

**DEPARTMENT OF INFORMATION TECHNOLOGY**

**NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR**



**ELECTIVE SYLLABUS**

**FOR**

**B. TECH. INFORMATION TECHNOLOGY**

**2023 BATCH**

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Management Information Systems	ITT001	2-0-0-2
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
C01	<u>Examine</u> the MIS and its importance in various applications.	4
C02	<u>Assess</u> and <u>illustrate</u> decision making and its role in business.	5
C03	<u>Design</u> and <u>development</u> of information systems.	6
C04	<u>Developing</u> applications for the digital firm.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction to MIS:</b> Information Systems: Need of Information Systems, Case Studies, Data, Information and Knowledge, Examples. Management Information Systems: Need, Objectives, Levels of MIS – Operational level, Management level and Strategic level, Approaches to MIS – Technical, Behavioural, Socio-technical. IT Infrastructure for MIS: IT Infrastructure Services, Evolution of IT Infrastructure, IT Infrastructure components, Emerging technologies for IT Infrastructure, Case Studies and architecture.	<b>6</b>
<b>Module 2</b>	<b>Decision Making and Business Intelligence:</b> Decision Making: Decision making and information systems, Business value of improved decision making, Types of decisions, Decision making process, Automated decision making. Business Intelligence: Business Intelligence Environment, Business Intelligence Technology: Data Warehousing, Enterprise Resource Planning, Customer Relationship Management, Analytics capabilities, Management strategies for developing Business Intelligence, Decision Support System.	<b>8</b>
<b>Module 3</b>	<b>Information System Design and Development:</b> Systems as planned organizational change: Systems development and organizational change, Business process redesign. System development: System analysis, System design, System development process. Modelling and designing systems: Structured and object oriented methodologies.	<b>8</b>

	System design approaches: Traditional systems life cycle, Prototyping, End user development, Application software packages and outsourcing.	
<b>Module 4</b>	<p><b>Application development for the digital firm:</b>  Application development: Rapid Application Development (RAD), Component based development and web services, Mobile application development.  MIS projects/ Case Studies: Management decision problems, Improving decision making: using database software to design a customer System, Achieving operational excellence: analyzing information flow in MIS system.  Tools and techniques for the development of web based MIS systems.</p>	<b>6</b>

**Books Recommended:**

1. Lauaon Kenneth & Landon Jane, "Management Information Systems: Managing the Digital firm".
2. Uma G. Gupta, "Management Information Systems – A Management Prespective", Galgotia publications Pvt., Ltd.
3. Louis Rosenfel and Peter Morville, "Information Architecture for the World wide Web", O'Reilly Associates.

**Other Books Recommended:**

1. Steven Alter, "Information Systems – A Management Perspective".
2. Uma Gupta, "Information Systems – Success in 21st Century".
3. Robert G. Murdick, Joel E. Ross and James R. Claggett, "Information Systems for Modern Management".

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Software Project Management	ITT002	2-0-0-2
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

<b>COs</b>	<b>Course Outcome</b>	<b>Bloom's Taxonomy Level</b>
<b>CO1</b>	<u>Determining</u> the integration of Project Management principles into the software development process.	<b>5</b>
<b>CO2</b>	<u>Demonstrating</u> the application of basic project management concepts, frameworks, and process models in practical scenarios.	<b>2</b>
<b>CO3</b>	<u>Evaluate</u> software process models and software effort estimation techniques to comprehend their intricacies and potential applications. <u>Assess</u> and <u>anticipate</u> risks associated with different project activities, considering factors such as scope, timeline, and resource allocation.	<b>6</b>
<b>CO4</b>	<u>Assess</u> and define checkpoints within the project timeline, establish a robust project reporting structure, and implement effective project progress and tracking mechanisms, drawing upon project management principles. <u>Analyze</u> the staff selection process and identify issues related to people management, such as team dynamics, conflict resolution, and motivation strategies.	<b>5</b>

**Detailed Syllabus:**

<b>Module No.</b>	<b>Contents</b>	<b>Hours</b>
<b>Module 1</b>	<b>PROJECT EVALUATION AND PROJECT PLANNING:</b> Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost- benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	<b>6</b>
<b>Module 2</b>	<b>PROJECT LIFE CYCLE AND EFFORT ESTIMATION:</b> Software process and Process Models – Choice of Process models - mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II A Parametric Productivity Model - Staffing Pattern.	<b>8</b>
<b>Module 3</b>	<b>ACTIVITY PLANNING AND RISK MANAGEMENT:</b> Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring –	<b>8</b>

	PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.	
<b>Module 4</b>	<p><b>PROJECT MANAGEMENT AND CONTROL:</b> Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking – Change control- Software Configuration Management – Managing contracts – Contract Management.</p> <p><b>STAFFING IN SOFTWARE PROJECTS:</b> Managing people – Organizational behaviour – Best methods of staff selection – Motivation – The Oldham-Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures – Virtual teams – Communications genres – Communication plans.</p>	<b>6</b>

**Books Recommended:**

1. Pankaj Jalote: Software Project Management in Practice 1st Edition.
2. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management - Fifth Edition, Tata McGraw Hill, New Delhi.

**Other Books Recommended:**

1. Robert K. Wysocki Effective Software Project Management – Wiley Publication.
2. Walker Royce: Software Project Management- Addison-Wesley.

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Realtime Operating System	ITT003	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Operating System.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
C01	<u>Examine</u> the fundamental concepts of Real-Time Operating Systems (RTOS), including their structure, key components, and essential characteristics, fostering a foundational comprehension of real-time system operation.	4
C02	<u>Illustrate</u> examples and demonstrations of process management principles and scheduling policies utilized in operating systems, showcasing their functionality and significance within the system architecture.	2
C03	<u>Analyzing</u> synchronization and memory management techniques in OS, <u>explaining</u> their importance and how they work to manage resources efficiently.	4
C04	<u>Implement</u> I/O operations, manage interrupts, and develop device drivers in an operating system environment, demonstrating practical understanding and proficiency in handling input/output processes and ensuring device functionality.	3

#### Detailed Syllabus:

Module No.	Contents	Hours
<b>Module 1</b>	<b>INTRODUCTION TO OS AND RTOS:</b> Operating system objectives, architecture and functions, Evolution of operating systems, Batch, multi programming. Multitasking, Multiuser, parallel, distributed & real-time O.S. <b>PROCESS MANAGEMENT OF OS/RTOS:</b> Process, thread, lifecycle of a process, Context Switching Basic Scheduling algorithms in O.S. Real Time Task Scheduling: Process state and scheduling, Clock driven and Event driven scheduling, Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Fault-Tolerant Scheduling. UNIX Multilevel feedback queue scheduling, Thread Scheduling, Multiprocessor Scheduling concept, Real Time Scheduling concepts.	<b>8</b>
<b>Module 2</b>	<b>PROCESS SYNCHRONIZATION:</b> Principles of Concurrency, Mutual Exclusion, Semaphores and Mutex, Message Passing, Monitors, Some Classical Problems of Synchronization, Handling resource sharing and dependencies among real time tasks: Resource sharing Protocols: Priority Inheritance Protocol, Highest locker protocol, priority ceiling protocol, Priority Inversion, Issues in resource sharing protocols. Inter-process Communication: Signals, Shared Memory Communication, Message-Based Communication.	<b>13</b>

<b>Module 3</b>	<b>MEMORY &amp; I/O MANAGEMENT:</b> Memory Management: Requirements, partitioning. Memory allocation Strategies, Fragmentation, Swapping, Segmentation, Paging, Virtual Memory, Demand paging, Page Replacement Policies. Real-time Memory Management: Process Stack Management, Dynamic Allocation. Evaluating and Optimizing Operating System Performance: Effects of scheduling, Response-time Calculation, Interrupt latency, Time-loading, Memory Loading, Power Optimization. Strategies for Processes, Advanced Configuration and Power Interface. I/O Operations: Synchronous and Asynchronous I/O, Interrupt Handling, Details on Device Drivers.	<b>13</b>
<b>Module 4</b>	<b>RTOS APPLICATION DOMAINS:</b> Comparison and study of RTOS: Vxworks and $\mu$ COS – Case studies: RTOS for Image Processing – Embedded RTOS for voice over IP – RTOS for fault Tolerant Applications – RTOS for Control Systems.	<b>8</b>

**Books Recommended:**

1. Silberschatz, Peter Galvin, Greg Gagne “Operating System Principles”.
2. William Stallings, “Operating Systems – internals and design principles”, Prentice Hall.
3. Andrew S. Tannenbaum & Albert S. Woodhull, “Operating System Design and Implementation”, Prentice Hall.
4. Andrew S. Tannenbaum, “Modern Operating Systems”, Prentice Hall.

**Other Books Recommended:**

1. Real-time Operating Systems: The engineering of real-time embedded systems) by Jim Cooling.

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Embedded Systems	ITT004	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
100 Marks	26 Marks	24 Marks	50 Marks

**Pre-requisites:** C programming, Basic Electronics, Digital Electronics.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Determining</u> differences between the general computing system and the embedded system, also recognize the classification of embedded systems.	5
CO2	<u>Analyzing</u> the architecture and instruction set of 8051 Processor and PIC-18.	4
CO3	<u>Developing</u> a robust proficiency in programming embedded systems, encompassing the creation, optimization, interrupt handling and troubleshooting of software tailored for embedded devices.	6
CO4	<u>Analyzing</u> a comprehensive understanding of embedded system design by exploring fundamental principles, programming, accompanied by practical examples that demonstrate the real-world application of these concepts.	4

#### Detailed Syllabus:

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction to Fundamentals:</b> Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	<b>8</b>
<b>Module 2</b>	<b>8051 Processor Architecture and Instruction Set:</b> 8051 Processor Architecture And Instruction Set: The CPU, Addressing modes, external addressing, Interrupt handling, Instruction execution, Instruction set – data movement; arithmetic; bit operators, branch.	<b>13</b>
<b>Module 3</b>	<b>Software Development Tools and Hardware Features for 8051:</b> Software development tools like assemblers; simulators; cross-compilers, O/P file formats. Device packaging, Chip technology, Power considerations, Reset, System clock/oscillators, Parallel I/O, Timers, Interrupts, Serial I/O, Control store and External memory devices. <b>Communication and Interfacing with Hardware:</b>	<b>13</b>

	<p>Pic Microcontrollers and Instruction Set: PIC-18 architecture, File selection register, Memory organization, Addressing modes, Instruction set.</p> <p><b>Interrupt handling in PIC-18:</b> Reset, low power operations, oscillator connections, I/O ports, Timers, Interrupts, ADC. Interfacing an LCD to the 8051, 8051 interfacing to ADC, Sensors, Interfacing a Stepper Motor,</p> <p><b>8051 Microcontroller Interfacing Techniques:</b> 8051 interfacing to the keyboard, Interfacing a DAC to the 8051, 8255 Interfacing with 8031/51, 8051/31 interfacing to external memory.</p>	
<b>Module 4</b>	<p><b>Embedded Software:</b> Programming embedded systems in assembly and C – Meeting real time constraints –Multi-state systems and function sequences. Embedded software development tools –Emulators and debuggers.</p> <p><b>Embedded System Design:</b> Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design. Design Examples: Telephone PBX- System Architecture, Ink jet printer - Hardware Design and Software Design, Personal Digital Assistants, Set-top Boxes.</p>	<b>8</b>

**Text Books:**

1. Andrew N Sloss, D. Symes and C. Wright, “ARM system developers guide”, Morgan Kaufman/ Elsevier.
2. Michael J. Pont, “Embedded C”, Pearson Education.

**Reference Books:**

1. Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, Steve Heath.
2. 8051 Microcontroller and Embedded System, M.A Mazidi, J.C. Mazidi

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Simulation using Matlab and Python	ITL005	1-0-2-2
3 <sup>rd</sup> Year (6 <sup>th</sup> Semester)	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
<b>Evaluation Policy</b>	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Articulate</u> the basics of the Matlab environment. Study various conditional loops and functions in Matlab	3
CO2	<u>Analyze</u> and <u>evaluate</u> the advanced functionalities of Matlab	5
CO3	<u>Criticize</u> the basic operations, loops and functions of Python	5
CO4	<u>Review</u> the file and exception handling in Python	2

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>INTRODUCTION TO MATLAB</b> Introduction to the basic environment, data types, Numbers, Arithmetic Operations and Special Characters, Vectors and Matrices, colon notation, strings and arrays  <b>CONDITIONALS AND FUNCTIONS:</b> Decision, conditionals, loops, scripts and functions, solving non-linear problems, Data import and output.	<b>8</b>
<b>Module 2</b>	<b>ADVANCED FUNCTIONALITIES</b> Plotting, graphics, algebra, calculus, Integration, differential, polynomials and transforms.	<b>6</b>
<b>Module 3</b>	<b>INTRODUCTION TO PYTHON:</b> Why Python? Basic syntax, variable types, basic operations, conditional statements, looping, control statements.	<b>6</b>

<b>Module 4</b>	<b>DATA MANIPULATION AND FUNCTIONS:</b> String manipulation, List, Tuple, Dictionary, Functions, searching and sorting, Modules. <b>FILES AND EXCEPTION HANDLING:</b> Opening and closing files, reading and writing files, functions specific to files, Exceptions, Exception handling, User-defined exceptions	<b>8</b>
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**Books Recommended:**

1. MATLAB: Easy Way of Learning by S. Swapna Kumar
2. Learning MATLAB: A Problem Solving Approach by Walter Gander
3. Learning Python by Mark Lutz, David Ascher
4. Beginning Python by M. L. Hetland

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	<b>Geographical Information System</b>	<b>ITT006</b>	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Database Management Systems.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Apply</u> the basics and usage of Geographical Information Systems, Use GIS to identify, explore, understand, and solve spatial problems of demarcation of earth.	3
CO2	<u>Design</u> and <u>implementation</u> of earth-based spatial database systems.	6
CO3	<u>Capture</u> , pre-processing, and <u>analysis</u> of spatial data of land and environmental problems using GIS.	4
CO4	<u>Evaluate</u> Spatial information visualization techniques and internet-based representation of data, Emerging trends in GIS.	5

