Development: Code Optimization: Introduction; The principal sources of optimization; Peephole optimization; Optimization of basic blocks; Loops in flow graphs.</p> <p>Compiler Development: Planning a compiler; Approaches to compiler development; the compiler development environment; Testing and maintenance.</p> | 9 |
| | Total | 45 |

Text Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|-----------------------------------------------------|----------------------------------------------------|-------------------------------------------|----------------------------|------|
| Alfred V Aho, Ravi Sethi, Jeffrey D Ullman | Compilers Principles, Techniques, and Tools, | Updated 2e, 2 nd Edition | Pearson Education India | 2023 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|----------------------------------------------------|---------------------------------------------------------|--------------------------|-------------------------------|------|
| Charles Fischer, Richard LeBlanc, Ron Cytron | Crafting a Compiler with C | 1 st Edition | Pearson | 1991 |
| Andrew W. Appel | Modern Compiler Implementation in C | 1st Edition (Revised) | Cambridge University Press | 2004 |
| Kenneth C. Louden | Compiler Construction: Principles and Practice | 1 st Edition | Course Technology Inc. | 1997 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| TCS601.1 | Understand the various phases and fundamental principles of compiler design like lexical, syntactical, semantic analysis, code generation and optimization. | 2 | - | - | - | - | - | - | 3 | - | 1 | - | - | - | - | 1 |
| TCS601.2 | Compare and contrast various parsing techniques such as SLR, CLR, and LALR etc. | 3 | 1 | 2 | - | - | - | - | 1 | - | 1 | - | 2 | 2 | 1 | 3 |
| TCS601.3 | Use annotated tree to design the semantic rules for different aspects of programming language. | 2 | 2 | 2 | 3 | - | - | - | 1 | - | 1 | - | 1 | - | 1 | 2 |
| TCS601.4 | Implement lexical analyser and parser by using modern tools like Flex and Bison. | 1 | 2 | - | - | - | - | - | - | 1 | - | - | 2 | - | 2 | - |
| TCS601.5 | Examine patterns, tokens & regular expressions for solving a problem in the field of data mining. | 1 | 2 | - | - | - | - | - | 1 | - | 2 | - | 1 | - | 2 | 1 |
| TCS601.6 | Design a compiler for concise programming language. | 3 | 1 | | | 2 | | | | 2 | | 1 | 1 | | 2 | |
| TCS 601 | | 2 | 1.6 | 2 | 3 | 2 | - | - | 1.5 | 1.5 | 1.25 | 1 | 1.4 | 2 | 1.6 | 1.75 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

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|----|-----------------------------|----------|---------------|----------------------|--|--|
| 1. | Subject Code: | TCS 611 | Course Title: | Software Engineering | | |
| 2. | Contact Hours: | L: 3 | T: 0 | P: 0 | | |
| 3. | Examination Duration (Hrs): | Theory 4 | Practical 0 | | | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 | | |
| 5. | Credits: | 3 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSC | | | | |

8. Pre-requisite: Fundamental of Computer & Introduction to Programming (TCS101), Object Oriented Programming with C++ (TCS307)

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| 9. | Course Outcome: | After completion of the course the students will be able to: CO1 Understand Software Development Life Cycle and importance of engineering the software. CO2 Development of efficient software requirement specification for desired product. CO3 Compare various software development methodologies ad conclude on their applicability in developing specific type of product. CO4 Construct an efficient design specification document for attainment of user desired product. CO5 Develop applications using the concepts of various phases of software development life cycle. CO6 Study various software testing techniques and identify their relevance to developing a quality software. |
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10. Details of the Course:

| S. NO. | Contents | Contact Hours |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1 | Unit 1: Introduction: What is Software Engineering and its history, Software Crisis, Evolution of a Programming System Product, Characteristics of Software, Brooks' No Silver Bullet, Software Myths Software Development Life Cycles: Software Development | 10 |

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| | Process, The Code-and-Fix model, The Waterfall model, The Evolutionary Model, The Incremental Implementation, Prototyping, The Spiral Model, Software Reuse, Critical Comparisons of SDLC models, An Introduction to Non-Traditional Software Development Process: Rational Unified Process, Rapid Application Development, Agile Development Process | |
| 2 | <p>Unit 2:</p> <p>Requirements: Importance of Requirement Analysis, User Needs, Software Features and Software Requirements, Classes of User Requirements: Enduring and Volatile; Sub phases of Requirement Analysis, Functional and Non-functional requirements; Barriers to Eliciting User Requirements, The software requirements document and SRS standards, Requirements Engineering, Case Study of SRS for a Real Time System</p> <p>Tools for Requirements Gathering: Document Flow Chart, Decision Table, Decision Tree; Structured Analysis: DFD, Data Dictionary, Introduction to non-traditional Requirements Analysis Tools: FSM, Statecharts and Petrinets;</p> | 9 |
| 3 | <p>Unit 3:</p> <p>Software Design: Goals of Good Software Design, Design Strategies and Methodologies, Data Oriented Software Design, Structured Design: Structure Chart, Coupling, Cohesion, Modular Structure, Packaging; Object Oriented Design, Top-Down and Bottom-Up Approach, Design Patterns</p> <p>Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.</p> <p>Development: Selecting a Language, Coding Guidelines, Writing Code, Code Documentation</p> | 8 |
| 4 | <p>Unit 4:</p> <p>Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards, Automated Testing</p> | 10 |

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| 5 | <p>Unit 5:</p> <p>Software Maintenance and Software Project Management: Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.</p> <p>Software Quality Assurance: SQA Plans, ISO 9000 models, SEI-CMM Model</p> | 8 |
| | Total | 45 |

Textbooks:

| Authors Name | Title | Edition | Publisher, Country | Year |
|------------------------|----------------------------------------------------|-------------------------|-----------------------------------|------|
| Roger Pressman | S. SOFTWARE ENGINEERING: A PRACTITIONER'S APPROACH | 7 th Edition | McGraw Hill Education | 2009 |
| Pratap K. J. Mohapatra | Software engineering: (a lifecycle approach) | -- | New Age International, New Delhi. | 2010 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|-------------------------------|------------------------------------------------|-------------------------|--------------------|------|
| Ian Sommerville | Software Engineering | 8 th Edition | Addison Wesley | 2006 |
| Pankaj Jalote | An Integrated Approach To Software Engineering | -- | Narosa | 2005 |
| Carlo Ghezzi, M. Jarayeri, D. | Fundamentals of Software | 2 nd Edition | PHI Publication. | 2003 |

| | | | | |
|-------------|--------------------------------------------|-------------------------|--------------------------|------|
| Manodrioli, | Engineering | | | |
| Rajib Mall | Fundamentals of Software Engineering | 5 th Edition | PHI Publication. | 2018 |
| Pfleeger | Software Engineering. | 3 rd Edition | Macmillan Publication | 2006 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|-------------------------------------------------------------------------------------------------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| TCS611.1 | Understand Software Development Life Cycle and importance of engineering the software. | 1 | | | | | | | 1 | 1 | 1 | | | 1 | 1 | |
| TCS611.2 | Development of efficient software requirement specification for desired product. | 1 | 2 | 3 | | 1 | | 1 | 1 | 1 | 2 | | | 2 | 1 | |
| TCS611.3 | Compare various software development methodologies and conclude on their applicability in developing specific type of product | 2 | 3 | | 1 | | | 1 | 1 | 1 | 2 | | 2 | 2 | 2 | |
| TCS611.4 | Construct an efficient design specification document for attainment of user desired product. | 1 | 2 | 3 | | 2 | 2 | | 2 | 2 | | 2 | 1 | 3 | 1 | |
| TCS611.5 | Develop applications using the concepts of various phases of software development life cycle. | 1 | 2 | 3 | | 3 | | 2 | 1 | 2 | | 2 | 1 | 3 | 2 | |
| TCS611.6 | Study various software testing techniques and identify their relevance to developing a quality software. | 1 | 1 | 2 | 2 | 1 | | 2 | | 2 | 2 | | 1 | 1 | | 2 |
| TCS 611 | | 1.16 | 2 | 2.75 | 1.5 | 1.75 | 2 | 1.5 | 1.2 | 1.5 | 1.75 | 2 | 1.25 | 2 | 1.4 | 2 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