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<p><b>INTRODUCTION TO GIS</b></p> <p>Introduction to GIS, History of GIS, Early developments in GIS, Applications of GIS. Basic GIS components: hardware, software, and data.</p> <p><b>MAP AND MAP SCALES</b></p> <p>Introduction to Maps, History of Maps, Map Scales, Types of Maps, Map and Globe. Georeferencing and Projection: Understanding Earth, Coordinate System, Map Projection, Transformation, Georeferencing.</p>	<b>13</b>
<b>Module 2</b>	<b>SPATIAL DATA INPUT AND EDITING</b>	<b>8</b>

	Primary Data, Secondary Data, Data Editing. Spatial Analysis: Introduction to spatial analysis, Vector Operations and Analysis, Network Analysis, Raster Data Spatial Analysis.	
<b>Module 3</b>	<p><b>SPATIAL DATABASE MANAGEMENT SYSTEMS</b></p> <p>Introduction. Data Storage, Database Structure Models, Database Management system, Entity Relationship Model, Normalization. Data Models and Data Structures: Introduction, GIS Data Model, Vector Data Structure, Raster Data structure, Geodatabase and metadata.</p>	<b>8</b>
<b>Module 4</b>	<p><b>CURRENT AND EMERGING TRENDS IN GIS:</b></p> <p>Introduction, Map layout, Data presentation, Toposheet Indexing, Distribution Maps. Software tools and platforms used in GIS: ArcGIS, QGIS, and open-source GIS technologies. Emerging trends and applications of GIS: spatial data analytics, machine learning in GIS, Integration of GIS with emerging technologies like virtual reality, and augmented reality. Web GIS: Introduction to Web GIS, OGC Standards and services.</p>	<b>13</b>

**Books Recommended:**

1. Lo, C.P. and Albert Yeung “Concepts and Techniques of GIS”., 2<sup>nd</sup> Edition, Prentice Hall.
2. Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., Geographic Information Systems and Science.
3. Software Training: Gorr, W. and Kurland, K. GIS Tutorial: Workbook for ArcView 9.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	E-Health	ITT007	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Examine</u> e-Health and its applications.	4
CO2	<u>Analyze</u> the basics of telemedicine	4
CO3	<u>Apply</u> and <u>analyze</u> different sub-domains of telemedicine	4
CO4	<u>Evaluate</u> security aspects of e-Health .	5

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>INTRODUCTION</b> What is e-Health? Concepts and definitions. Types of e-Health applications. History of IT in healthcare. Success factors and barriers to e-Health implementation.	<b>8</b>
<b>Module 2</b>	<b>TELEMEDICINE</b> History of Telemedicine, Block diagram of telemedicine system, Definition of telemedicine, Telehealth, Tele care, origins and Development of Telemedicine, Scope, Benefits and limitations of Telemedicine.	<b>8</b>
<b>Module 3</b>	<b>TELEMEDICINE SYSTEM</b> Teleradiology: Basic parts of Teleradiology system: Image Acquisition system, Display system, Communication network, Interpretation. Tele Pathology: Multimedia databases, color images of sufficient resolution: Dynamic range, spatial resolution, compression methods, Interactive control of colour, Controlled sampling, security and confidentiality tools. Tele cardiology, Teleoncology, Telesurgery..	<b>13</b>
<b>Module 4</b>	<b>SECURITY</b>	<b>13</b>

	Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, Phases of Encryption. Protocols: TCP/IP, OSI, Standards to BE followed DICOM, HL7. Ethical and legal aspects of E-Health/Telemedicine: Confidentiality and Law, patient rights and consent, access to medical Records, Consent treatment, jurisdictional Issues, Intellectual property rights. Future prospects in e-Health.	
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**Books Recommended:**

1. Olga Ferrer-Roca, M.Sosa Ludicissa, Handbook of Telemedicine, IOS press.
2. A.C.Norris, Essentials of Telemedicine and Telecare, John Wiley & Sons.
3. The Patient Will See You: The Future of Medicine is in Your Hands, by Eric Topol

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	System Design	ITT008	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Apply</u> the basic concepts of System development life cycle.	3
CO2	<u>Analyze</u> the feasibility analysis of a system.	4
CO3	<u>Evaluate</u> the building of general and detailed models that assist programmers in implementing a system.	5
CO4	<u>Simulate</u> the operational details of a system.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>INTRODUCTION</b> Overview of system analysis and design, Business system concepts, system development life cycle, project selection, feasibility analysis, design implementation testing, and evaluation.	<b>8</b>
<b>Module 2</b>	<b>FEASIBILITY STUDIES</b> Technical and economic feasibility, cost and benefit analysis, system requirement specification and analysis, fact-finding techniques. Draw flow diagrams, data dictionaries, process organization and interaction, decision trees and table: structural English advanced modeling methods, ER Diagram & DFDS, Entity-relationship model.	<b>13</b>
<b>Module 3</b>	<b>PROJECT SELECTION</b> Source of project requests, managing project review, and selection, preliminary investigation.	<b>8</b>

<b>Module 4</b>	<p><b>DETAILED DESIGN</b></p> <p>Modularization, module specification, files design, system development involving database, program design, practical design, System control, and quality assurance, system administration and training, conversion and operation plans hardware and software selection.</p>	<b>13</b>
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**Books Recommended:**

1. Raja Raman. V. "System analysis and design", Prentice-Hall.
2. Murdic, r.g. rose, j.e. & claggt, J.R. "Information systems for modern management", Prentice-Hall India.
3. Wigardes. K. Svenson, A. Sehong, L.A. & Dahlgren, G., "Structured Analysis and Design of Information System", McGraw Hill Book Company.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Network Management & Administration	ITT009	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Computer Networks.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Articulate</u> the fundamental concepts of networking, including network management goals, organizational structures, and key functions, demonstrating comprehension of the principles underlying effective network administration and optimization.	3
CO2	<u>Apply</u> the concept of ASN.1 and encode the data representation.	3
CO3	<u>Examine</u> SNMP communication model and analyse its operation.	4
CO4	<u>Analyze</u> the Management of Ethernet, RMON and broadband networks.	4

**Detailed Syllabus:**

Module No.	Contents	Hours
Module 1	<b>Fundamentals of Networks:</b> LAN Administration, Monitoring file use, virus scanning, printer & Storage Management, Tracking network activity.	8
Module 2	<b>LAN Restoration Planning:</b> Network Reliability and Availability, Recovery Options, Server Restoration, data protection, Load Balancing.	13
Module 3	<b>Storage Network Management:</b> SAN, SAN Management, Role of IP, Storage virtualization.	13
Module 4	<b>Managing Wireless Infrastructure:</b> Mobile IP, Performance Monitoring, setting SNMP Traps, Managing Voice Systems: Centralised Vs. distributed, Virtual networks, VPN architecture.	8

**Books Recommended:**

1. Nathan J. Muller, "LANs to WANs the complete management guide"
2. William Stallings, "SNMP, SNMPv2, SNMPv3 and RMON 1 and 2", Addison Wesley

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Parallel Programming	ITT010	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Operating System, Computer Architecture.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Examine</u> the issues in parallel computing.	4
CO2	<u>Analyze</u> distributed memory programming using MPI.	4
CO3	<u>Illustrating</u> the shared memory paradigm with Pthreads and with OpenMP.	4
CO4	<u>Evaluating</u> GPU based parallel programming using OpenCL and CUDA.	5

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>FOUNDATIONS OF PARALLEL PROGRAMMING:</b> Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware-SIMD – MIMD – Interconnection networks – cache coherence –Issues in shared memory model and distributed memory model –Parallel Software- Caveats- coordinating processes/ threads- hybrid model – shared memory model and distributed memory model - I/O – performance of parallel programs— parallel program design.	<b>6</b>
<b>Module 2</b>	<b>DISTRIBUTED MEMORY PROGRAMMING WITH MPI:</b> Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMDprograms– MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication -MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm	<b>9</b>
<b>Module 3</b>	<b>SHARED MEMORY PARADIGM WITH PTHREADS:</b> Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety-Pthreads case study.  <b>SHARED MEMORY PARADIGM WITH OPENMP:</b> Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive –	<b>18</b>

	loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search	
<b>Module 4</b>	<b>GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA:</b> Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command-Queue - Event Object - case study. Introduction to CUDA programming.	<b>9</b>

**Books Recommended:**

1. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, —OpenCL programming guidel, Addison Wesley, 2011
2. M. J. Quinn, —Parallel programming in C with MPI and OpenMPI, Tata McGraw Hill, 2003.
3. Peter S. Pacheco, —An introduction to parallel programmingl, Morgan Kaufmann, 2011
4. Rob Farber, —CUDA application design and developmentl, Morgan Haufmann, 2011.
5. W. Gropp, E. Lusk, and A. Skjellum, —Using MPI: Portable parallel programming with the message passing interfacel, Second Edition, MIT Press, 1999

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Bioinformatics	ITT011	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

<b>COs</b>	<b>Course Outcome</b>	<b>Bloom's Taxonomy Level</b>
<b>CO1</b>	<u>Examine</u> the basis of genes and proteins.	<b>4</b>
<b>CO2</b>	<u>Determine</u> knowledge of sources of sequences and protein structure data.	<b>3</b>
<b>CO3</b>	<u>Analyze</u> the data generating technique.	<b>4</b>
<b>CO4</b>	<u>Evaluate</u> basic algorithms used for processing and analyzing genomic data.	<b>5</b>

**Detailed Syllabus:**

<b>Module No.</b>	<b>Contents</b>	<b>Hours</b>
<b>Module 1</b>	<b>Basics of Bioinformatics</b> Bioinformatics: an Overview, Definition and History; Information Networks: Internet in Bioinformatics, Evolution of Bioinformatics: Scope, Potentials of Bioinformatics, Human Genome Project. Introduction to Biological Databases: NCBI, EMBL, PIR, SWISS-Prot, PubChem, Compound, KEGG-Pathway, ChEMBL, BindingDB; Analysis of Three Dimensional Structures of Proteins: RCSB-PDB; Primary and Secondary database ; Various file formats for bio-molecular sequences: genbank, fasta, gcg, msf, nbrf-pir etc. Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues ; Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series.	<b>8</b>
<b>Module 2</b>	<b>Computational methods for sequence analysis</b> Pairwise and Multiple sequence alignments: basic concepts of sequence alignment, Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results. Sequence-based Database Searches: what are sequence-based database searches, BLAST and FASTA algorithms, various versions of basic BLAST and FASTA. Phylogeny: Phylogenetic analysis, Definition and description of phylogenetic trees and various types of trees, Method of construction of Phylogenetic trees [distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method]; Codon usage analysis and its implications in modern biology.	<b>13</b>
<b>Module 3</b>	<b>Programming for Bioinformatics</b> Introduction to PERL as scripting language; variables; Array; Initialization and manipulation. Arithmetic and logical operators; Conditional statement and	<b>13</b>

	Loops; Regular Expressions; Function and subroutines. Application of PERL in Bioinformatics; concatenating DNA fragments; DNA to RNA; Reading protein. Files: Finding motifs; ORFs; DNA to protein. Use of R-Programming for statistical analysis, data structure, regex, functions, loops and if statement	
<b>Module 4</b>	<p><b>Genomics and Proteomics</b></p> <p>Nucleic acids and their structure; synthesis, modification and repair of DNA; repetitive and unique DNA sequences; split genes, overlapping genes and pseudo-genes. Plasmids, IS elements; transposons and retro-elements. Gene Identification: Genome information and special features, coding sequences (CDS), untranslated regions (UTR's), cDNA library, expressed sequence tags (EST). Gene expression and DNA Microarray: Introduction, Basic steps for gene expression, concept of microarrays; gene expression analysis, Public Microarray data sources. DNA sequencing methods: manual and automated methods. Chain termination method; Basecalling and sequence accuracy. Quality assessment, NGS data assembly, annotation, Polymorphisms, Single Nucleotide Polymorphisms (SNPs). Proteomics: Definition–Transcriptomics; Proteomics, metabolomics. Techniques of proteomics – 2D PAGE, Mass spectrophotometer–(MALDI–TOF) MS, Protein Micro array in protein expression, profiling</p>	<b>8</b>

**Books Recommended:**

1. Methods of Biostatistics by T. Bhaskara Rao.
2. Introduction to database system by J. M. Martin, Prentice-Hall.
3. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck).
4. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J)

**Other Books Recommended:**

1. Bioinformatics; Methods and applications; Genomics, Proteomics and Drug Discovery; (Rastogi, S. C. and Mendiratta and Rastogi, P.
2. Bioinformatics; A practical guide to the analysis of genes and proteins.; Edited by, Andreas D. Baxevanis and Francis Oulelette.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Ad hoc and Wireless Sensor Networks	ITT012	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Computer Networks

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Examine</u> the basics of MANETS.	4
CO2	<u>Review</u> mobile network layers and protocols.	2
CO3	<u>Analyze</u> the WSNs and learn about their management.	4
CO4	<u>Evaluate</u> security in WSNs.	5

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction to MANETS, Self-organization, Routing protocols:</b> Introduction to ad hoc wireless networks, Elements of Ad hoc Wireless Networks characteristics of MANETs , Application of MANETs, challenges , Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV), Topology-based versus positions- based approaches, topology based routing protocols, positions based routing, other routing protocols	<b>10</b>
<b>Module 2</b>	<b>Mobile Network Layers, Protocols:</b> MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.	<b>12</b>
<b>Module 3</b>	<b>WSN Introduction ,Coverage, Mobile Sensor Networks, Network management:</b> Basics of wireless sensors and applications: The Sensor Motes, Sensing and Communication Range, Design Issues, Energy consumption, Clustering of Sensors, Applications. Data retrieval in sensor networks: classification of WSNs, MAC layer routing layer, high level application layer support, adapting to the inherent dynamic nature of WSNs.	<b>12</b>
<b>Module 4</b>	<b>Security in WSNs, Security in MANETs:</b> Security in ad-hoc wireless networks and Wireless Sensor Networks, key management, secure routing cooperation in MANETs, intrusion detection, Byzantine attacks, Limitations in securing MANETs and WSNs.	<b>8</b>

**TEXT BOOKS:**

1. Ad Hoc and sensor networks, Carlos Corderio Dharma P. Aggarwal, world scientific publication/ Cambridge University press, March 2006 T2.
2. Wireless sensor networks: An information processing approach, Feng Zhao, Leonidas Guibas, Elsevier Science imprint, Morgan Kauffman publishers, 2005, rp2009

**REFERENCE BOOKS:**

1. Ad hoc Wireless Networks- Architecture and Protocols, C.Siva Ram Murthy, B.S.Murthy, Pearson
2. Wireless sensor networks-Principles and Practice, FeiHu, Xiaojun Cao, An Auerbach book CRC press.
3. Wireless Ad Hoc Mobile wireless Networks- principle, protocols and applications,

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Blockchain	ITT013	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Information Security.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Determine</u> the idea behind blockchain and Architecture of Blockchain.	3
CO2	<u>Illustrate</u> cryptographic concepts relevant to blockchain and Bitcoin, providing examples and explanations of their application within decentralized systems, demonstrating a practical understanding of cryptographic techniques used for securing transactions and ensuring the integrity of distributed ledgers.	3
CO3	<u>Examine</u> the fundamentals of the Blockchain framework. <u>Understand</u> the distributed consensus mechanisms and blockchain frameworks in detail.	4
CO4	<u>Analyze</u> and implement the blockchain network in practical with tools available. <u>Understand</u> the real world uses cases and some research aspects.	4

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>History, Evolution of Blockchain and Impact on Digitalization:</b> Basic ideas behind blockchain, how it is changing the landscape of digitalization, History of blockchain, Architecture of blockchain. <b>Blockchain Technology And Cryptocurrencies:</b> Hashing, public key cryptosystems, private vs public blockchain and use cases, Hash Puzzles, Basic Crypto primitives, Bitcoin Basics.	<b>8</b>
<b>Module 2</b>	<b>Blockchain Architecture and Components:</b> Introduction, Advantage over conventional distributed database, Block Structure, Genesis block, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit. <b>Transaction Processing and Network Policies:</b> Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Forks, Double Spending Private and Public blockchain.	<b>13</b>
<b>Module 3</b>	<b>Blockchain Consensus Mechanisms:</b> The real need for mining, Distributed Consensus, Byzantine Generals Problem, and Consensus as a distributed coordination problem, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level. <b>Permissioned Blockchain and Hyper Ledger Fabric Basics:</b> Permissioned Blockchain-RAFT, BFP, PBFT. Ethereum, Ethereum Virtual Machine (EVM),	<b>13</b>

	Wallets for Ethereum, Solidity, Smart Contracts, some attacks on smart contracts, Hyper Ledger Fabric Basics.	
<b>Module 4</b>	<b>Blockchain Applications And Research Aspects:</b> Blockchain as a Secured and Transparent service, Blockchain and Internet of Things, Medical Record Management System, Blockchain in Supply Chain Management, Blockchain in Finance services (Compliance, Mortgage and financial trade), Blockchain in Government (Tax Payments and Land registry and records). Blockchain Future: Secured Multiparty Computation, Blockchain for Big Data, Blockchain and AI.	<b>8</b>

**Books Recommended:**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. SWAYAM (NPTEL ): Introduction to Blockchain Technology and Applications.
3. Wattenhofer, The Science of the Blockchain.
4. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies.
5. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.
6. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Foundation of Automatic Verification	ITT014	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Discrete Mathematics.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
C01	<u>Examine</u> the importance of formal verification in the specification and verification of systems.	4
C02	<u>Analyze</u> various formal methods for verifying the various properties of the systems.	4
C03	<u>Evaluate</u> the various formal verification tools to implement and execute model checking algorithms.	5
C04	<u>Analyze</u> the concepts of Computational Tree Logic (CTL) and Binary Decision Diagrams (BDDs), as well as their applications in model checking.	4

**Detailed Syllabus:**

Module No.	Contents	Hours
Module 1	<b>Introduction to Computer Logic:</b> Logic as a formal language, Propositional logic, Normal forms, Predicate logic.	8
Module 2	<b>Fundamentals of Temporal Logic:</b> Model checking and temporal logic, linear temporal logic, syntax and semantics of LTL.	13
Module 3	<b>Model Checking Tool:</b> SPIN or NuSMV model checker, running of the checker, and examples.	13
Module 4	<b>Computational Tree Logic (CTL):</b> Syntax and semantics of CTL, CTL model checking algorithms, expressive powers of LTL and CTL. <b>Binary Decision Diagrams (BDD):</b> Binary decision diagrams and ordered BDDs, BDD algorithms, Symbolic model checking.	8

**Books Recommended:**

1. M. Huth and M. Ryan. "Logic in Computer Science: Modelling and Reasoning about Systems". Cambridge University Press.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Synthesis of Digital Systems	ITT015	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Data Structures.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Determine</u> automatic generation of digital circuits from high-level descriptions.	3
CO2	<u>Articulate</u> with the VHDL basics, Modelling timing.	3
CO3	<u>Evaluate</u> the high-level synthesis and various compiler transformations.	5
CO4	<u>Analyze</u> different types of scheduling. <u>Understand</u> the fundamentals of Finite state machine and logic synthesis.	4

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction to Fundamentals:</b> What is synthesis? Chip design flow and hardware modelling. Introduction to VLSI Design Automation.	<b>8</b>
<b>Module 2</b>	<b>Hardware Description Languages And VHDL:</b> Introduction to Hardware Description Languages and VHDL basics. Modelling timing - events and transactions, specifying hardware behaviour with processes, specifying structure, test benches, parametrization and libraries.	<b>13</b>
<b>Module 3</b>	<b>High-Level Synthesis:</b> Introduction to High-level Synthesis, language front-end design representation. <b>Compiler transformation in high-level synthesis:</b> Constant folding, dead code elimination, constant propagation, strength reduction. Memory modelling - common sub-expression elimination and loop invariant code motion. Loop unrolling, function inlining.	<b>13</b>
<b>Module 4</b>	<b>Scheduling:</b> Hardware transformations, ASAP and ALAP scheduling, List scheduling and time-constrained scheduling. Force-directed scheduling and register allocation, high-level synthesis and timing issues. <b>Finite State Machine And Logic Synthesis:</b> File operation such as storing, retrieving and updating a file.	<b>8</b>

**Books Recommended:**

1. Schaums Outline of Theory and Problems of programming with C: Gottfried
2. Programming with C , Byron Gottfried, Third Edition. (McGrawHill).
3. Mastering C by Venugopal, Prasad – TMH
4. Programming in ANSI C, Balaguruswamy
5. C How to Program, P. J. Deitel and H. Deitel

**Other Books Recommended:**

1. Complete reference with C Tata McGraw Hill
2. Engineering Problem Solving with ANSI C, Delores M. Etter, Prentice Hall
3. C Programming, Ivor Horton, Wrox Press Limited
4. The C programming language: Kerningham and Ritchie

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Cyber Security & Forensics	ITT016	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Evaluating</u> the need for securing systems from cyber-attacks.	5
CO2	<u>Addressing</u> weaknesses, <u>implementing</u> preventative measures to counter cyber threats and its applications.	3
CO3	<u>Acquiring</u> a comprehensive understanding of the foundational principles and methodologies that constitute the field of Digital Forensics.	3
CO4	<u>Examining</u> the application of Digital Forensics involves investigating digital systems and electronic evidence using specialized techniques.	4

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction to Cyber Security and Its Need:</b> Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.	<b>8</b>
<b>Module 2</b>	<b>Cyber Security Vulnerabilities and Cyber Security Safeguards:</b> Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. <b>Cyber Security</b> <b>Cyber Security Safeguards:</b> Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management. <b>Applications of Cyber Security:</b> Guidelines to choose web browsers, Securing web browser, Antivirus, Email security, setting up a Secure password, Two-steps authentication, Guidelines for social media security, practices for safer Social Networking, Smartphone Security, Android Security, IOS Security.	<b>13</b>

<b>Module 3</b>	<b>Fundamentals of Digital Forensics:</b> Forensics science, computer forensics, and digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics. Incident-Response Methodology.	<b>13</b>
<b>Module 4</b>	<b>Cyber Crime Scene Analysis:</b> Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.	<b>8</b>

**Books Recommended:**

**Text Books**

1. Charles Brooks and Christopher Grow, "Cybersecurity Essentials", Sybex.
2. Michele Loi, "The Ethics of Cybersecurity", Springer.
3. John Sammons, "The Basics of Digital Forensics: The Primer for Getting Started in Digital", Syngress.
4. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Laxmi Publications.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Natural Language Processing	ITT017	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Probability, Computer Programming (Python).

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Apply</u> the natural language processing algorithms to machine translation.	3
CO2	<u>Design</u> the techniques for classification of text using supervised and unsupervised learning.	6
CO3	<u>Implement</u> models for the feature extraction	3
CO4	<u>Evaluate</u> text summarization techniques and know about the various NLP architectures and developments.	5

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction:</b> NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.	<b>8</b>
<b>Module 2</b>	<b>Linear Text Classification:</b> Words:-Words and pattern matching, Lexical representations for NLP, Neural nets: neural word embedding, Word sense disambiguation; Texts:-Text categorization and naive Bayes, Generalized linear models, feedforward networks, Sentiment analysis, Unsupervised methods in NLP.	<b>13</b>
<b>Module 3</b>	<b>Sequences and Trees:</b> N-gram Language Models (Feature Extraction methods) :-The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Part Of Speech Tagging and Sequence Labeling:-Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). Trees-Context-free grammars and syntax- CKY parsing, Probabilistic CFG parsing, Dependency grammar.	<b>13</b>
<b>Module 4</b>	<b>Text Summarization and Vector Representation:</b> Automated Text summarization, Extractive and Abstractive Text summarization, Sequence to Sequence, Encoder Decoder; Vector Representation: Character level encoding, One hot encoding, Word2Vec, Document Vectors, NLP Architecture and Developments: Attention mechanism, Attention mechanism models, Data normalization using attention mechanism, Transformers, BERT, Open AI GPT-2.	<b>8</b>

**Books Recommended:**

1. Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition Second Edition Daniel Jurafsky.
2. Introduction to Natural Language Processing, by Jacob Eisenstein, MIT Press, 2019.

**Other Books Recommended:**

1. Natural Language Processing Fundamentals by Sohom Ghosh and Dwight Gunning.
2. Deep Learning for Natural Language Processing, Karthiek Reddy Bokka, Shubhangi Hora, Tanuj Jain and Monicah Wambugu

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Distributed Computing	ITT018	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Data Structures and Algorithms, Operating Systems, Database Management Systems.

**Course Outcomes:** At the end of the course, the student will be able to:

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Evaluate</u> the architectures of distributed systems	5
CO2	<u>Analyze</u> the mechanisms to implement ordering in distributed systems	4
CO3	<u>Examine</u> the state of art distributed systems	4
CO4	<u>Implement</u> the consistency models for distributed systems	3

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	Introduction and types of distributed systems – Architecture of DS - Overview of processes - Taxonomy of Distributed Systems - scalable performance - load balancing and availability. Models of computation - shared memory and message passing system - synchronous and asynchronous systems. Communication in Distributed Systems - Remote Procedure Calls and Message Oriented Communications and implementation - High-level communication and publish-subscribe in Map reduce.	<b>10</b>
<b>Module 2</b>	Logical time and event ordering - Global state and snapshot algorithms - distributed snapshots in VMs - clock synchronization - Distributed mutual exclusion - Group based Mutual Exclusion - leader election - deadlock detection - termination detection	<b>10</b>

<b>Module 3</b>	Distributed Databases - implementations over a simple distributed system and case studies of distributed databases and systems - Distributed file systems: scalable performance, load balancing, and availability. Examples from Dropbox, Google FS (GFS)/ Hadoop Distributed FS (HDFS), Bigtable/HBase MapReduce, RDD	<b>10</b>
<b>Module 4</b>	Consistency control: Data Centric Consistency - Client Centric Consistency - Replica Management - Consistency Protocols. Fault tolerance and recovery: basic concepts - fault models - agreement problems and its applications - commit protocols - voting protocols - check pointing and recovery. Case Studies from Apache Spark, Google Spanner, Amazon Aurora, Block Chain Systems etc.	<b>12</b>

**Books Recommended:**

1. Andrew S. Tannenbaum and Maarten Van Steen, “Distributed Systems: Principles and Paradigms”, Second Edition, Pearson, 2007.
2. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, “Distributed Systems: Concepts and Design”, Fifth Edition, Addison Wesley, 2011.
3. James E. Smith, and Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, First Edition, Morgan Kaufmann, 2005

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Expert Systems	ITT019	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Data Structures, Probability.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
C01	<u>Create</u> the features and basic building blocks for designing expert systems	6
C02	<u>Apply</u> the inference and knowledge representation techniques for implementing expert systems	3
C03	<u>Analyze</u> the system architecture of the expert systems.	4
C04	<u>Design</u> the expert systems using the tools.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>INTRODUCTION TO EXPERT SYSTEM:</b> What are Expert Systems, Features of Expert System, features of good Expert System, Role of human in Expert System, Expert System organization, Difference between expert system and conventional program, Basic activities of expert system and the areas in which they solve problems, Prospector systems-features, working model. <b>INFERENCE:</b> Rule based expert systems- Forward chaining, backward chaining - Development Process - Languages and Tools - Explanation facilities - knowledge acquisition.	<b>8</b>
<b>Module 2</b>	<b>KNOWLEDGE REPRESENTATION &amp; EXPERT SYSTEM TOOLS:</b> Knowledge representation in expert systems-using rules semantic nets, frames, Types of tools available for expert system building and how they are used, Stages in the development of expert system tools, Shells and Case Studies, Expert System Shells, Knowledge System Building Tools for Expert System, Expert System tools case study – DENDRIL-MYCIN – EMYCIN –ELIZA, Knowledge Management (Wiki Web case study) Examples of knowledge Engineering.	<b>13</b>
<b>Module 3</b>	<b>EXPERT SYSTEM ARCHITECTURES:</b> Introduction, Rule Based System Architecture, Non-Production System, Architecture, Dealing with uncertainty, Knowledge Acquisition and Validation, Learning and expert system, , Forms of learning, Rote learning, learning by taking advice, Learning in problem solving, Induction leaning, Explanation based learning, Formal learning theory. Connectionist models- learning in Neural network, Architecture of expert system, expert system shell, explanation, knowledge, Acquisition, case studies of an expert system.	<b>13</b>
<b>Module 4</b>	<b>BUILDING EXPERT SYSTEMS:</b> Necessary requirements for expert systems development, Justification for expert system development, Task in building expert systems, Stages of expert system development, Choosing a tool for	<b>8</b>

	building expert system, Acquiring knowledge from the experts, Examples of the expert system- building process, Examples of expert system used in different areas. Difficulties in developing an expert system. Common pitfalls in-planning an expert system, Scaling with the domain expert during development process.	
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**Books Recommended:**

1. Peter Jackson, Introduction to Expert Systems, Addison Wesley Longman, 1999. ISBN 0-20187686-8.
2. J. Giarratano and G. Riley, "Expert Systems -- Principles and Programming". 4th Edition, PWS Publishing Company, 2004.