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|----|-----------------------------|-----------------|--------------------|------------------------------|--|--|
| 1. | Subject Code: | TCS 604 | Course Title: | Computer Networks - I | | |
| 2. | Contact Hours: | L: 3 | T: 0 | P: 0 | | |
| 3. | Examination Duration (Hrs): | Theory 3 | Practical 0 | | | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 | | |
| 5. | Credits: | 3 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSC | | | | |

8. Pre-requisite: Fundamental of Computer & Introduction to Programming (TCS 101), Data Structures with C (TCS 302)

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| 9. Course Outcome: | After completion of the course the students will be able to: CO1 Apply and Characterize computer networks from the viewpoint of components and from the viewpoint of services. CO2 Display good understanding of the flow of a protocol in general and a network protocol in particular CO3 Evaluate and select the most suitable Application Layer protocol (such as HTTP, FTP, SMTP, DNS, BitTorrent) as per the requirements of the network application and work with available tools to demonstrate the working of these protocols. CO4 Design a Reliable Data Transfer Protocol and incrementally develop solutions for the requirements of Transport Layer CO5 Describe the essential principles of Network Layers and use IP addressing to create subnets for any specific requirements CO6 Evaluate and select the appropriate technology to meet Data Link Layer requirements and design a framework to implementing TCP/IP protocol suite. |
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10. Details of the Course:

| Sl. No. | Contents | Contact Hours |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1 | Unit 1: Introduction: Computer Networks and the Internet, Overall view: As components and as services; What is a protocol, what is a network protocol, Access Networks and | 10 |

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| | Physical Media, Circuit and Packet Switching, Internet Backbone, Delays: Processing, Queuing, Transmission and Propagation delays, The Layered Architecture: Protocol Layering, The OSI Reference Model and the TCP/IP protocol stack, History of Computer Networking, and the Internet. | |
| 2 | Unit 2: Application Layer: Principles and Architectures of Network Applications, Client and Server processes, the idea of socket, Transport services available to Application Layer especially in the internet Application Layer Protocols: The Web and http: Persistent and Nonpersistent connections, http message format, cookies, proxy server, conditional GET, File Transfer Protocol, Email: smtp, mail message formats, mail access protocols: pop3, imap, MIME, DNS: Services, How it works, Root, Top-Level and Authoritative DNS servers, Resource Records, DNS messages A simple introduction to p2p file distribution: BitTorrent | 8 |
| 3 | Unit 3: Transport Layer: Introduction and Services, The Transport layer in internet, Difference between Connection Oriented and Connectionless services, UDP: Segment structure, checksum in UDP, stop-and-wait, Go Back N, Selective Repeat, TCP: Connection Establishment, TCP header, Sequence and acknowledgement numbers, Round Trip Time, Flow Control, Congestion, Control. | 8 |
| 4 | Unit 4: Network Layer: Introduction, Packet Forwarding and Routing, Difference between Virtual Circuits and Datagram networks, The internals of a router: Input ports, output ports, switching architecture The Internet Protocol(IP), Datagram format, IP fragmentation, IPv4, addressing, subnets, CIDR, classful addressing, DHCP, Network Address Translation(NAT), Universal Plug and Play as a provider of NAT, Internet Control Message Protocol(ICMP), IPv6 Header, Moving from IPv4 to IPv6: tunnelling. Routing Algorithms: Introduction, global vs decentralized routing, The Link State(LS) Routing Algorithm, The Distance Vector (DV) Routing Algorithm, Hierarchical Routing, Introduction to Routing in the Internet: RIP, OSPF, BGP; Introduction to Broadcast and Multicast Routing. | 9 |
| 5 | Unit 5: Link Layer and Local Area Networks: Introduction to Link Layer and its services, Where Link Layer is implemented? Error detection and correction techniques: | 10 |

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| | Parity checks, Checksum, CRC; Multiple Access protocols: Channel Partitioning, Random Access (Slotted Aloha, Aloha, CSMA), Taking Turns; Link Layer Addressing: MAC addresses, ARP, Ethernet, CSMA/CD, Ethernet Technologies, Link Layer Switches, Switches vs Routers, VLANs | |
| | Total | 45 |

Textbooks:

| Authors Name | Title | Edition | Publisher, Country | Year |
|-----------------|--------------------------------------------|-------------------------|------------------------|------|
| Ross and Kurose | Computer Networking: “A Top Down Approach” | 7 th Edition | Pearson/Addison-Wesley | 2017 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|---------------------------------------|--------------------------------------|-------------------------|--------------------|------|
| Andrew Tanenbaum and David Wetherhall | Computer Networks | 6 th Edition | Prentice Hall | 2022 |
| Peterson and Davie | Computer Networks: A System Approach | 5 th Edition | Elsevier | 2011 |
| Forouzan | Data Communication and Networking | 5 th Edition | McGraw Hill | 2017 |
| William Stallings | Data and Computer Communication | 8 th Edition | Pearson Education | 2007 |
| Nader F. Mir | Computer and Communication Networks | 1 st Edition | Pearson Education | 2007 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|-------------|----------|-------------|----------|----------|------------|------------|-------------|-------------|------------|------------|----------|------------|
| TCS604.1 | Apply and Characterize computer networks from the viewpoint of components and from the viewpoint of services | 1 | 2 | - | - | - | - | - | 1 | - | 2 | 1 | - | - | - | 1 |
| TCS604.2 | Display good understanding of the flow of a protocol in general and a network protocol in particular | - | 2 | - | - | - | - | - | 1 | - | 1 | 1 | - | - | - | 3 |
| TCS604.3 | Evaluate and select the most suitable Application Layer protocol (such as HTTP, FTP, SMTP, DNS, BitTorrent) as per the requirements of the network application and work with available tools to demonstrate the working of these protocols. | 2 | 2 | 3 | - | - | - | - | 2 | 2 | 1 | - | 2 | - | 1 | 2 |
| TCS604.4 | Design a Reliable Data Transfer Protocol and incrementally develop solutions for the requirements of Transport Layer | 1 | 1 | - | 3 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | | 2 | 2 | 1 |
| TCS604.5 | Describe the essential principles of Network Layers and use IP addressing to create subnets for any specific requirements | 2 | 2 | 3 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 3 | 1 |
| TCS604.6 | Evaluate and select the appropriate technology to meet Data Link Layer requirements and design a framework to implementing TCP/IP protocol suite. | 2 | 1 | 1 | - | 1 | - | - | 2 | 2 | 1 | - | 3 | - | 2 | - |
| TCS 604 | | 1.6 | 1.66 | 2.33 | 3 | 1.66 | 1 | 1 | 1.5 | 1.5 | 1.16 | 1.25 | 2.5 | 1.5 | 2 | 1.6 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