**Other Books Recommended:**

1. Durkin, J., Expert systems Design and Development, Macmillan, 1994.
2. Elias M. Awad, Building Expert Systems, West Publishing Company 1996.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Natural Algorithms	ITT020	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Design and Analysis of Algorithms

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Discover</u> the need and basics of natural computing and bio-inspired networking.	3
CO2	<u>Illustrate</u> various design approaches used for implementing genetic algorithms.	4
CO3	<u>Analyze</u> various evolutionary computing algorithms.	4
CO4	<u>Review</u> social and immunocomputing algorithms.	2

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction To Natural Computing:</b> Three facets of natural computing, an overview of Natural computing algorithms, Families of naturally inspired algorithms. <b>Bio-Inspired Networking and Inter-cell Signalling:</b> Bio-inspired networking (motivation and appealing characteristics), challenges in networking, steps for developing bio-inspired methods. Juxtacrine Signaling, Delta-Notch Signaling (mathematical modeling and application).	<b>7</b>
<b>Module 2</b>	<b>Evolutionary Computing:</b> Introduction to Evolutionary Computing, Genetic algorithm, Canonical genetic algorithm (GA), various design questions while implementing GA and their proposed techniques.	<b>11</b>
<b>Module 3</b>	<b>Other Evolutionary Computing algorithms:</b> Evolution strategies and Evolutionary programming, Canonical differential evolution algorithm, Genetic Programming.	<b>12</b>
<b>Module 4</b>	<b>Social Computing:</b> Particle swarm algorithms, Ant algorithms, Other foraging algorithms - Honeybee foraging, Other social algorithms - Glow Worm and Bat algorithm. <b>Immunocomputing:</b> Natural immune system, Artificial immune algorithms, Negative selection algorithm.	<b>12</b>

**Recommended Books:**

1. Natural Computing Algorithms by Anthony Brabazon, Michael O'Neill and Seán McGarragh
2. De Castro, Leandro Nunes. Fundamentals of natural computing: basic concepts, algorithms, and applications. CRC Press.
3. Toivanen, M. K. P., & Beliczynski, B. Adaptive and Natural Computing Algorithms.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Advanced Artificial Intelligence	ITT021	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Artificial Intelligence

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Discover</u> the use of advanced computing techniques and tools of AI and ML to <u>design, implement, and evaluate</u> secure hardware and/or software systems with assured quality and efficiency.	5
CO2	<u>Explore</u> contemporary research issues and gaps, and to propose original ideas and solutions in AI and ML.	4
CO3	<u>Analyze</u> the different kinds of robot manipulator and actuators and sensors.	4
CO4	<u>Develop</u> knowledge of decision making and learning methods.	3

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>INTRODUCTION:</b> Definition of AI, Intelligent agents, perception and language processing, problem solving, searching, heuristic searching, game playing, Logics, logical reasoning. Forward vs Background, knowledge representation, frame problems, heuristic functions, weak methods of matching	<b>8</b>
<b>Module 2</b>	<b>DECISION MAKING:</b> Bayes theorem, multiple features, decision boundaries, estimation of error rates, histogram, kernels, window estimators, nearest neighbour classification, maximum distance pattern classifier, adaptive decision boundaries.	<b>10</b>
<b>Module 3</b>	<b>Natural Language Processing:</b> NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field. N-Gram Language Models: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.	<b>10</b>

	Part Of Speech Tagging And Sequence Labeling:Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training).	
<b>Module 4</b>	<p><b>ROBOTICS</b></p> <p>Classification of Robots, Advantages and Disadvantages of Robots, Robot Components, Degree of Freedom, Joints, Robot Coordinates, Reference Frames, Programming Modes, Robot Characteristics, Robot Workspace, Robot Languages, Application of Robots</p> <p><b>SPATIAL DESCRIPTIONS AND TRANSFORMATION</b></p> <p>Robot as Mechanisms, Matrix Representation, Description of Position and Orientation, Frames and Displacement mappings, Homogeneous transforms, Transformation of free vectors, examples.</p>	<b>8</b>
<b>Module 5</b>	<p><b>MANIPULATORS MANIPULATOR FORWARD KINEMATICS:</b></p> <p>Link description, link connection, Denavit – Hartenberg parameters, examples.</p> <p><b>MANIPULATOR INVERSE KINEMATICS:</b> Solvability, algebraic and geometric approaches, Degeneracy and Dexterity, Examples.</p> <p><b>JACOBIANS: VELOCITIES, STATIC FORCES AND MANIPULATOR DYNAMICS ANALYSIS:</b> Velocity analysis, linear and rotational velocity of rigid bodies, velocity propagation, Jacobians, velocity transformation and inverse velocity, force transformation and inverse force, examples</p>	<b>6</b>

**Books Recommended:**

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill, 1993.
2. Earl Gose, Richard Johnsonbaugh, Steve Jost, “Pattern Recognition and Image Analysis”, Prentice Hall of India Pvt. Ltd., New Delhi, 1999.
3. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.
4. Artificial Intelligence, R.B. Mishra, PHI, India, 2010.
5. Robert Schalkoff, Pattern Recognition: Statistical Structural and Neural Approaches, Wiley – India, 2009
6. Artificial Intelligence: A new synthesis, Nils J Nilsson, Morgan Kaufmann Publishers

**Other Books Recommended:**

1. AbhishekVijayvargia, Machine Learning for Python: An Approach to Applied Machine Learning, BPB Publications.
2. Saeed B. Niku, Introduction To Robotics, Analysis, Systems , Application.
3. Kevin M. Lynch and Frank C. Park, Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press, 2017.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Advanced Computer Graphics	ITT022	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Computer Graphics, Basics of Machine Learning.

**Course Outcomes:** At the end of the course, the student will be able to:

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	<u>Apply</u> global illumination and rendering.	3
CO2	<u>Assess</u> and <u>illustrate</u> augmented reality rendering and motion capture.	5
CO3	<u>Analyze</u> and <u>create</u> physically based animation.	6
CO4	<u>Create</u> and <u>design</u> projects based on illumination, rendering, VR, AR and PBA.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
Module 1	Introduction to the Course, Raytracing, Radiometry and BRDF, Radiosity, Monte-Carlo Raytracing, Volume Graphics, LightFields, Neural Radiance Fields,	12
Module 2	Augmented Reality: Introduction, Displays, Tracking, Coherent Rendering, Learning for Rendering, Motion Capture, Skinning, Kinematics, Motion Graphs	12
Module 3	Phase-Functioned Neural Networks for Character Control, Physically-based Animation 1, Physically-based Animation 2, Particle Fluids, Grid Fluids.	12
Module 4	Project Presentations	6

**Text Books:**

1. Augmented Reality (1/e), Deiter Schmalstieg and Tobias Hollerer, Addison Wesley.
2. Physically-based Rendering : From Theory to Implementation (2/e), Matt Pharr and Greg Humphreys, Morgan Kaufmann.
3. Computer Animation : Algorithms and Techniques (3/e), Rick Parent, Morgan Kaufmann.

**Reference books:**

4. Advanced Animation and Rendering Techniques, Alan Watt and Mark Watt, Addison Wesley

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	High Performance Computing	ITT023	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Basic computer architecture, Computer Programming, Digital Design

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	Implement the processor pipeline.	3
CO2	Demonstrate the effect of memory hierarchy on the overall system performance.	3
CO3	Design a memory system for a multicore system.	6
CO4	Evaluate the reliability and security of modern processors.	5

**Detailed Syllabus:**

Module No.	Contents	Hours
Module 1	<b>INTRODUCTION TO PIPELINING:</b> Basic pipelining and dependencies, Fetch, decode, execute and commit stages, Instruction renaming, Load store queue	10
Module 2	<b>MEMORY HIERARCHY:</b> Memory system design, DRAMs and SRAMs, Virtual Memory, Caches, Cache optimization techniques	10
Module 3	<b>MULTICORE SYSTEMS:</b> Parallel Programming and Hardware Threads, Consistency and Coherence protocols, Memory models	12
Module 4	<b>NETWORK ON CHIP:</b> Need of an on-chip network, Topologies, Routing algorithms, Router Pipelining <b>RELIABILITY AND SECURITY:</b> Soft Errors and Hard errors, Process Variation, security concerns, on-chip attacks	10

**Books Recommended:**

1. "Advanced Computer Architecture" by Smruti R. Sarangi.
2. "Digital Design and Computer Architecture" By Harris et al.
3. "Computer Organization and Embedded Systems" by Carl Hamachar, Z. Vranesic, s. Zaky, and N. Manjikian.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Advanced Database Management Systems	ITT024	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Data Structures and Algorithms, Operating Systems, Database Management Systems.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Explain</u> and <u>evaluate</u> the fundamental theories and requirements that influence the design of modern database systems, <u>Assess</u> and <u>apply</u> database functions and packages suitable for enterprise database development and database management	5
CO2	Critically <u>evaluate</u> alternative designs and architectures for databases and data warehouses, <u>Discuss</u> and <u>evaluate</u> methods of storing, managing, and interrogating complex data	5
CO3	<u>Explain</u> and critically <u>evaluate</u> database solutions for data exchange	5
CO4	<u>Analyze</u> the background processes involved in queries and transactions, and <u>explain</u> how these impacts on database operation and design	4

#### Detailed Syllabus:

Module No.	Contents	Hours
Module 1	<p><b>DISTRIBUTED DATABASES</b></p> <p>Introduction, Design Framework, Design of database fragmentation, The Allocation of Fragments, Translation of global queries to fragment queries, Optimization of access queries, Distributed Transaction Management, Concurrency Control, and Reliability.</p> <p><b>INTRODUCTION TO DIFFERENT DATABASE SYSTEMS</b></p> <p>Multimedia Database Systems, Deductive Database Systems, Spatial Database</p>	8

	Systems. Hierarchical, Network, Relational and Object-Oriented Databases.	
<b>Module 2</b>	<p><b>SEMI-STRUCTURED DATA AND XML</b></p> <p>Semi-Structured Data, Introduction to XML, XML hierarchical Model, DTD &amp; XML schema, XML Namespace, XML query. Transformation: Xpath, XSLT, XQuery, Storage of XML data, XML Technologies: DOM; SAX Interfaces X pointer, Xlink, XHTML, SOAP, WSDL, UDDI, XML database Application</p>	<b>13</b>
<b>Module 3</b>	<p><b>REAL TIME DATABASES</b></p> <p>Transaction priorities – Concurrency control issues – Disk scheduling algorithms – Two phase approach to improve predictability.</p> <p>Emerging trends and technologies in advanced database management systems: cloud databases, big data analytics, and in-memory databases</p>	<b>8</b>
<b>Module 4</b>	<p><b>ADVANCED APPLICATION DEVELOPMENT IN DATABASES</b></p> <p>Performance Tuning, Performance Benchmarks, Standardization, E-Commerce, Legacy Systems,</p> <p>Large-scale Data Management with HADOOP, Semi structured database COUCHDB: Introduction, Architecture and principles, features..</p>	<b>13</b>

**Books Recommended:**

1. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter: Cloud Computing: A Practical Approach, McGraw Hill, 2010.
2. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.
3. Ovidiu Vermesan and Peter Friess: Internet of Things –From Research and Innovation to Market Deployment, River Publishers, 2014
4. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
5. Cloud Computing Bible, Barrie Sosinsky.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Introduction to Logic and Functional Programming	ITT025	2-1-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Data Structures and Algorithms.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Discover</u> the basics of functional programming.	2
CO2	<u>Assess</u> and <u>illustrate</u> Lambda calculus as a computational model and programming language.	5
CO3	<u>Analyze</u> the basics of first-order logic, including its fundamental concepts and rules.	4
CO4	<u>Evaluate</u> the constraints logic programming paradigm, analyzing its specific principles, methodologies, and limitations that influence its approach to programming, gaining insight into its unique characteristics and potential applications.	5

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction to Functional Programming:</b> Fundamentals of functional programming, higher-order functions and types, type inference, polymorphic type system, recursion and induction, Algebraic Data Types – Lists and Trees.	<b>8</b>
<b>Module 2</b>	<b>Lambda Calculus:</b> Lambda-Calculus as a Computational Model and as a Programming Language. Recursion and Type inferencing in $\lambda$ -calculus. $\beta$ -reduction, $\eta$ -reduction, Notions of Reduction, normal forms. Introduction to the Untyped $\lambda$ calculus.	<b>13</b>
<b>Module 3</b>	<b>Fundamentals of First-Order Logic:</b> Computing with relation, First-order logic: syntax and semantics. Fundamental concepts: relations, rules, unification, recursion and SLD-Resolution. Relation between logic and logic programming: semantics, soundness and completeness.	<b>8</b>
<b>Module 4</b>	<b>PROLOG:</b> Programming in a logic programming language, such as Prolog. Encoding of algorithms and data structures; controlled backtracking, negation as failure, solving search problems and constraint problems. Similarities and differences with imperative, object-oriented, and functional programming.	<b>13</b>

	<p><b>Constraint Logic Programming:</b> Introduction to Constraint Logic Programming: Constraint logic programming scheme, Constraint satisfaction, constraint propagation.</p> <p><b>Constraint Logic Programming and Temporal Logic:</b> Constraint Logic Programming over the reals, Constraint Logic Programming over finite domains. Introduction to non-classical logics. Modal logic. Accessibility. Relation and Kripke possible world semantics. The logic of knowledge and belief, Autoepistemic knowledge, Temporal logic</p>	
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**Books Recommended:**