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|----|-----------------------------|----------------|---------------|-----------------------------------|------------------|------------|
| 1. | Subject Code: | TCS 693 | Course Title: | Full stack web Development | | |
| 2. | Contact Hours: | L: 3 | T: 0 | P: 0 | | |
| 3. | Examination Duration (Hrs): | Theory | | 3 | Practical | |
| 4. | Relative Weight: | CIE | 25 | MSE | 25 | ESE |
| 5. | Credits: | 3 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSC | | | | |

8. Pre-requisite: Programming in Java (TCS 408), Data Base Management Systems (TCS 503)

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| 9. | Course Outcome: | After completion of the course the students will be able to: CO1 Apply HTML and CSS effectively to create interactive websites CO2 Implement client-side scripting using JavaScript to design dynamic websites. CO3 Develop XML, AJAX and JQuery based web applications. CO4 Implement server-side scripting using PHP. CO5 Design PHP application with Database connectivity. CO6 Ability to design and deploy simple web applications using MVC architecture. |
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10. Details of the Course:

| Sl. No. | Contents | Contact Hours |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1 | Unit 1: HTML Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of HTML5. CSS Need for CSS, introduction to CSS, basic syntax and structure, using CSS, type of CSS, background images, | 8 |

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| | colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, Introduction to Bootstrap. | |
| 2 | Unit 2: JavaScript: Client-side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes. Advance JavaScript: JavaScript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, JSON. | 8 |
| 3 | Unit 3: XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas. Ajax: Introduction to Ajax , XMLHttpRequest Methods and Properties, JavaScript code for Ajax , Implementing Ajax techniques with a server scripting language , Handling the Response, Ajax with JSON JQuery: jQuery Introduction, Install and Use jQuery Library, jQuery Syntax, Ajax with jQuery, Load method, jQuery get and getJson methods. | 10 |
| 4 | Unit 4: PHP XAMPP Server Configuration, Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files. Advance Features: Cookies and Sessions, Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables. | 10 |
| 5 | Unit 5: MERN Web Application Deployment, Content Management System (CMS). MERN Stack: MongoDB: Overview, Environment, Data Modelling, Database Operations. Express: Installing ExpressJS, Environment, Routing React: React Intro, React Lifecycle, Building Forms using React, states and components. Node: Install node, simple server, HTML and JSON Response. | 10 |
| | Total | 46 |

Textbooks:

| Authors Name | Title | Edition | Publisher, Country | Year |
|--------------|----------------------------------------------------------------|-------------------------|-------------------------|------|
| Robin Nixon | Learning PHP, MySQL, JavaScript, CSS & HTML5 | 3 rd Edition | O'Reilly, International | 2014 |
| Azat Mardan | Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. | 2 nd Edition | Apress, International | 2018 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|------------------------------------------|------------------------------------------------------------|-------------------------|-----------------------------------------------------------|------|
| Fritz Schneider, Thomas Powell | JavaScript – The Complete Reference | 3 rd Edition | McGraw Hill, International | 2017 |
| Steven Holzener | PHP – The Complete Reference | 1 st Edition | Mc-Graw Hill, International | 2017 |
| Robin Nixon | Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5 | 1 st Edition | Shroff Publishers & Distributors Private Limited - Mumbai | 2015 |
| Paul Deitel, Harvey Deitel, Abbey Deitel | Internet & World Wide Web - How to Program | 6 th Edition | Pearson Education, International | 2020 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|------------------------------------------------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| TCS693.1 | Apply HTML and CSS effectively to create interactive websites | 2 | 1 | 1 | - | - | - | - | 1 | - | - | - | - | 3 | 1 | 1 |
| TCS693.2 | Implement client-side scripting using JavaScript to design dynamic websites. | - | - | 2 | 3 | 2 | - | - | - | 2 | 2 | 1 | 2 | 1 | 2 | 3 |
| TCS693.3 | Develop XML, AJAX and JQuery based web applications. | 1 | 1 | 3 | - | 2 | - | - | 1 | - | 2 | - | 1 | 2 | 1 | 1 |
| TCS693.4 | Implement server-side scripting using PHP. | - | 2 | - | 2 | 1 | - | - | 2 | 1 | 1 | 1 | - | 1 | 2 | 1 |
| TCS693.5 | Design PHP application with Database connectivity. | - | - | 3 | 1 | 2 | - | - | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 1 |
| TCS693.6 | Ability to design and deploy simple web applications using MVC architecture | - | 2 | 2 | 3 | 3 | - | - | 1 | 2 | 1 | 1 | - | 2 | 2 | 3 |
| TCS 693 | | 0.2 | 1.66 | 2 | 2 | - | - | - | 1.2 | 1.5 | 1.4 | 1 | 1.66 | 2 | 2 | 2 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

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|----|-----------------------------|-----------------------------------------------------------------------------------------|--------------------|----------------------------|--|--|
| 1. | Subject Code: | PCS 601 | Course Title: | Compiler Design Lab | | |
| 2. | Contact Hours: | L: 0 | T: 0 | P: 2 | | |
| 3. | Examination Duration (Hrs): | Theory 0 | Practical 2 | | | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 | | |
| 5. | Credits: | 1 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSC | | | | |
| 8. | Pre-requisite: | Finite Automata and Formal Languages (TCS 402), Computer Programming Lab - II (PCS 251) | | | | |

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| 9. Course Outcome: | After completion of the course the students will be able to: CO1 Construct lexical analyzer and parser layout by using modern tools like Flex and Bison. CO2 Explore the different finite automata problems with the help of tools. CO3 Compare and contrast various parsing techniques such as SLR, CLR, and LALR with the help of bison tool. CO4 Analyse the syntax rules by designing the syntax trees from different aspects of programming languages. |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

10. Details of the Course:

| Sl. No. | List of problems for which student should develop program and execute in the Laboratory | Contact Hours |
|----------------|--------------------------------------------------------------------------------------------------------------------------|----------------------|
| 1. | Design a LEX Code to count the number of lines, space, tab-meta character, and rest of characters in each Input pattern. | 1 |
| 2. | Design a LEX Code to identify and print valid Identifier of C/C++ in given Input pattern. | 1 |
| 3. | Design a LEX Code to identify and print integer and float value in given Input pattern. | 2 |
| 4. | Design a LEX Code for Tokenizing (Identify and print OPERATORS, SEPERATORS, KEYWORDS, IDENTIFERS) in the C-fragment: | 2 |
| 5. | Design a LEX Code to count and print the number of total characters, words, white spaces in given 'Input.txt' file. | 2 |

| | | |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 6. | Design a LEX Code to replace white spaces of 'Input.txt' file by a single blank character into 'Output.txt' file. | 2 |
| 7. | Design a LEX Code to remove the comments from any C-Program given at run-time and store into 'out.c' file. | 2 |
| 8. | Design a LEX Code to extract all html tags in the given HTML file at run time and store into Text file given at run time. | 2 |
| 9. | Design a DFA in LEX Code which accepts string containing even number of 'a' and even number of 'b' over input alphabet {a, b}. | 2 |
| 10. | Design a DFA in LEX Code which accepts string containing third last element 'a' over input alphabet {a, b}. | 2 |
| 11. | Design a DFA in LEX Code to Identify and print Integer & Float Constants and Identifier. | 2 |
| 12. | Design YACC/LEX code to recognize valid arithmetic expression with operators +, -, * and /. | 2 |
| 13. | Design YACC/LEX code to evaluate arithmetic expression involving operators +, -, * and / without operator precedence grammar & with operator precedence grammar. | 2 |
| | Total | 24 |