1. Tasami Hagiya and Philip waddle, "Functional and Logic Programming" ,8/E, 2006
2. Testsuo Ida, Atsushi Ohori and Masato Takichi, "Functional and Logic Programming", 2006
3. John Harrison. (1997). Introduction to Functional Programming.
4. Elements of ML Programming (ML 97 Ed.), J. D. ULLMAN, Prentice Hall, 1998.
5. Ivan Bratko, Prolog Programming for Artificial Intelligence (Fourth Edition). Addison-Wesley Publ. Co., 2012.
6. David S. Warren, Programming in Tabled Prolog. (Online)
7. W. F. Clocksin and C.S.Mellish, Programming in Prolog (Fourth Edition), Springer-Verlag, 2000.
8. Ulf Nilsson and Jan Maluszynki, Logic Programming and Prolog (Second Edition), 2000.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Biometrics and Network Security	ITT026	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Information Security.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Demonstrate</u> the principles and concepts of biometrics and its applications in various fields.	2
CO2	<u>Analyze</u> various biometric technologies, <u>evaluating</u> their strengths and weaknesses, and discerning the suitability of each for different applications and environments, gaining insight into the comparative effectiveness and limitations of different biometric modalities.	5
CO3	<u>Articulate</u> the principles of Network Security.	3
CO4	<u>Illustrating</u> various network vulnerabilities.	2

#### Detailed Syllabus:

Module No.	Contents	Hours
<b>Module 1</b>	<b>BIOMETRICS:</b> Introduction- benefits of biometrics over traditional authentication systems -benefits of biometrics in identification systems-selecting a biometric for a system –Applications - Key biometric terms and processes verification, identification and biometric matching–Performance measures in biometric systems: FAR, FRR, FTE rate, EER and ATV rate, biometric matching methods -Accuracy in biometric systems.	<b>8</b>
<b>Module 2</b>	<b>PHYSIOLOGICAL BIOMETRIC TECHNOLOGIES:</b> Fingerprint biometrics – Fingerprint recognition system – Minutiae extraction – Fingerprint indexing – experimental results – Biometrics using vein pattern of palm – Advantages and disadvantages – Basics of hand geometry Background of face recognition – Design of face recognition system – Neural network for face recognition – Face detection in video sequences – Challenges in face biometrics – Face recognition methods – Advantages and disadvantages Iris segmentation method – Determination of iris region – Experimental results of iris localization – applications of iris biometrics – Advantages and disadvantages. DNA biometrics.	<b>13</b>
<b>Module 3</b>	<b>MULTI BIOMETRICS AND APPLICATIONS:</b> Multi biometrics and multi factor biometrics - two-factor authentication with Passwords – tickets and tokens – executive decision - implementation plan. Criminal and citizen identification, surveillance, PC/network access, e-commerce and retail/ATM – costs to deploy – other issues in deployment.	<b>13</b>

<b>Module 4</b>	<p><b>NETWORK SECURITY:</b> Principles of Network Security, Network Security Terminologies, Network Security and Data Availability, Components of Network Security, Network Security Policies, Electronic mail security, Network management security. Security for electronic commerce: SSL, SET IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange (IKE).</p> <p><b>WEB SECURITY:</b> Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application. Vulnerabilities, Attacks, and Countermeasures, Same Origin Policy, Cross-Site Scripting Attack, Cross-Site Request Forgery Attack, SQL-Injection Attack, Click-Jacking Attack, Web Tracking, Web Proxy and Firewall, VPN Fundamentals, VPN Design and Architecture, VPN Security, Configuring a VPN.</p>	<b>8</b>
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**Books Recommended:**

1. Samir Nanavathi, Michel Thieme, and Raj Nanavathi, "Biometrics -Identity verification in a network", Wiley Eastern.
2. G R Sinha and Sandeep B. Patil, Biometrics: Concepts and Applications, Wiley, 2013
3. JohnChirillo and Scott Blaul," Implementing Biometric Security", Wiley Eastern Publications.

**Other Books Recommended:**

1. William Stallings, "Network Security Essentials", Pearson.
2. Chris Sanders and Jason Smith, "Applied Network Security Monitoring", Syngress
3. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN13:9780133354690.

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Deep Learning	ITT027	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Computer Programming (Python) and Machine Learning.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	Implement Neural Networks	3
CO2	Evaluate the use of CNNs on the computer vision tasks	5
CO3	Implement deep learning architectures for image classification	3
CO4	Design sequence models for text generation	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>NEURAL NETWORKS AND BACKPROPAGATION:</b> Introduction to neural networks, Backpropagation, Multi-Layer Perceptrons, Normalization, Regularization of Neural Networks, Activation Functions, Loss Models	<b>12</b>
<b>Module 2</b>	<b>DEEP LEARNING FOR VISION:</b> CNN for images, Architectures, Concolution and Polling layers, Popular CNN architectures like AlexNet, VGG, ResNet etc.	<b>10</b>
<b>Module 3</b>	<b>DEEP LEARNING FOR NLP:</b> Sequence Modelling, Recurrent Neural Networks, Long-Short term Memory, Language Modelling, Attention and Transformers	<b>12</b>
<b>Module 4</b>	<b>GENERATIVE MODELS:</b> Generative Adversarial Network, Diffusion models Autoregressive models	<b>8</b>

**Books Recommended:**

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville
2. Neural Networks and Deep Learning by Charu C Agarwal
3. Dive into Deep Learning by Aston Zhang et. al.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Pervasive Computing	ITT028	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Analyze</u> the fundamentals of Wireless Networks and Mobile Computing.	4
CO2	<u>Evaluate</u> and <u>analyze</u> the basics of Mobile computing environment and security. Devise the concepts of tracking management schemes for wireless mobile networks.	5
CO3	<u>Analyze</u> the concepts of Pervasive Computing.	4
CO4	<u>Evaluate</u> the open protocols and context-aware sensor networks	5

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<p><b>EMERGING TECHNOLOGIES</b> Wireless networks- Emerging technologies - Bluetooth, WiFi, WiMAX, 3G, WATM.-Mobile IP protocols WAP push architecture-Wml scripts and applications. Pervasive Architecture: Local Area Networks – Wireless LANs - Relationship of Wireless, Internet and Ubiquitous Computing – Pervasive Computing and Ubiquitous Computing.</p> <p><b>MOBILE COMPUTING ENVIRONMENT AND SECURITY</b> Mobile computing environment Functions -Architecture-Design considerations - content architecture -CC/PP exchange protocol -context manager - Data management in WAE- Coda file system- Caching schemes- Mobility QOS - Security in mobile computing.</p>	<b>13</b>

<b>Module 2</b>	<p><b>HANDOFF AND TRACKING MANAGEMENT SCHEMES</b></p> <p>Handoff in wireless mobile networks-Reference model-Handoff schemes- Location management in cellular networks - Mobility models- Location and tracking management schemes- Time, movement, profile, and distance-based update strategies - AI technologies.</p>	<b>8</b>
<b>Module 3</b>	<p><b>PERVASIVE COMPUTING</b></p> <p>Pervasive Computing- Principles, Characteristics- Interaction transparency - Context-aware - Automated experience capture. Architecture for pervasive computing- Pervasive devices - Embedded controls.- Smart sensors and actuators -Context communication and access services</p>	<b>8</b>
<b>Module 4</b>	<p><b>OPEN PROTOCOLS AND CONTEXT AWARE SENSOR NETWORKS</b></p> <p>Open protocols- Service discovery technologies- SDP, Jini, SLP, UPnP protocols data synchronization- SyncML framework - Context-aware mobile services -Context-aware sensor networks - Addressing and communications Context-aware security</p>	<b>13</b>

**Books Recommended:**

1. Ivan Stojmenovic, "Handbook of Wireless Networks and mobile computing", John Willey & sons Inc, Canada, 2002.
2. Asoke K Taukder, Roopa R Yavagal, " Mobile Computing", Tata McGraw Hill Pub Co. New Delhi, 2005.
3. Seng Loke, " Context-aware computing pervasive systems" Auerbach Pub., New York 2007.
4. Uwe Hansmann etl, "Pervasive Computing", Springer, New York.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Advanced Algorithms	ITT029	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Design and Analysis of Algorithms

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	Analyze the asymptotic performance and fundamental concepts of algorithms.	4
CO2	Review various approximation and geometric algorithms.	2
CO3	Illustrate linear programming technique and its applications.	4
CO4	Discover and implement probability-based analysis.	3

**Detailed Syllabus:**

Module No.	Contents	Hours
Module 1	<p><b>Analysis of Algorithms:</b> Review of algorithmic strategies, asymptotic analysis: upper and lower complexity bounds. Identifying differences among best, average and worst Case Behaviours. Big O, little O, omega and theta notations, Standard complexity classes. Empirical measurements of performance. Time and space trade-offs in algorithms. Analysing recursive algorithms using recurrence relations.</p> <p><b>Fundamental Computing Algorithms:</b> Numerical algorithms, Sequential and binary search algorithms. Quadratic sorting algorithms and <math>O(n \log n)</math> sorting algorithms. Algorithms on graphs and their complexities using Greedy Approach for Prim's and Kruskal's Algorithm for minimum spanning tree, Single source shortest path Algorithm, all pair shortest paths in Graph.</p>	12
Module 2	<p><b>Approximation And Geometric Algorithms:</b> Introduction, Absolute approximation, Epsilon approximation, Polynomial time Approximation schemes, probabilistically good algorithms. Geometric algorithm prerequisites – Basic properties of line, intersection of line, line segment, polygon etc. Line segment properties, detaining segment intersection in time complexity (<math>n \log n</math>), Convex full problem – formulation, solving by Graham scan algorithm, Jarvis march algorithm; closest pair of points – problem formulation, solving by divide &amp; conquer method, Hardness of Approximation</p>	12
Module 3	<p><b>Linear Programming:</b> Standard and Slack forms, formulation of problems as linear programs, simplex algorithm, duality, initial basic feasible solution. Problem formulation for – single source shortest path, maximum flow problem, Vertex cover problem, Knapsack problem.</p>	9
Module 4	<p><b>Probability-Based Analysis:</b> Expectations: Introduction, Moments, Expectations of functions of more than one random variable, transform methods,</p>	9

	moments and transforms of distributions, computation of mean time to failure, inequalities and limit theorems.	
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**Recommended Books:**

1. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms", Addison Wesley.
2. Cormen, Leiserson, Rivest, "Algorithms", PHI
3. Bressard, "Fundamentals of Algorithms", PHI
4. S. Baase, S and A. Van Gelder, "Computer Algorithms: Introduction to Design and Analysis, 3rd edition. Addison Wesley, 2000.
5. Kishore S. Trivedi, "Probability & Statistics with Reliability, Queing, and Information Technology Applications" PHI

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Advanced Image Processing	ITT030	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Image Processing, Introductory Machine learning.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcomes	Bloom's Taxonomy Level
CO1	<u>Understand</u> and <u>apply</u> various morphological operations on a digital image.	3
CO2	<u>Illustrate</u> wavelet image processing and <u>apply</u> different image compression techniques.	4
CO3	<u>Analyze</u> texture in spatial and transform domain. Extract and evaluate various features using different image analysis techniques.	4
CO4	<u>Create</u> image pattern classifiers using ML and deep learning techniques.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Survey of fundamental image processing steps:</b> Enhancement, segmentation, quantification. <b>Morphological Image Processing:</b> Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Some Basic Morphological Algorithms, Morphological Reconstruction, Summary of Morphological Operations on Binary Images, Grayscale Morphology.	<b>8</b>
<b>Module 2</b>	<b>Wavelet and Other Image Transforms:</b> Matrix-based Transforms, Correlation, Basis Functions in the Time-Frequency Plane, Basis Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform , Haar Transform, Wavelet Transforms.	<b>12</b>

	<b>Image Compression and Watermarking:</b> Fundamentals, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-length Coding, Symbol-based Coding, Bit-plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding, Digital Image Watermarking.	
<b>Module 3</b>	<b>Texture:</b> Texture classification and quantification, Detection of image features, scale space models, texture characterization and modeling; statistical methods (histograms, first order statistics, particular points, second order statistics ...), - spectral methods (Laws filters, Fourier ...), - segmentation. <b>Feature extraction:</b> Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT), Harris corner detector, Speeded Up Robust Features (SURF), Markov models, and other similar image analysis methods.	<b>12</b>
<b>Module 4</b>	<b>Image Pattern Classification:</b> Patterns and Pattern Classes, Pattern Classification by Prototype Matching, Optimum (Bayes) Statistical Classifiers, Neural Networks and Deep Learning using image data, Deep Convolutional Neural Networks, Some Additional Details of Implementation	<b>10</b>

**Text Books:**

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing - Pearson Education
2. Rafael C Gonzalez, Richard E Woods, Digital Image Processing with MATLAB- Pearson Education.
3. Deep Learning for Computer Vision : Image Classification, Object Detection, and Face Recognition in Python, Jason Brownlee, 2019.