Text Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|-------------------------------------|------------------------------------------------|---------------------------------|--------------------------------------|------|
| Charles N. Fischer, Richard LeBlanc | Crafting a Compiler with C | 1 st Edition | Pearson Education | 2007 |
| Andrew W Apple | Modern Compiler Implementation in C | 1 st Revised Edition | Cambridge University Press | 2004 |
| Kenneth C. Louden | Compiler Construction: Principles and Practice | 1 st Edition | Course Technology Inc. International | 1997 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|--------------------------------------------|----------------------------------------------|-----------------------------|-------------------------|------|
| Alfred V Aho, Ravi Sethi, Jeffrey D Ullman | Compilers Principles, Techniques, and Tools, | 2 nd Edition, 2e | Pearson Education India | 2023 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|---------------------------------------------------------------------------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| PCS601.1 | Construct lexical analyser and parser layout by using modern tools like Flex and Bison. | 2 | - | 1 | 2 | 3 | - | - | - | 1 | 1 | 1 | 1 | 3 | 1 | 1 |
| PCS601.2 | Explore the different finite automata problems with the help of tools. | - | 1 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 2 | 1 |
| PCS601.3 | Compare and contrast various parsing techniques such as SLR, CLR, and LALR with the help of bison tool. | 1 | 2 | - | 3 | 1 | - | - | - | 1 | - | 1 | 2 | 3 | 1 | 1 |
| PCS601.4 | Analyse the syntax rules by designing the syntax trees from different aspects of programming languages. | - | - | 3 | 1 | 1 | - | - | - | - | - | 1 | - | 3 | 1 | 1 |
| PCS 601 | | 1.5 | 1.5 | 2 | 1.75 | 1.66 | - | - | - | 1 | 1 | 1 | 1.5 | 2.75 | 1.25 | 1 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

| | | | | | | |
|----|-----------------------------|--------------------------------------------------------------------------------------------|--------------------|------------------------------|--|--|
| 1. | Subject Code: | PCS 604 | Course Title: | Computer Networks Lab | | |
| 2. | Contact Hours: | L: 0 | T: 0 | P: 2 | | |
| 3. | Examination Duration (Hrs): | Theory 0 | Practical 2 | | | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 | | |
| 5. | Credits: | 1 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSC | | | | |
| 8. | Pre-requisite: | Fundamental of Computer & Introduction to Programming (TCS101), Computer Networks (TCS604) | | | | |

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|----|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9. | Course Outcome: | After completion of the course the students will be able to: CO1 Understand various components that make up a computer network, including routers, switches, hubs, servers, and clients and learn about the basic commands used troubleshooting. CO2 Design UTP cable for cross and direct connection using crimping tool. CO3 Implement the common network protocols such as TCP/IP, UDP, HTTP, DNS, DHC, FTP and NAT Understand how these protocols function and their role in facilitating communication between devices using network simulation tool like Packet tracer. CO4 Apply the static and dynamic routing concepts in the network core and monitoring network traffic using Wireshark and develop skills in troubleshooting network connectivity issues. CO5 Design network applications using UDP and TCP socket programming concepts and network design principles and test these applications using real or virtual network devices. |
|----|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

10. Details of the Course:

| Sl. No. | List of problems for which student should develop program and execute in the Laboratory | Contact Hours |
|---------|------------------------------------------------------------------------------------------|---------------|
| 1. | Problem Statement 1: Familiarization of Network Environment, Understanding and | 2 |

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| | using network utilities: ipconfig, netstat, ping, telnet, ftp, traceroute etc. | |
| 2. | Problem Statement 2: Familiarization with Transmission media and tools: Co-axial cable, UTP cable, Crimping tool, Connectors etc. Preparing the UTP cable for cross and direct connection using crimping tool. | 2 |
| 3. | Problem Statement 3: Installation and introduction of simulation tool. (Packet Tracer) | 2 |
| 4. | Problem Statement 4: To configure a basic network topology consisting of routers, switches, and end devices such as PCs or laptops. Configure IP addresses and establish connectivity between devices. (Using packet Tracer) | 2 |
| 5. | Problem Statement 5: To configure a DHCP server on a router or a dedicated DHCP server device. Assign IP addresses dynamically to devices on the network and verify successful address assignment. (Using packet Tracer) | 2 |
| 6. | Problem Statement 6: To configure a local DNS server to resolve domain names within a network. (Using packet Tracer) | 2 |
| 7. | Problem Statement 7: NAT (Network Address Translation): Set up NAT on a router to translate private IP addresses to public IP addresses for outbound internet connectivity. Test the translation and examine how NAT helps conserve IPv4 address space. (Using packet Tracer) | 2 |
| 8. | Problem Statement 8: Network Troubleshooting: Simulate network issues such as connectivity problems, incorrect configurations, or routing failures. Use Packet Tracer's simulation mode to diagnose and troubleshoot the network. | 2 |

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| 9. | Problem Statement 9: To monitor network traffic using Wire Shark | 2 |
| 10. | Problem Statement 10: To analyze complete TCP/IP protocol suite layer's headers using Wire Shark | 2 |
| 11. | Problem Statement 11: TCP Client-Server Communication: Implement a TCP client program that sends a message to a TCP server program. Implement the corresponding TCP server program that receives the message and displays it. Test the communication between the client and server by exchanging messages (Using 'C' Language) | 2 |
| 12. | Problem Statement 12: UDP Client-Server Communication: Implement a UDP client program that sends a message to a UDP server program. Implement the corresponding UDP server program that receives the message and displays it (Using 'C' Language) | 2 |
| 1. | Optional programs for advanced learner Problem Statement 1: File Transfer using TCP: Implement a TCP server program that listens for incoming connections. Implement a TCP client program that sends a file to the server. The server should receive the file and save it on the local machine. Verify the successful transfer by comparing the original file with the received file | |

| | | |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| | Problem Statement 2: Chat Application using TCP: 2. Implement a TCP client program for a chat application. Implement the corresponding TCP server program. Multiple clients should be able to connect to the server and exchange messages. Test the chat application by simulating multiple clients communicating with each other. | |
| | Problem Statement 3: DNS Lookup using UDP: 3. Implement a UDP client program that sends a domain name to a DNS server. Implement the corresponding DNS server program that resolves the domain name to an IP address. The server should send the resolved IP address back to the client. Test the program by performing DNS lookups for different domain names | |
| | Problem Statement 4: HTTP Server using TCP: 4. Implement a TCP server program that acts as an HTTP server. The server should be able to handle HTTP requests and send back appropriate HTTP responses. Test the server by accessing it through a web browser and requesting different resources. | |
| | TOTAL | 24 |