**Reference Books:**

1. William K Pratt, Digital Image Processing, John Willey
2. A.K. Jain, PHI, Fundamentals of Digital Image Processing, Pearson Education.
3. Chanda & Majumdar, "Digital Image Processing and Analysis" , PHI.
4. Mark Nelson, Jean-Loup Gailly "The Data compression Book", bpb Publications.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Virtualization and Cloud	ITT031	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Cloud Computing.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
C01	<u>Analyze</u> the components of cloud computing showing how business agility in an organization can be created.	4
C02	<u>Evaluate</u> the deployment of web services from cloud architecture, and critique the consistency of services deployed over it.	5
C03	<u>Compare</u> and <u>contrast</u> the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.	5
C04	Critically <u>analyze</u> case studies to derive the best practice model to <u>apply</u> when developing and deploying cloud based applications.	4

#### Detailed Syllabus:

Module No.	Contents	Hours
<b>Module 1</b>	<b>Understanding Cloud Computing:</b> Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage –Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing. <b>Cloud Computing Services and Deployment Models:</b> Infrastructure as a Service; Platform as a Service; Software as a Service; Private Cloud; Public Cloud; Community Cloud; Hybrid Cloud.	<b>8</b>
<b>Module 2</b>	<b>Developing Cloud Services:</b> Web-Based Application – Pros and Cons of Cloud Service Development – Web Services – On-Demand Computing – Discovering Cloud Services Development Services and Tools – Amazon Ec2 – Google App Engine – IBM Clouds. <b>Cloud Computing For Everyone:</b> Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community –Collaborating on Group Projects and Events – Cloud Computing for the Corporation.	<b>13</b>

<b>Module 3</b>	<p><b>Using Cloud Services:</b> Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management –Collaborating on Event Management – Collaborating on Contact Management –Collaborating on Project Management -- Collaborating on Databases – Storing and Sharing Files.</p> <p><b>Other Ways To Collaborate Online:</b> Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services –Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware –Collaborating via Blogs and Wikis.</p>	<b>13</b>
<b>Module 4</b>	<p><b>Security Issues:</b> Securing the Cloud, Securing Data, Establishing identity and presence.</p> <p><b>Cloud Computing and IoT:</b> Federated Cloud Services Management -Cloud Data Monitoring -Cloud Data Infrastructure Configuration and re-Configuration, Open IoT Architecture: Explanation and Usage.</p>	<b>8</b>

**Books Recommended:**

1. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter: Cloud Computing: A Practical Approach, McGraw Hill, 2010.
2. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.

**Other Books Recommended:**

1. Ovidiu Vermesan and Peter Friess:Internet of Things –From Research and Innovation to Market Deployment, River Publishers,2014
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Computer vision and Robotics	ITT032	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Image Processing

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Discover</u> the basics of kinematics and review various types of transformations.	2
CO2	<u>Illustrate</u> and <u>implement</u> trajectory generation and planning.	4
CO3	<u>Explore</u> motion planning and inverse kinematics.	4
CO4	<u>Design</u> and <u>implement</u> robot sensing, vision and control.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<p><b>Fundamentals of Robotics:</b> Automation and Robotics, Basic Structure of Robots, Robot Anatomy, Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, Gripper Subassemblies.</p> <p><b>Direct Kinematics and Transformations:</b> Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems, Composite Rotation matrix, Homogeneous Transformations. Robotic Manipulator Joint Co-ordinate System, Euler Angle &amp; Euler Transformations, Algorithm for Computing the ZYX Euler Angles. Roll–Pitch–Yaw Angles Transformation, Displacement Matrices for Standard.</p> <p><b>Jacobian Transformation in Robotic Manipulation:</b> Space Jacobian, Body Jacobian, Visualizing the Space and Body Jacobian, Relationship between the Space and Body Jacobian.</p>	13

<b>Module 2</b>	<p><b>Trajectory Planning:</b> Trajectory Planning: Trajectory Interpolators, Basic Structure of Trajectory, Interpolators, Cubic Joint Trajectories.</p> <p><b>Trajectory Generation:</b> Point-to-Point Trajectories, Straight-Line Paths, Time Scaling a Straight-Line Path.</p> <p><b>General Design Consideration on Trajectories:-</b> 4-3-4 &amp; 3-5-3 Trajectories. Dynamics of Robotic Manipulators.</p>	<b>8</b>
<b>Module 3</b>	<p><b>Motion Planning:</b> Types of Motion Planning Problems, Properties of Motion Planners, Motion Planning Methods. Describing a Robot Arm, Forward Kinematics: A 2-Link Robot, A 6-Axis Robot.</p> <p><b>Inverse Kinematics:</b> Under-Actuated Manipulator, Redundant Manipulator. Generalized Robotic Coordinates, Jacobian for a Two link Manipulator, Euler Equations, The Lagrangian Equations of motion.</p> <p><b>Application of Lagrange:</b> Euler Dynamic Modeling of Robotic Manipulators, Velocity of Joints, Kinetic Energy of Arm, Potential Energy of Robotic Arm, Two Link Robotic Dynamics with Distributed Mass.</p>	<b>13</b>
<b>Module 4</b>	<p><b>Robotic Control Design:</b> Control Loops of Robotic Systems, trajectory, velocity and force control, Computed Torque control, Linear and Nonlinear controller design of robot.</p> <p><b>Robot Sensing and Vision:</b> Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors, visual servo-control.</p>	<b>8</b>

**Books Recommended:**

1. Lynch and Park., Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press 2017.
2. Bruno Siciliano, Oussama Khatib: Robotics, Vision and Control Fundamental Algorithms in MATLAB, Springer, 2013.
3. Fu, Lee and Gonzalez., Robotics, control vision and intelligence-, McGraw Hill International, 2nd edition, 2007.
4. John J. Craig, Introduction to Robotics-, Addison Wesley Publishing, 3rd edition, 2010

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Green Computing	ITT033	2-0-0-2
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Software Engineering, Big Data.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
C01	<u>Discover</u> the basic requirements and need for Green Computing.	2
C02	<u>Explore</u> green devices and hardware along with green software methodologies.	4
C03	<u>Analyze</u> the various key sustainability and green computing trends.	4
C04	<u>Review</u> various standards and initiatives for regulating green computing.	2

#### Detailed Syllabus:

Module No.	Contents	Hours
<b>Module 1</b>	<b>Green Computing Fundamentals:</b> Environmental concerns and sustainability concerns, environmental impacts of IT, holistic approach of greening IT, applying IT for enhancing environmental sustainability. Energy-efficient, power efficient and thermal aware computing and communication.	<b>6</b>
<b>Module 2</b>	<b>Middleware Support for Green Computing:</b> Data De - Duplication, Virtualization, Management, Bigger Drives, Involving the Utility Company. <b>Energy Efficient Computing:</b> Low Power Computers, PCs, Linux, Components, Servers, Computer Settings, Storage, Monitors, Power Supplies, Wireless Devices, Power states, voltage and frequency scaling. <b>Optimisation:</b> ACPI support for LINUX and Windows, Compiler optimisation, and server consolidation.	<b>8</b>
<b>Module 3</b>	<b>Energy Efficiency Strategies:</b> Cooling Costs, Power Cost, Causes of Cost, Calculating Cooling Needs, Reducing Cooling Costs, Economizers, On-Demand Cooling, HP's Solution. <b>Optimizing Data Center Infrastructure:</b> Optimizing Airflow, Hot Aisle/Cold Aisle, Raised Floors, Cable Management, Vapour Seal, Prevent Recirculation of Equipment Exhaust. <b>Advanced Cooling Technologies:</b> Supply Air Directly to Heat Sources, Fans, Humidity, Adding Cooling, Fluid Considerations, System Design, Green Data centre Design, Centralized Control.	<b>8</b>
<b>Module 4</b>	<b>Big Data Processing:</b> Hadoop, Map-Reduce, Dynamic thermal-aware scheduling, resource management in virtualized environment, embedded computing and networking, optimizing for minimizing battery consumption, safe and sustainable cyber-physical systems (Medical devices).	<b>6</b>

	<b>Green Computing Standards, Global Initiatives and Compliance:</b> Standards and metrics for green computing, Initiatives and Standards: Global Initiatives: United Nations, Basel Action Network, Basel Convention, WEEE Directive, RoHS.	
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**Books Recommended:**

1. Green Computing and Green IT Best Practices by *Jason Harris*  
Initiatives and Standards: Global Initiatives: United Nations, Basel Action Network, Basel Convention, WEEE Directive, RoHS.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Advanced Computer Networks	ITT034	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Computer Networks

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Analyze</u> different routing protocols, traffic engineering methods and Quality of services deployed in networking.	4
CO2	<u>Discover</u> the paradigm and underlying concepts of Software Defined Networking (SDN).	2
CO3	<u>Implement</u> and <u>understand</u> Network Function Virtualization.	3
CO4	<u>Review</u> the concept and implications of Data Center Networking.	2

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Routing:</b> Routing in Packet Networks, Shortest Path Routing, Inter and Intra Domain Routing, Advanced Routing and Network Congestion Control Algorithms; Traffic Management at packet level, and at flow level. <b>Advanced Network Architecture:</b> Integrated Services in Internet, Internet Quality of Services Architecture, Traffic policing, Shaping and Scheduling, RSVP, Differentiated Services, MPLS, Real-time Transport Protocol.	<b>12</b>
<b>Module 2</b>	<b>Software Defined Networking (SDN):</b> Internet Impasse and Network Ossification, Network Virtualization, Active Networks, Evolution of Switches and Control Planes, Data and Control Plane Separation, How SDN Works, Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, Alternate SDN Methods, Prospects and Challenges.	<b>10</b>
<b>Module 3</b>	<b>Network Function Virtualization:</b> Introduction, Existing Network Virtualization Framework (VMWare and others), NFV Framework and Architecture, Services Engineered Path, Service Locations and Chaining, NFV at ETSI, Non-ETSI NFV, Mininet and BMV2 Switches, High Performance Network Packet Processing, Comparison with SDN, Programmable Networks, P4 Programming.	<b>10</b>
<b>Module 4</b>	<b>Data Center Networking:</b> Introduction to Data Center Networking, Characteristics and Challenges, Multipath Topologies and Routing, Fault	<b>10</b>

	Tolerance, Trends in Data Center Networking, Protocols, Network Telemetry, Serverless Computing, Network Softwarization, SmartNICs, SDN 3.0, Green and Sustainable Data Centers, Content Distribution in IP Networks, Information Centric Networking.	
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**Recommended Books:**

1. Communication Network by Alberto Leon Garcia and Indra Widjaja.
2. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher.
3. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014.
4. Tanenbaum, A., Computer Networks, 3rd ed., Prentice-Hall, 1996. Wright and Stevens, TCP/IP Illustrated v.2, Addison-Wesley.
5. Kurose and Ross, ``Computer Networking: A Top-Down Approach," Addison-Wesley, 2000.
6. Peterson and Davie, ``Computer Networks: A Systems Approach," 2nd ed., Morgan Kaufmann, 2000.
7. Huitema, C., Routing in the Internet, 2nd ed., Prentice-Hall, 2000. Keshav, S., An Engineering Approach to Computer Networking, Addison-Wesley, 1997.

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Compiler Design	ITT0035	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Theory of Computation

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Demonstrate</u> compiler construction tools and <u>evaluate</u> the functionality of each stage of compilation process.	5
CO2	<u>Apply</u> Grammars for Natural Languages and <u>evaluate</u> the Syntactical Errors/Semantic errors during the compilations using parsing techniques.	5
CO3	<u>Analyze</u> different representations of intermediate code.	4
CO4	<u>Construct</u> a new compiler for new languages.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>INTRODUCTION TO COMPILERS:</b> Definition of compiler, interpreter and its differences, the phases of a compiler, role of lexical analyzer, regular expressions, finite automata, from regular expressions to finite automata, pass and phases of translation, bootstrapping, LEX-lexical analyzer generator. <b>PARSING:</b> Parsing, role of parser, context free grammar, derivations, parse trees, ambiguity, elimination of left recursion, left factoring, eliminating ambiguity from dangling-else grammar, classes of parsing, top down parsing - backtracking, recursive descent parsing, predictive parsers, LL(1) grammars..	<b>12</b>
<b>Module 2</b>	<b>BOTTOM UP PARSING:</b> Definition of bottom up parsing, handles, handle pruning, stack implementation of shift-reduce parsing, conflicts during shift-reduce parsing, LR grammars, LR parsers-simple LR, canonical LR(CLR) and Look Ahead LR (LALR) parsers, error recovery in parsing, parsing ambiguous grammars, YACC-automatic parser generator. <b>SYNTAX DIRECTED TRANSLATION:</b> Syntax directed definition, construction of syntax trees, Sattributed and L-attributed definitions, translation schemes, emitting a translation.	<b>10</b>
<b>Module 3</b>	<b>INTERMEDIATE CODE GENERATION:</b> intermediate forms of source programs– abstract syntax tree, polish notation and three address code, types of three address statements and its implementation, syntax directed translation into three-address code, translation of simple statements, Boolean expressions and flow-of-control statements.	<b>12</b>

	<p><b>TYPE CHECKING:</b> Definition of type checking, type expressions, type systems, static and dynamic checking of types, specification of a simple type checker, equivalence of type expressions, type conversions, overloading of functions and operators.</p> <p><b>RUN TIME ENVIRONMENTS:</b> Source language issues, Storage organization, storage-allocation strategies, access to non-local names, parameter passing, symbol tables and language facilities for dynamic storage allocation.</p>	
<b>Module 4</b>	<p><b>CODE OPTIMIZATION:</b> Organization of code optimizer, basic blocks and flow graphs, optimization of basic blocks, the principal sources of optimization, the directed acyclic graph (DAG) representation of basic block, global data flow analysis.</p> <p><b>CODE GENERATION:</b> Machine dependent code generation, object code forms, the target machine, a simple code generator, register allocation and assignment, peephole optimization.</p>	<b>8</b>

**Books Recommended:**

1. Compilers Principles, Techniques and Tools by Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Pearson Education.

**Other Books Recommended:**

1. Principles of compiler design, Indian student edition by Alfred V. Aho, Jeffrey D. Ullman, Pearson Education.
2. Compiler Construction– Principles and Practice by Kenneth C. Loudon .
3. Theory of computer science- Automata Languages and computation by K. L. P Mishra, N. Chandrashekar, Prentice Hall of India.
4. Modern Compiler Implementation C by Andrew W. Appel , Cambridge University Press.