Text Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|---------------------|-----------------------------------|-------------------------|---------------------------|-------------|
| Forouzan | Data Communication and Networking | 5 th Edition | McGraw Hill | 2017 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|---------------------|--------------------------------------------|-------------------------|---------------------------|-------------|
| Ross and Kurose | Computer Networking: "A Top-Down Approach" | 7 th Edition | Pearson/Addison-Wesley | 2017 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| PCS604.1 | Understand various components that make up a computer network, including routers, switches, hubs, servers, and clients and learn about the basic commands used troubleshooting. | | | | | | | | | | | | | | | |
| PCS604.2 | Design UTP cable for cross and direct connection using crimping tool. | | | | | | | | | | | | | | | |
| PCS604.3 | Implement the common network protocols such as TCP/IP, UDP, HTTP, DNS, DHC, FTP and NAT. Understand how these protocols function and their role in facilitating communication between devices using network simulation tool like Packet tracer. | | | | | | | | | | | | | | | |
| PCS604.4 | CO4 Apply the static and dynamic routing concepts in the network core and monitoring network traffic using Wireshark and develop skills in troubleshooting network connectivity issues. | | | | | | | | | | | | | | | |
| PCS604.5 | Design network applications using UDP and TCP socket programming concepts and network design principles and test these applications using real or virtual network devices. | | | | | | | | | | | | | | | |
| PCS 604 | | | | | | | | | | | | | | | | |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

| | | | | | | |
|----|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|------------------|------------|
| 1. | Subject Code: | PCS 693 | Course Title: | Web Development Lab | | |
| 2. | Contact Hours: | L: 0 | T: 0 | P: 2 | | |
| 3. | Examination Duration (Hrs): | Theory | | 0 | Practical | |
| 4. | Relative Weight: | CIE | 25 | MSE | 25 | ESE |
| 5. | Credits: | 1 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSC | | | | |
| 8. | Pre-requisite: | Programming in Java (TCS 408) Programming in Java LAB (PCS 408), Data Base Management Systems (TCS 503), Data Base Management Systems LAB (PCS 503) | | | | |

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| 9. | Course Outcome: | After completion of the course the students will be able to: CO1 Design basic websites using HTML and Cascading Style Sheets. CO2 Develop dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms. CO3 Develop modern interactive web applications using PHP, XML and MySQL CO4 Understand client(JS) and server-side(PHP) scripting and their applicability |
|----|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

10. Details of the Course:

| S. No. | List of problems for which student should develop program and execute in the Laboratory | Contact Hours |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 1. | Basic Html Tags: To create a simple html file to demonstrate the use of different tags. | 1 |
| 2. | Html Tags (List, Table) : To create a simple html file to demonstrate the use of different tags. | 1 |
| 3. | Html Tags (Form) | 1 |
| 4. | Frames & iFrames : To create an html page with different types of frames such as floating frame, navigation frame & mixed frame. | 1 |
| 5. | Map: To create an html page with different types of image | 1 |

| | | |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| | map such as circle, rect , poly & mixed map. | |
| 6. | CSS: Inline, Internal and External Style sheets To create an html file by applying the different styles using inline, external & internal style sheets. | 1 |
| 7. | Input Output In JavaScript: To create an HTML page to explain input and output using a calculator with the use of various predefined functions and objects in JavaScript. | 1 |
| 8. | Window Object methods alert() , prompt() , confirm(), open(), close() , print(): To create an html page to explain the use of various predefined functions in window object in java script. | 1 |
| 9. | Event Handling - Background Colour Change: To create an html page to change the background colour for every click of a button using JavaScript. | 1 |
| 10. | Event Handling - calendar for the month and year by combo box: To create an html page with 2 combo box populated with month & year, to display the calendar for the selected month & year from combo box using JavaScript. | 1 |
| 11. | Window object method setInterval, clearInterval: To create an html page with three buttons START PAUSE and RESET for controlling stopwatch. | 1 |
| 12. | PHP XAMPP Server: Install and configure PHP, web server, MYSQL (XAMPP), Write a program to print "Welcome to PHP", Create a php program to find odd or even number from given number. Write a php program to find maximum of three numbers. | 2 |
| 13. | PHP Basic: Write a program to enter TWO numbers and print the Swap Numbers using PHP Example. | 1 |
| 14. | Form Handling in PHP: Write a PHP Program to demonstrate the variable function: gettype() and settype(),Write a PHP Program to demonstrate the variable unction: isset() ,Write a PHP Program to demonstrate the variable unction: unset() | 2 |
| 15. | Session Handling Using PHP: Create login page using session variables | 2 |
| 16. | Cookies Management: Write PHP program to implement a cookie and session-based counter. Create Cookies variable using PHP, Display the cookies variable using PHP. | 1 |
| 17. | File Uploading Using PHP (To Understand File Uploading in PHP): Create PHP To upload the user input file and using | 1 |

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|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| | constraints file type, file size. | |
| 18. | PHP with MySQL: Write a PHP program to connect to a database and retrieve data from a table and show the details in a neat format, a simple application to Enter data into database, Develop a simple application to Update, Delete table data from database. | 2 |
| 19. | File Handling Using PHP: Write a php program to Read from existing file., Write a php program to Write a file. | 2 |
| | TOTAL | 24 |

Text Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|--------------|----------------------------------------------------------------|-------------------------|--------------------|------|
| Robin Nixon | Learning PHP, MySQL, JavaScript, CSS & HTML5 | 3 rd Edition | O'Reilly | 2014 |
| Azat Mardan | Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. | 2 nd Edition | Apress | 2018 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|------------------------------------------|------------------------------------------------------------|-------------------------|-----------------------------------------------------------|------|
| Fritz Schneider, Thomas Powell | JavaScript – The Complete Reference | 3 rd Edition | McGraw Hill. | 2017 |
| Steven Holzener | PHP – The Complete Reference | 1 st Edition | Mc-Graw Hill | 2017 |
| Robin Nixon | Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5 | 1 st Edition | Shroff Publishers & Distributors Private Limited - Mumbai | 2015 |
| Paul Deitel, Harvey Deitel, Abbey Deitel | Internet & World Wide Web - How to Program | 6 th Edition | Pearson Education. | 2020 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|--------------------------------------------------------------------------------------------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| PCS693.1 | Design basic websites using HTML and Cascading Style Sheets. | - | - | 3 | 1 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| PCS693.2 | Develop dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms. | - | 1 | 3 | 1 | 1 | - | - | - | 1 | 1 | 1 | 2 | 1 | 2 | 3 |
| PCS693.3 | Develop modern interactive web applications using PHP, XML and MySQL | 1 | 1 | 2 | - | 1 | - | - | - | - | 1 | 1 | 2 | 1 | 2 | 2 |
| PCS693.4 | Understand client(JS) and server-side(PHP) scripting and their applicability | 3 | 1 | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | 1 |
| PCS 693 | | 2 | 1 | 2.66 | 1 | 1 | - | - | - | 1 | 1 | 1 | 2 | 1.5 | 1.5 | 1.75 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

| | | | | | | |
|----|-----------------------------|----------------------------------------------------------------------------------------------------|--------------------|---------------------------------------------|--|--|
| 1. | Subject Code: | TCS 691 | Course Title: | Image Processing and Computer Vision | | |
| 2. | Contact Hours: | L: 3 | T: 1 | P: 0 | | |
| 3. | Examination Duration (Hrs): | Theory 3 | Practical 0 | | | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 | | |
| 5. | Credits: | 3 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSE | | | | |
| 8. | Pre-requisite: | Engineering Mathematics-I (TMA 101), Engineering Mathematics-II (TMA201), Any Programming Language | | | | |

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| 9. | Course Outcome: | After completion of the course the students will be able to: |
| | | CO1 Understand the principals the Image Processing terminology used to describe features of images. |
| | | CO2 Understand the mathematical foundations for digital manipulation of images |
| | | CO3 Design, code and test digital image processing applications using MATLAB. |
| | | CO4 Analyse a wide range of problems and provide solutions related to the design of image-processing systems through suitable algorithms, structures, diagrams, and other appropriate methods. |
| | | CO5 Plan and undertake a major individual image processing project. |
| | | CO6 Write programs in Matlab for digital manipulation of images; image acquisition; pre-processing; segmentation. |