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Data Communication	ITT036	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Signal and Systems

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcomes	Bloom's Taxonomy Level
CO1	<u>Discover</u> the basics of data communication and the OSI and TCP/IP reference models.	3
CO2	<u>Analyze</u> the existing types of transmission media and the basics of data and signals.	4
CO3	<u>Evaluate</u> the techniques of analog and digital conversions.	5
CO4	<u>Compare</u> multiplexing and error control techniques used at the physical and data link layers.	5

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Data communication Networks:</b> Basic concept of data network, Types of networks (LAN, MAN, and WAN), Different network topologies like star, ring, hybrid, and tree. Network models (OSI and TCP/IP).	<b>8</b>
<b>Module 2</b>	<b>Transmission media:</b> Guided and unguided media, twisted wire pair, co-axial cable, optical fiber, microwave links, satellite microwave link, their characteristic features and applications for data transmission. <b>Data and signals:</b> Data, Signals, types of Signals, Bandwidth, spectrum, transmission impairments, Shanon capacity.	<b>8</b>
<b>Module 3</b>	<b>Digital Transmission Techniques:</b> Digital-to-digital conversions: NRZ, RZ, Biphasic, Manchester coding, AMI. Analog-to-digital conversions: Nyquist sampling theorem, quantization, Pulse code modulation, Delta modulation. <b>Analog Transmission Techniques:</b> Digital-to-analog conversion: ASK, FSK, PSK, QAM. Signal constellation. Analog-to-analog conversion: amplitude modulation, frequency modulation, phase modulation.	<b>13</b>
<b>Module 4</b>	<b>Bandwidth Utilization Techniques:</b> Frequency Division Multiplexing, Time Division Multiplexing, Wavelength Division Multiplexing, Spread Spectrum. <b>Error Detection And Correction:</b> Errors in data communication: Types of errors, error detection and correction techniques, simple parity check, computation of CRC, Checksum, Hamming code.	<b>13</b>

**Recommended Books:**

1. Behrouz A. Forouzan. Data communications and Networking
2. William Stallings. Data & Computer Communications, PHI
3. JF Kurose, KW Ross. Computer Networking: A Top-Down Approach
4. Andrew Tanenbaum. Computer Networks, PHI
5. Sklar. Digital Communications Fundamentals & Applications

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Computer Graphics	ITT037	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** C/C++ programming, Data structures.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcomes	Bloom's Taxonomy Level
CO1	<u>Apply</u> the algorithms to scan convert and fill the basic geometrical output primitives.	3
CO2	<u>Analyse</u> the concepts of 2D geometric transformations, viewing and clipping of graphics objects.	4
CO3	<u>Analyse</u> and <u>assess</u> the concepts of 3D geometric and modeling transformations, viewing and clipping. 3D representations.	5
CO4	<u>Design</u> the surface detection techniques for display of 3D scene.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	Computer graphics survey and applications, CRT, displays, Raster Scan & Random Scan systems, graphics input and output devices. Point generation algorithm, DDA and Bresenham's lines drawing algorithm, midpoint circle algorithm, midpoint ellipse generating algorithm, other curves, conic sections, polynomial and spline curves. Pixels addressing, filled- area primitives, scan-line polygon filled algorithms, inside-outside tests, scan-line fill of curved boundary algorithms, boundary fill algorithms, flood-fill algorithms, character generation. Attributes of output primitives, Anti-aliasing.	<b>12</b>
<b>Module 2</b>	2D transformations: translation, rotation, scaling, reflection, shear, composite transformations. Viewing pipeline, window to viewport transformation, point clipping, line clipping: Cohen-Sutherland, Liang-Barsky, Nicholl-Lee-Nicholl algorithms, polygon clipping: Sutherland-Hodgeman, Weiler-Atherton, Curve and text clipping.	<b>10</b>

<b>Module 3</b>	3D transformations: translation, rotation, scaling, reflection, shear, composite transformations. Viewing pipeline, world to viewing coordinates, projections, general projection transformations, clipping. Spline representations, cubic spline interpolation, Bezier curves and surfaces, b-spline curves and surfaces, beta splines, rational splines, octrees, BSP trees, fractal geometry methods.	<b>10</b>
<b>Module 4</b>	Visible surface detection algorithms: Back-face detection, depth buffer method, A-buffer method, scan-line method, depth sorting method, BSP-tree method, area division method, Octree methods, Ray-casting methods, Hidden line methods.	<b>10</b>

**Text Books:**

1. Computer Graphics (C version) by D Hearn and M P Baker, Pearson Education.
2. Computer Graphics (Principles and Practice in C) by Foley, A. van Dam, Feiner and Hughes, Pearson Education.
3. Fundamentals of Computer Graphics (Fourth Edition), Peter Shirley, Steve Marschner and others, A K Peters/CRC Press (2015)

**Reference books:**

1. Mathematical Elements for Computer Graphics by D F Rogers, McGraw Hill
2. Procedural Elements for Computer Graphics by D F Rogers, McGraw Hill
3. Interactive Computer Graphics - A Top-Down Approach Using OpenGL (6/e), Edward Angel
4. Computer Graphics using OpenGL (3/e), F. S. Hill Jr. and S. M. Kelley
5. Computer Graphics with OpenGL (3/e), D. D. Hearn and M. P. Baker

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Cloud Computing	ITT038	3-0-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcomes	Bloom's Taxonomy Level
CO1	<u>Analyze</u> the elements of cloud computing, encompassing virtualization and the diverse cloud service models (SaaS, PaaS, IaaS).	4
CO2	<u>Analyze</u> and <u>Evaluate</u> web services, AJAX, and mashups in the context of cloud computing, including SOAP, REST, and asynchronous interfaces.	5
CO3	<u>Explore</u> Anatomy of the Cloud and to implement the cloud applications using map reduce programming models and Identify and address the security challenges and issues in cloud computing,	4
CO4	<u>Analyze</u> blockchain technology and assess the consensus algorithm.	5

**Detailed Syllabus:**

Module No.	Contents	Hours
Module 1	<p><b>New Computing Paradigms &amp; Services:</b> Cloud computing , Edge computing , Grid computing , Utility computing , Cloud Computing Architectural Framework, Cloud Deployment Models, Virtualization in Cloud Computing, Parallelization in Cloud Computing, Security for Cloud Computing, Cloud Economics, Metering of services.</p> <p><b>Introduction to Cloud Computing:</b> Definition and characteristics of cloud computing, Cloud service models: SAAS, PAAS, IAAS, and others, Virtualization concepts and benefits, Overview of cloud providers and building blocks, Introduction to hypervisors and their role in virtualization.</p>	8
Module 2	<p><b>Understanding web services:</b> SOAP and REST, Comparing SOAP and REST, AJAX for asynchronous interfaces in cloud applications, Mashups and their role in creating user interface services, Pitfalls and considerations of virtualization technology.</p> <p><b>Virtualization:</b> Types of Virtualization, Grid technology , Browser as a platform, Web 2.0, Autonomic Systems, Cloud Computing Operating System, Deployment of applications on the cloud, Case studies- Xen, VMware, Eucalyptus, Amazon EC2.</p>	10

<b>Module 3</b>	<p><b>Data Management in the Cloud:</b> Relational databases in the cloud, Cloud file systems: GFS, HDFS, BigTable, HBase, and Dynamo.</p> <p><b>Map Reduce:</b> Introduction to Map-Reduce and its applications in cloud computing, Information retrieval through Mapreduce, Page Ranking using Map Reduce.</p> <p><b>Security Challenges in Cloud Computing:</b> Issues in cloud computing and real-time applications, Intercloud environments and quality of service (QoS) issues, Dependability, data migration, and streaming in the cloud, Cloud computing security considerations.</p>	<b>12</b>
<b>Module 4</b>	<p><b>Blockchain:</b> Introduction, Concept, History, Definition of Blockchain, Fundamentals of Blockchain, Characteristics of Blockchain, Consensus in Trust-Building Exercise, Public, Private, and Hybrid Blockchains, Distributed Ledger Technologies, DLT Decentralized Applications and Databases, Architecture of Blockchain, Transactions, Chaining Blocks, Value Proposition of Blockchain Technology.</p> <p><b>Cryptography Background:</b> Hash Functions, Puzzle Friendly Hash, Collision Resistant Hash, Digital Signatures, Verifiable Random Functions, Memory Hard Algorithm and Zero-Knowledge Systems.</p> <p><b>Consensus:</b> Approach, Consensus Algorithms, Byzantine Agreement Methods</p>	<b>12</b>

**Books Recommended:**

1. Cloud Computing for Dummies by Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper.
2. Enterprise Cloud Computing by Gautam Shroff.
3. Cloud Security by Ronald Krutz and Russell Dean Vines.
4. Blockchain Technology: Concepts and Applications by Kumar Saurabh, Ashutosh Saxena, Wiley.

**Other Books Recommended:**

1. Google Apps by Scott Granneman.
2. Cloud Security & Privacy by Tim Malhar, S. Kumaraswamy, S. Latif.
3. Cloud Computing: A Practical Approach by Anthony T. Velte, et al.
4. Cloud Computing Bible by Barrie Sosinsky.
5. Blockchain for Social Business: Principles and Applications by Mukkamala, Raghava Rao, Ravi Vatrappu, Pradeep Kumar Ray, Gora Sengupta, and Sankar Halder, IEEE Engineering Management Review.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Information Security	ITT039	2-1-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Computer Networks

**Course Outcomes:** At the end of the course, the student will be able to:

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	<u>Explore</u> the risks faced by computer systems and networks and then <u>identify</u> and <u>analyze</u> security problems in computer systems and networks.	4
CO2	<u>Demonstrate</u> how standard security mechanisms work.	3
CO3	<u>Assess</u> security mechanisms to protect computer systems and networks.	5
CO4	<u>Apply</u> cryptography algorithms and protocols to achieve computer security	3

#### Detailed Syllabus:

Module No.	Contents	Hours
<b>Module 1</b>	<p><b>Information and Network Security Concepts:</b> Cybersecurity, Information Security, Network Security, The OSI Security Architecture, Security attacks, services and mechanisms, Cryptography, Network Security, Trust and Trustworthiness.</p> <p><b>Classical Encryption Techniques:</b> Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.</p> <p><b>Block Ciphers and the Data Encryption Standard:</b> Traditional Block Cipher Structure, The Data Encryption Standard: example and strength, Block Cipher Design Principles.</p>	<b>8</b>
<b>Module 2</b>	<p><b>Advanced Encryption Standard:</b> AES Structure, Transformation Functions, Key Expansion, Example, Implementation.</p> <p><b>Block Cipher Operation:</b> Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode, XTS-AES Mode for Block-Oriented Storage Devices, Format-Preserving Encryption.</p> <p><b>Stream Ciphers:</b> Stream Ciphers, RC4, LFSRs, True Random Number Generators.</p>	<b>10</b>

<b>Module 3</b>	<p><b>Public-Key Cryptography:</b> Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.</p> <p><b>Cryptographic Hash Functions:</b> Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA), SHA-3</p> <p><b>Message Authentication Codes:</b> Message Authentication Requirements, Functions, Requirements for Message Authentication Codes, Security of MACs, HMAC, DAA and CMAC, Authenticated Encryption: CCM and GCM, Key Wrapping, Pseudorandom Number Generation Using Hash Functions and MACs.</p> <p><b>Digital Signatures:</b> Digital Signatures, ElGamal and Schnorr Digital Signature Scheme, NIST, Elliptic Curve and RSA-PSS Digital Signature Algorithm.</p>	<b>12</b>
<b>Module 4</b>	<p><b>Cryptographic Key Management and Distribution:</b> Symmetric Key Distribution Using Symmetric and Asymmetric Encryption , Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure</p> <p><b>User Authentication:</b> Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User-Authentication Using Asymmetric Encryption , Federated Identity Management.</p> <p><b>Network and Internet Security:</b> Transport-Level Security, Wireless Network Security, Electronic Mail Security, IP Security, Network endpoint security, Cloud Security, IoT Security.</p>	<b>12</b>

**Text Books:**

1. Network Security Principles And Practice, 8<sup>th</sup> Edition, William Stallings, Pearson.
2. Michael E. Whitman, Herbert J. Mattord, “Principles of information security”, Course Technology, Cengage Learning.

**Reference Books:**

1. Michael E. Whitman, Herbert J. Mattord, “Hands-On Information Security Lab Manual” Course Technology, Cengage Learning.
2. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
3. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
4. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Internet of Things	ITT 040	3-0-0-3
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Computer Networks.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcomes	Bloom's Taxonomy Level
CO1	<u>Interpret</u> the underlying framework for the internet of things.	2
CO2	<u>Implement</u> the state of art architecture in IoT. Overview of new emerging technologies with IoT.	3
CO3	<u>Discover</u> the hardware, software and architectural requirements in IoT including data analytics.	3
CO4	<u>Design</u> and <u>implement</u> IoT applications using IoT simulators and <u>illustrate</u> the need for maintaining security and privacy in IoT environments.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>INTRODUCTION:</b> Internet, Wireless Sensor Network, Sensor Node Architecture, Examples and Applications, Internet of Things: Definition, Basic Components of IoT, Thing, Sensing & Actuators, Vision, Physical Parameters, Web 3.0.	<b>8</b>
<b>Module 2</b>	<b>ARCHITECTURE:</b> Basic Architecture: 3 layer and 5 layer Architecture, ITU-IoT Reference Model, Machine to Machine Communication, IoT Gateways. <b>APPLICATION AREAS:</b> Home Automation, Smart Cities, Medical, Logistics, Environment, Analytics. Smart Grids. IoT in relation to Big Data and Cloud Computing, Overview of Fog computing.	<b>13</b>
<b>Module 3</b>	<b>TECHNOLOGIES:</b> IPv4, IPv6, Identification Technology: RFID System, Types, Components and applications. Bluetooth Low Energy(BLE), ZigBee: Architecture, Comparison with other wireless standards. Electronic Product Code (EPC), Near Field Comm. (NFC), 6LoWPAN, End to End Reliability: COAP, MQTT, SCADA, XML.	<b>13</b>
<b>Module 4</b>	<b>HARDWARE AND SOFTWARE PLATFORMS:</b> Hardware: Raspberry Pi, Arduino, Intel Galileo Software: TinyOS, Contiki OS, RTOS, WebOS. <b>INTERNET OF THINGS PRIVACY AND SECURITY:</b> Introduction, Privacy and Security Issues, Steps towards a security platform in IoT.	<b>8</b>

**Books Recommended:**

1. Vijay Madiseti and Arshdeep Bahga, “Internet of Things ( A Hands on Approach)”.
2. Hakima Chaouchi (editor) “The Internet of Things Connecting Objects to the Web” by Wiley publications

**Other Books Recommended:**

1. Francis daCosta, “Rethinking Internet of Things: A scalable Approach to Connecting Everything.”
2. Raj Kamal “Internet of Things: Architecture and Design Principles.”