10. Details of the Course:

| S. No. | Contents | Contact Hours |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1 | Unit 1: INTRODUCTION TO IMAGE PROCESSING AND COMPUTER VISION: Pixels, Intensity, Coordinate Conventions, Sampling and Quantization, Histogram Analysis, Videos, Image Processing Pipeline, Image Processing and Computer Vision Research Areas: Low- | 9 |

| | | |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| | level, Mid-Level and High-Level Vision. INTRODUCTION TO MATLAB / OCTAVE: Basic Operations, Image / Video handling, Flow Control, Vectorization. INTRODUCTION TO PYTHON: Basic Operations, Lists, Tuples, Strings, Dictionaries, Flow Control, Numpy, Image/Video handling, OpenCV, PIL, Orange. | |
| 2 | Unit 2: IMAGE PROCESSING / LOW-LEVEL VISION: Image Enhancement in Spatial Domain, Image Enhancement in Frequency Domain, Edge Detection, Image Restoration, Color Image Processing, Wavelet Transform, Image Compression, Morphological Image Processing, Colour Image Processing, Stereo Vision, Motion Analysis, Local and Image Features, Visual Saliency | 9 |
| 3 | Unit 3: MID-LEVEL VISION: Hough Transform, Otsu Thresholding, k-means, GraphCut, GrabCut, Normalized Cut, Watersheds, Skeleton Extraction, Object Proposals, Cosegmentation, Background Subtraction in Videos, Motion History Image | 10 |
| 4 | Unit 4: HIGH-LEVEL VISION: Image Classification, Object Localization, Object Recognition, Object Detection, CNN, AlexNet, VGG, GoogleNet, DenseNet, FCN for Semantic Segmentation, YOLO, Image Captioning, generative adversarial networks | 9 |
| 5 | Unit 5: APPLICATIONS OF IMAGE PROCESSING AND COMPUTER VISION: Video Surveillance Systems, Medical Diagnosis, Facial recognition system, Automatic activity recognition system, Fire detection System, traffic sign detection and recognition | 9 |
| | Total | 46 |

Textbooks:

| Authors Name | Title | Edition | Publisher, Country | Year |
|-----------------------------------------------------------|--------------------------------|-------------------------|--------------------|------|
| R. C. Gonzalez, R. E. Woods and S. L. Eddins | Digital Image Processing | 4 th Edition | Pearson. | 2017 |
| R. C. Gonzalez, R. E. Woods and S. L. Eddins , Publisher: | Digital Image Processing using | 2 nd Edition | Pearson | 2017 |

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|----------------------------|-----------------------------------|-------------------------|----------|------|
| | MATLAB | | | |
| Rajalingappa Shanmugamani, | Deep Learning for Computer Vision | 1 st Edition | O Reilly | 2018 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|--------------------------|-----------------------------------------|-------------------------|--------------------|------|
| Antonio Gulli, Sujit Pal | Deep Learning with Keras | 1 st Edition | O Reilly | 2017 |
| Jan Salem | Programming Computer Vision with Python | 1 st Edition | O Reilly | 2012 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----|-----|------|-----|-----|-----|-----|------|------|------|------|------|------|------|
| TCS691.1 | Understand the principals the Image Processing terminology used to describe features of images. | 2 | 2 | - | 1 | 1 | - | - | - | 1 | 1 | - | 2 | 2 | 2 | 1 |
| TCS691.2 | Understand the mathematical foundations for digital manipulation of image | 2 | 2 | - | 1 | 1 | - | - | - | 1 | 1 | - | 2 | 2 | 2 | 1 |
| TCS691.3 | Design, code and test digital image processing applications using MATLAB | 1 | - | 3 | 1 | 3 | - | - | - | 1 | - | 1 | 2 | 3 | 2 | 2 |
| TCS691.4 | Analyse a wide range of problems and provide solutions related to the design of image-processing systems through suitable algorithms, structures, diagrams, and other appropriate methods | 1 | 3 | 1 | - | 2 | - | - | - | - | - | 2 | 1 | 3 | 2 | 1 |
| TCS691.5 | Plan and undertake a major individual image processing project. | 1 | - | 1 | 2 | 2 | - | - | - | 2 | 2 | 2 | 1 | 2 | 1 | 1 |
| TCS691.6 | Write programs in Matlab for digital manipulation of images; image acquisition; pre-processing; segmentation | 1 | 1 | 1 | - | 3 | - | - | - | - | - | - | - | 1 | 1 | 2 |
| TCS 691 | | 1.33 | 2 | 1.5 | 1.25 | 2 | - | - | - | 1.25 | 1.33 | 1.66 | 1.6 | 2.16 | 1.66 | 1.33 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

| | | | | |
|----|-----------------------------|-----------------------------------------------------|--------------------|------------------------|
| 1. | Subject Code: | TCS 651 | Course Title: | DevOps on Cloud |
| 2. | Contact Hours: | L: 3 | T: 1 | P: 0 |
| 3. | Examination Duration (Hrs): | Theory 3 | Practical 0 | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 |
| 5. | Credits: | 3 | | |
| 6. | Semester: | VI | | |
| 7. | Category of Course: | DSE | | |
| 8. | Pre-requisite: | Fundamental of Cloud Computing and Bigdata (TCS351) | | |

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| 9. Course Outcome: | After completion of the course the students will be able to: CO1 Define and understand ideas of DevOps. CO2 Describe and demonstrate how DevOps relate to working in the cloud. CO3 Describe and demonstrate how DevOps tools work together. CO4 Use a public/private cloud environment as a framework to examine the ideas of DevOps. CO5 Examine some use cases, deployment, test automation, continuous delivery, and the public/private cloud toolsets for DevOps. |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

10. Details of the Course:

| S. No. | Contents | Contact Hours |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 1 | Unit 1: An introduction to DevOps, Gain insights of the DevOps environment, DevOps Vs Agile, DevOps Ecosystem. | 9 |
| 2 | Unit 2: Version Control with Git, Install GIT and work with remote repositories, GIT workflows, Branching and Merging in Git. Understand the importance of Continuous Integration, Introduction to Jenkins, Jenkins management. Build and automation of Test using Jenkins and Maven. | 9 |
| 3 | Unit 3: Continuous Testing, learn and Install Selenium, create test cases in Selenium, Integrate Selenium with Jenkins, Continuous Deployment. | 10 |

| | | |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 4 | Unit 4: Introduction to Docker, understanding images and containers, Docker Ecosystem, Introduction to Docker Networking, Monolith and Micro services, features of Micro services Architecture, Advantages of Micro services. | 9 |
| 5 | Unit 5: Introduction of Kubernetes, Kubernetes Architecture, Docker Swarm and Kubernetes, Application deployment using Docker and Kubernetes. | 9 |
| | Total | 46 |

Text Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|------------------------------------------------------|----------------------------------------------------------------------|-------------------------|-------------------------|------|
| Kevin Behr, Gene Kim and George Spafford | The Visible Ops Handbook | 1 st Edition | IT Process Institute | 2004 |
| Michael Hüttermann | DevOps for Developers | 1 st Edition | Apress | 2012 |
| Eliyahu M. Goldratt, Jeff Cox Author, David Whitford | The Goal: A Process of Ongoing Improvement | 1 st Edition | North River Pr | 2012 |
| Ethan Thorpe | Devops: a comprehensive beginners guide to learn devops step by step | 1 st Edition | Independently Published | 2019 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|-----------------------------|-------------------------------------------------------------------------------------|-------------------------|--------------------|------|
| Jez Humble and David Farley | Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment | 3 rd Edition | Addison-Wesley | 2010 |

| | | | | |
|----------|------------------------------------------------------------------------------|-------------------------|---------------------|------|
| | Automation (Addison-Wesley Signature Series (Fowler)) | | | |
| Gene Kim | The Phoenix Project: A Novel about It, Devops, and Helping Your Business Win | 3 rd Edition | It Revolution Press | 2013 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|----------------------------------------------------------------------------------------------------------------------------|------|-----|-----|-----|------|-----|-----|-----|-----|------|------|------|------|------|------|
| TCS651.1 | Define and understand ideas of DevOps. | 3 | 1 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 2 | 1 | 1 |
| TCS651.2 | Describe and demonstrate how DevOps relate to working in the cloud. | 2 | 2 | - | 1 | - | - | - | - | - | 2 | 1 | 2 | 2 | 1 | 2 |
| TCS651.3 | Describe and demonstrate how DevOps tools work together | 2 | 2 | - | - | 3 | - | - | - | - | 1 | - | 2 | 2 | 1 | 1 |
| TCS651.4 | Use a public/private cloud environment as a framework to examine the ideas of DevOps | 2 | 1 | - | 2 | 1 | - | - | - | - | - | 2 | 1 | 2 | 1 | 3 |
| TCS651.5 | Examine some use cases, deployment, test automation, continuous delivery, and the public/private cloud toolsets for DevOps | - | - | 3 | 2 | 3 | - | - | - | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| TCS 651 | | 2.25 | 1.5 | 3 | 1.5 | 2.33 | - | - | - | 1 | 1.25 | 1.25 | 1.4 | 2 | 1 | 1.6 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

| | | | | | | |
|----|-----------------------------|-----------------------------------------------------------------------------------------|--------------------|----------------------------------------|--|--|
| 1. | Subject Code: | TCS 671 | Course Title: | Big data Storage and Processing | | |
| 2. | Contact Hours: | L: 3 | T: 1 | P: 0 | | |
| 3. | Examination Duration (Hrs): | Theory 3 | Practical 0 | | | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 | | |
| 5. | Credits: | 3 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSE | | | | |
| 8. | Pre-requisite: | Fundamental of Cloud Computing and Big data (TCS-351), Big data Visualization (TCS-571) | | | | |

| | | |
|----|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9. | Course Outcome: | After completion of the course the students will be able to: CO1 Understand the concepts and significance of big data, including its capture, management, organization, and analysis CO2 Utilize the HDFS command line interface to interact with the file system, manage data nodes, and work with the data flow. CO3 Describe the concept of MapReduce, its features, types, and formats, and comprehend the workflow of a MapReduce job. CO4 Set up a Hadoop cluster, considering system requirements, and understand the different installation mode CO5 Analyse and manage big data using Hadoop ecosystem tools and techniques, such as HDFS, MapReduce, and NoSQL databases. CO6 Apply critical thinking and problem-solving skills to address technological challenges associated with big data and propose appropriate solutions. |
|----|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

10. Details of the Course:

| S. No. | Contents | Contact Hours |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| 1 | Unit 1: Big Data Overview: Understanding Big Data, Capturing Big Data, benefitting from big data, management of big data, Big Data Architecture and Characteristics, | 10 |

| | | |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| | Organizing big data, Technological Challenges from big data. | |
| 2 | Unit 2: Hadoop Distributed File System (HDFS), HDFS design, HDFS concepts: Data node, name node, Command line interface, File system, Data flow, limitations | 10 |
| 3 | Unit 3: Hadoop I/O: Data integrity, compression, serialization, File based data structures, Concept of Map Reduce, features, types, and formats, Working of Map Reduce: Shuffle and sort, Task execution, Job tracker, task tracker | 9 |
| 4 | Unit 4: Setting up a Hadoop cluster: Basic system requirements, installation and cluster formation, Modes of installation: the standalone, pseudo-distributed, and distributed, purpose of different modes of installations and applications | 9 |
| 5 | Unit 5: Hadoop Eco System and YARN: Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 Features NoSQL Databases: - RDBMS Vs. NoSQL, Types of No SQL Databases, Architecture of NoSQL Databases, CAP Theorem, | 8 |
| | Total | 46 |

Text Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|--------------|----------------------------|-------------------------|-------------------------|------|
| Tom White | Hadoop: A definitive guide | 3 rd Edition | O'Reilly, International | 2012 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|--------------|------------------------------------------|-------------------------|---------------------------------|------|
| Fei Hu | Big Data: Storage, Sharing and Security, | 1 st Edition | CRC Press, Taylor, and Francis. | 2016 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| TCS671.1 | Understand the concepts and significance of big data, including its capture, management, organization, and analysis | 2 | - | 2 | - | 1 | - | - | - | - | - | - | 2 | 3 | 2 | 1 |
| TCS671.2 | Utilize the HDFS command line interface to interact with the file system, manage data nodes, and work with the data flow. | - | 2 | - | 1 | 1 | - | - | - | - | 1 | - | 1 | 2 | 1 | 1 |
| TCS671.3 | Describe the concept of MapReduce, its features, types, and formats, and comprehend the workflow of a MapReduce job. | 1 | 1 | 2 | - | 1 | - | - | - | - | 2 | 1 | 2 | 2 | 1 | 1 |
| TCS671.4 | Set up a Hadoop cluster, considering system requirements, and understand the different installation mode | 1 | 2 | 1 | - | 3 | - | - | - | - | 2 | 1 | 2 | 2 | 2 | 1 |
| TCS671.5 | Analyse and manage big data using Hadoop ecosystem tools and techniques, such as HDFS, MapReduce, and NoSQL databases. | 1 | 3 | 1 | - | 3 | - | - | - | - | 1 | - | 2 | 3 | 2 | 1 |
| TCS671.6 | Apply critical thinking and problem-solving skills to address technological challenges associated with big data and propose appropriate solutions. | 1 | 1 | 3 | 3 | - | - | - | - | 2 | 1 | 2 | 2 | 1 | 3 | 2 |
| TCS 671 | | 1.2 | 1.8 | 1.8 | 2 | 1.8 | - | - | - | 2 | 1.4 | 1.33 | 1.83 | 2.16 | 1.83 | 1.16 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

| | | | | | | |
|----|-----------------------------|------------------------------------|---------------|------------------------------------|------------------|------------|
| 1. | Subject Code: | TCS 619 | Course Title: | Network and System Security | | |
| 2. | Contact Hours: | L: 3 | T: 1 | P: 0 | | |
| 3. | Examination Duration (Hrs): | Theory | | 3 | Practical | |
| 4. | Relative Weight: | CIE | 25 | MSE | 25 | ESE |
| 5. | Credits: | 3 | | | | |
| 6. | Semester: | VI | | | | |
| 7. | Category of Course: | DSE | | | | |
| 8. | Pre-requisite: | Computer system security (TCS 591) | | | | |

| | | |
|----|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9. | Course Outcome: | After completion of the course the students will be able to: CO1 Understand the basics of computer security CO2 Elaborate the cryptographic techniques. CO3 Discuss the transport layer security CO4 Find the pros and cons of various key distribution methods CO5 analyse the wireless Network security CO6 Find the level of system security |
|----|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

10. Details of the Course:

| S. NO. | Contents | Contact Hours |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1 | Unit 1: Introduction Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Models for network security, standards. | 9 |
| 2 | Unit 2: Cryptography Symmetric Encryption and Message Confidentiality Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Random and Pseudorandom Numbers, Stream Ciphers and RC4, Cipher Block Modes of Operation. | 9 |

| | | |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| | Public-Key Cryptography and Message Authentication 61 Approaches to Message Authentication, Secure Hash Functions, Message Authentication Codes, Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures | |
| 3 | Unit 3: Network security Application - I Key Distribution and User Authentication Symmetric Key Distribution Using Symmetric Encryption, Kerberos, Key Distribution Using Asymmetric Encryption, X.509 Certificates, Public-Key Infrastructure, Federated Identity Management Transport-Level Security Web Security Considerations, Secure Socket Layer and Transport Layer Security, Transport Layer Security, HTTPS, Secure Shell (SSH) | 10 |
| 4 | Unit 4: Network security Application - II Wireless Network Security IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Wireless Application Protocol Overview, Wireless Transport Layer Security, WAP End-to-End Security Electronic Mail Security Pretty Good Privacy, S/MIME, DomainKeys Identified Mail, IP Security IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Cryptographic Suites | 8 |
| 5 | Unit 5: System Security Intruders Intruders, Intrusion Detection, Password Management, Malicious Software Types of Malicious Software, Viruses, Virus Countermeasures, Worms, Distributed Denial of Service Attacks. Firewalls The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations, Legal and Ethical Aspects Cybercrime and Computer Crime, Intellectual Property, Privacy, Ethical Issues | 10 |
| | Total | 46 |

Text Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|--------------|-----------------------------|-------------------------|------------------------------|------|
| W. Stallings | Network Security Essentials | 6 th Edition | Prentice Hall, International | 2017 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|-------------------------|-----------------------|-------------------------|------------------------------|------|
| Shari Lawrence Pfleeger | Security in Computing | 4 th Edition | Prentice Hall, International | 2006 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------------|------------------------------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| TCS619.1 | Understand the basics of computer security | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 1 | 1 | 1 |
| TCS619.2 | Elaborate the cryptographic techniques. | - | - | - | 2 | - | - | - | - | - | 1 | - | - | 1 | 1 | 3 |
| TCS619.3 | Discuss the transport layer security | - | - | - | 2 | - | - | - | - | - | - | - | - | 1 | 2 | 1 |
| TCS619.4 | Find the pros and cons of various key distribution methods | - | 2 | - | 1 | - | - | - | 2 | - | 1 | - | 2 | 1 | 1 | 1 |
| TCS619.5 | analyse the wireless Network security | - | 3 | 1 | 1 | 1 | - | - | - | - | - | - | 1 | 3 | 1 | 2 |
| TCS619.6 | Find the level of system security | 3 | 1 | 1 | - | - | - | - | 1 | - | - | - | 1 | 1 | 1 | 2 |
| TCS 619 | | 2.5 | 2 | 1 | 1.5 | 1 | - | - | 1.5 | - | 1 | - | 1.5 | 1.33 | 1.16 | 1.66 |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER VI

Name of Department: - Computer Science and Engineering

| | | | | |
|----|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------------|
| 1. | Subject Code: | TCS 641 | Course Title: | Virtual Reality |
| 2. | Contact Hours: | L: 3 | T: 1 | P: 0 |
| 3. | Examination Duration (Hrs): | Theory 3 | Practical 0 | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 |
| 5. | Credits: | 3 | | |
| 6. | Semester: | VI | | |
| 7. | Category of Course: | DSE | | |
| 8. | Pre-requisite: | NIL | | |
| 9. | Course Outcome: | After completion of the course the students will be able to: CO1 Demonstrate an understanding of techniques, processes, technologies and equipment used in virtual reality CO2 Identify appropriate design methodologies for immersive technology development, especially from a physiological perspective CO3 Exploit the characteristics of human visual perception in Virtual Reality techniques CO4 Provide rendering to VR specific problems CO5 Effectively categorize the benefits/shortcomings of available VR technology platforms. CO6 Discuss the use of geometry in virtual reality | | |

10. Details of the Course:

| S.NO | Contents | Contact Hours |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1 | Unit 1: Introduction: Goals, VR definitions, Birds-eye view (general, hardware, software, sensation and perception), Applications of VR, Technical framework, Mixed and Augmented Reality Geometry of Virtual Worlds: Geometric modelling, Transforming models, Matrix algebra, 2D and 3D rotations, Axis-angle representations, Quaternions, Converting and multiplying rotations, Homogeneous transforms, Eye Transforms, Canonical view transform, Viewport Transform | 9 |

| | | |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 2 | Unit 2: Light and Optics: Interpretations of light, Refraction, Simple lenses, Dioptrics, Imaging properties of lenses, Lens aberrations, Photoreceptors, Sufficient resolution for VR, Light Intensity, Eye movements for VR, Neuroscience of vision | 9 |
| 3 | Unit 3: Visual Perception and Tracking Systems: Depth perception, Motion Perception, Frame rates and displays, Orientation Tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach | 9 |
| 4 | Unit 4: Visual Rendering: Shading models, rasterization, Pixel shading, VR specific problems, Distortion shading, Post-rendering image wrap | 9 |
| 5 | Unit 5: Audio: Physics and physiology, Auditory perception, Auditory Localization, Rendering, Spatialization and display, Combining other senses, Spatial Sound Interfaces: Locomotion, Manipulation, System Control, Social Interaction, VR Engines and Other Aspects of VR, Evaluation of VR systems | 9 |
| Total | | 45 |

Text Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|----------------------------|-----------------------------------------|-------------------------|----------------------------|------|
| Grigore C. Burdea, Coiffet | Virtual Reality Technology (IEEE Press) | 2 nd Edition | Wiley-IEEE Press | 2003 |
| Marschner, Shirley | Fundamentals of Computer Graphics | 4 th Edition | CRC Press | 2016 |
| Steven M. LaValle | Virtual Reality | 1 st Edition | Cambridge University Press | 2023 |

Reference Books:

| Authors Name | Title | Edition | Publisher, Country | Year |
|-------------------------------|-----------------------------------------------------------------------------|-------------------------|--------------------|------|
| Kay M. Stanney, Kelly S. Hale | Handbook of Virtual Environments: Design, Implementation, and Applications, | 2 nd Edition | CRC Press Inc. | 2014 |

Course Articulation Matrix

| CO | Statement | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | |
|----------------|-----------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|-------------|-----|-----|-----|-------------|-------------|-------------|-------------|----------|------------|-------------|---|
| TCS641.1 | Demonstrate an understanding of techniques, processes, technologies and equipment used in virtual reality | 1 | - | 2 | 1 | 2 | - | - | - | 1 | - | 2 | 1 | 1 | 1 | 2 | |
| TCS641.2 | Identify appropriate design methodologies for immersive technology development, especially from a physiological perspective | - | - | - | 1 | - | - | - | - | 2 | 2 | 2 | 2 | 3 | 1 | 1 | |
| TCS641.3 | Exploit the characteristics of human visual perception in Virtual Reality techniques | 1 | - | - | 1 | 1 | - | - | - | 1 | - | - | 1 | 3 | 2 | 1 | |
| TCS641.4 | Provide rendering to VR specific problems | - | - | - | - | 3 | - | - | - | - | - | - | - | 1 | 2 | 2 | 1 |
| TCS641.5 | Effectively categorize the benefits/shortcomings of available VR technology platforms. | 1 | - | - | 1 | 3 | - | - | - | 1 | 1 | 1 | 2 | 2 | 2 | 1 | |
| TCS641.6 | Discuss the use of geometry in virtual reality | - | 3 | - | - | - | - | - | - | - | 2 | 2 | 3 | 1 | 1 | 1 | |
| TCS 641 | | 1 | 3 | 2 | 1 | 2.25 | - | - | - | 1.25 | 1.66 | 1.75 | 1.66 | 2 | 1.5 | 1.16 | |

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)