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Information Security Lab	ITL041	0-0-2-1
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
100 Marks	40	-	60

**Pre-requisites:** C programming, Computer Networks

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Analyze</u> various information gathering tools and <u>evaluate</u> their efficacy and appropriateness across varied contexts.	5
CO2	<u>Compare</u> the inner workings of various symmetric and asymmetric encryption algorithms.	5
CO3	<u>Demonstrate</u> proficiency in conducting ethical hacking activities, including vulnerability assessment and exploitation.	3
CO4	<u>Create</u> custom security solutions to protect against various cyber threats and attacks	6

**Lab Details:**

1. Download and install VirtualBox, create a virtual machine, and install Kali Linux. Explore the Kali Linux system, create files, and manage directories. Understand basic network commands and sudo privileges in Kali.
2. Learn Python intermediate concepts like error handling and file I/O
3. Implement a simple symmetric key encryption and decryption algorithm using a substitution or transposition technique. Demonstrate the process with a sample message and highlight the use of modulo division.
4. Perform information gathering (footprinting) using tools such as Whois, Whatweb, and theHarvester. Obtain IP addresses, physical addresses, and gather emails. Explore Python-based email scraper tools.
5. Implement the AES encryption and decryption algorithm. Show the transformation functions, key expansion, and demonstrate the encryption and decryption process with a test case.

6. Perform the installation of vulnerable virtual machines. Use tools like Netdiscover and Nmap to perform various scans, discovering target operating systems and service versions.
7. Find vulnerabilities using Nmap scripts, manual analysis, and Nessus. Install Nessus and scan a Windows 7 machine to identify and analyze vulnerabilities.
8. Exploit vulnerabilities using Metasploit. Perform various exploits, including vsftp, Telnet, Samba, and SSH. Learn about different attacks such as brute force, Eternal Blue, and BlueKeep. Understand the usage of RouterSploit.
9. Explore post-exploitation theory, use Meterpreter basic commands, elevate privileges, and create persistence on the target system. Develop post-exploitation modules and a Python-coded backdoor.
10. Implement a simple hash function, then explore HMAC (Hash-based Message Authentication Code). Demonstrate the generation and verification of HMACs.
11. Learn website penetration testing theory, HTTP requests, and responses. Use tools like Dirb and Burpsuite for information gathering. Exploit vulnerabilities using ShellShock, Command Injection, XSS, and SQL Injection. Finally perform a brute force attack using Hydra.
12. Understand MitM attacks and use tools like Bettercap for ARP spoofing, Ettercap for password sniffing, and Scapy for manually poisoning target ARP caches.
13. Implement the ElGamal digital signature scheme. Generate key pairs, sign a message, and verify the signature.
14. Implement the mini project covering all the above experiments (To be assigned by the faculty)

<b>Year (Semester)</b>	<b>Course Title</b>	<b>Course Code</b>	<b>L-T-P-Credits</b>
-	Compiler Design Lab	ITL042	0-0-2-1
<b>Evaluation Policy</b>	<b>Mid-Term</b>	<b>Internal Assessment</b>	<b>End-Term</b>
100 Marks	40	-	60

**Pre-requisites:** None.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	<u>Demonstrate</u> use of lex and yacc tools for developing a scanner and a parser.	<b>3</b>
CO2	<u>Design</u> and <u>implement</u> LL and LR parsers.	<b>6</b>
CO3	<u>Use</u> different tools in construction of the phases of a compiler for the mini language.	<b>3</b>
CO4	<u>Design</u> , <u>develop</u> , and <u>implement</u> a compiler for any language.	<b>6</b>

**Lab Details:**

### 1. Basic

- a. Write a program to create a functions for string handling.  
i) Strlen(); ii) Strcpy(); iii) Strcat(); iv) Strcmp(); v) Strupr();
- b. Write a C program to Scan and Count the number of characters, words, and lines in a file.

### 2. Lexical Analyzer

- a. Design a lexical analyzer for the given language. The lexical analyzer should ignore redundant spaces, tabs and new lines, comments etc.
- b. Implementation of Lexical Analyzer using Lex Tool.

### 3. Tokens, Lexemes and Patterns

- a. Write a program to identify whether a given line is a comment or not.
- b. Write a program to check whether a given identifier is valid or not.
- c. Write a program to recognize strings under 'a', 'a\*b+', 'abb'.

### 4. Lexical Analyzer tools

- a. Implement the lexical analyzer using JLex and flex tool.
- b. Study the YACC tool and Evaluate an arithmetic expression with parentheses, unary and binary operators using Flex and Yacc (CALCULATOR)

### 5. NFA'S & DFA'S

- a. Write a C program to implement NFAs that recognize identifiers, constants, and operators of the mini language.

- b. Write a C program to implement DFAs that recognize identifiers, constants, and operators of the mini language. \
- c. Write a program to minimize any given DFA.
- d. Write a program to find  $\epsilon$  – closure of all states of any given NFA with  $\epsilon$  transition.

#### **6. Study of YACC and JFLAP**

- a. Generate YACC specifications for a few syntactic categories.
  - i) Program to recognize a valid arithmetic expression that uses operator +, −, \* and /.
  - ii) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
  - iii) Using JFLAP, create a DFA from a given regular expression.

#### **7. Semantic Analyzer and Symbol Table**

- a. Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, + and \* and computes the value.
- b. To write a C program to implement a symbol table.

#### **8. Top Down Pasing**

- a. Write a program to implement Predictive Parsing algorithm.

#### **9 . LL(1) Parsing**

- a. Create LL(1) parse table for a given CFG and hence Simulate LL(1) Parsing
- b. Write functions to find FIRST and FOLLOW of all the variables.

#### **10. Bottom Up Parsing**

- a. Write a program to design a LALR bottom up parser for the given language.
- b. Using JFLAP create SLR(1) parse table for a given grammar. Simulate parsing and output the parse tree proper format.
- c. Develop an operator precedence parser for a given language.

#### **11. Syntax Directed Translation**

- a. Write program to generate machine code from the abstract syntax tree generated by the parser. The following instruction set may be considered as target code.
- b. Convert the BNF rules into YACC form and write code to generate abstract syntax tree.

#### **12. Code Generation**

- a. Write a C program to generate three address code.
- b. Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using an 8086 assembler. The target assembly instructions can be simple move, add, sub, jump etc.

#### **13. Run time Environment**

- a. Write a program to perform loop unrolling.
- b. Write a program to perform constant propagation.

#### **14. Case Study**

- a. UML Diagram for ATM Transaction System.
- b. UML Diagram for College Administration System.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
-	Computer Graphics Lab	ITL043	0-0-2-1
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
100 Marks	40	-	60

**Pre-requisites:** C programming

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcomes	Bloom's Taxonomy Level
CO1	<u>Apply</u> programming for graphics problem-solving using code-blocks.	3
CO2	<u>Illustrate</u> the use of functions and various decision and loop control structures to implement various algorithms.	4
CO3	<u>Assess</u> diverse use cases of clipping in 2D and 3D	5
CO4	<u>Build</u> animations.	6

**Lab Details:**

### 1. Installation of code-blocks software

- a. Installation of Code-blocks.
- b. Introduction to Code-blocks.

### 2. DDA Line drawing Algorithm

- a. Develop a DDA algorithm for drawing the line with two endpoints on a raster scan pixel screen.
- b. Write a program for the DDA algorithm and run it with different input points. Use the `putpixel(int, int, int)` function instead of `setpixel()`.
  - I. Does the line get plotted according to the coordinates mentioned in the input? If not, explain the orientation of the line.
  - II. Study the `putpixel()` function and use it to change the color of the line.

### 3. Bresenham's Line Drawing Algorithm

- a. Develop a Bresenham's algorithm for drawing the line with two endpoints on a raster scan pixel screen.
- b. Write a program to demonstrate the above operation. Plot the line with default color first and further give the user choice for the line color.

### 4. Circle drawing Algorithm

- a. Develop a Mid-point algorithm for drawing a circle with center points and radius on a raster scan pixel screen.

- b. Write a program for plotting a circle using the Midpoint algorithm. Plot the circle with default color first and then give the user choice for the circle color. (At least 3 choices)

### **5. Ellipse drawing Algorithm**

- a. Write a program for plotting an ellipse using Mid-Point algorithm. Plot the ellipse with default colour and type first and then give the user choice for the ellipse colour. (At least 3 choices).
- b. Write a programme to plot a line using Bresenham's Line plotting algorithm. Plot the line with default type first and then give the user choice for the line type.

### **6. Line Capping**

- a. Write a program to plot a thick line. Give the user choice for the line width. Then apply the following caps:
  - I. Butt cap
  - II. Round cap
  - III. Projecting square cap (all the caps should be plotted on the same window)

### **7. Creating various types of texts and fonts**

- a. Write a program for displaying text in different sizes, different colors, different font styles.

### **8. Polygon filling Algorithms**

- a. Write a program for polygon filling (boundary fill). Extend it to circle and ellipse filling.
- b. Write a program to fill a polygon with different coloured edges using any colour through flood fill algorithm.

### **9. 2D Transformation**

- a. Write a program to demonstrate the following:
  - I. Translation of a line segment.
  - II. Rotation of a line segment.
- b. Magnify a triangle to four times its size while keeping one of the vertices as a fixed point.
- c. Rotate a triangle (70 degree) w.r.t. any of the edges.

### **10. 3D Transformation**

- a. Write a C-program for performing the basic transformations such as translation, Scaling, Rotation for a given 3D object

### **11. Line Clipping**

- a. Write a programme to clip a line outside the window boundary using Cohen-Sutherland line clipping algorithm.
- b. Write a program to clip a line outside the window boundary using the Liang-Barskey line clipping algorithm.

### **12. Polygon clipping**

- a. Write a programme to clip a polygon outside the window boundary using Sutherland-Hodgeman line clipping algorithm.

### **13. Curve Generation**

- a. Write a program for generating a curve for a given set of control points.

### **14. Simple animations using transformations. For example:**

- i. Sun/Moon moving from left to right and vice versa.
- ii. ROBOT
- iii. Wind mill rotation.
- iv. Man walking in rain.
- v. Simple animation of football goal.

Year (Semester)	Course Title	Course Code	L-T-P-Credits
3rd - V	Python Programming	ITT044	2-0-2-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Basic computer literacy, Basic problem-solving skills, fundamental mathematical skills.

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	Understand the fundamental concepts of Python programming, including variables, expressions, conditionals, loops, functions, and recursion.	2
CO2	Apply appropriate data structures such as strings, lists, tuples, sets, and dictionaries to solve computational problems.	3
CO3	Analyze and manipulate datasets using NumPy and Pandas for effective data processing and transformation.	4
CO4	Create visual representations of data using Matplotlib and Seaborn and demonstrate familiarity with advanced Python libraries such as Scikit-learn, TensorFlow, PyTorch, OpenCV, and NLTK.	6

**Detailed Syllabus:**

Module No.	Contents	Hours
Module 1	<p><b>Introduction:</b> Introduction to Python, programming languages, and programming errors.</p> <p><b>Variables, expressions and statements:</b> Identifiers, variables, assignment statements, expressions, named constants, simultaneous assignment, Boolean types, numeric data types, operators, operator precedence and associativity, augmented assignment operators, type conversion, and rounding.</p> <p><b>Conditionals and iteration:</b> Conditional expressions, random numbers, minimizing numerical errors, if statement, two-way if-else, nested if and multi-way if-elif-else statements, for loop, while loop, nested loops, break, and continue.</p> <p><b>Functions and recursion:</b> Defining a function, function call, return values, positional and keyword arguments, passing arguments by reference values, scope of variables, default arguments, returning</p>	10

	multiple values, recursion, recursion vs iteration, tail recursion, math functions.	
<b>Module 2</b>	<p><b>String:</b> string as a compound data type, length, string traversal, string slices, comparison, string functions, the str class.</p> <p><b>Lists:</b> List basics, copying lists, passing lists to functions, returning lists from functions, searching and sorting lists, and multidimensional lists.</p> <p><b>Tuples, sets, and dictionaries:</b> Introduction to tuples, operations on tuples, introduction to sets, set operations, creating a dictionary, adding, modifying, and retrieving values, deleting items, dictionary methods, operations on dictionaries.</p> <p><b>Files and exceptions:</b> Introduction, text input and output, pickling, exception handling, raising exceptions.</p>	<b>10</b>
<b>Module 3</b>	<p><b>Numpy arrays:</b> Arrays vs lists, data types, array creation routines, arrays from existing data, indexing and slicing, array manipulation, broadcasting, binary operators, mathematical functions, statistical functions, sort, search, and counting functions</p> <p><b>Handling data with pandas:</b> Introduction to pandas, series, data frame, descriptive statistics, sorting, working with CSV files, operations using data frames.</p> <p><b>Object-oriented programming terminology:</b> Creating classes, creating instance objects, accessing attributes, overview of OOP terminology, Class Inheritance, Overriding Methods, Data Hiding, Function Overloading.</p>	<b>12</b>
<b>Module 4</b>	<p><b>Data visualization with matplotlib and seaborn:</b> Line plot, multiple subplots in one figure, histograms, bar charts, pie charts, scatter plots; seaborn- color palette, histogram, kernel density estimates, plotting categorical data, facet grid, and pair grid.</p> <p><b>Introduction to Python libraries:</b> Scikit-learn, Tensorflow, PyTorch, OpenCV, nltk.</p>	<b>10</b>

#### Books Recommended:

1. Introduction To Programming Using Python By Y. Daniel Liang, Pearson
2. Python For Everybody. Author: Charles R. Severance. Publisher: Shroff Publishers.

#### References:

1. Python Programming: Using Problem-Solving Approach By Reema Thareja, Oxford University Press

Year (Semester)	Course Title	Course Code	L-T-P-Credits
3rd - VI	Fundamentals of Machine Learning	ITT045	2-1-0-3
Evaluation Policy	Mid-Term	Internal Assessment	End-Term
	26 Marks	24 Marks	50 Marks

**Pre-requisites:** Probability and Statistics, Linear Algebra, Python Programming

**Course Outcomes:** At the end of the course, the student will be able to:

COs	Course Outcome	Bloom's Taxonomy Level
CO1	Apply supervised learning techniques to learn the data dependencies	3
CO2	Evaluate the effect of learning techniques on the overall learning performance	5
CO3	Apply the artificial intelligence techniques to the classification of images	3
CO4	Design Machine Learning strategies for real world problems	6

**Detailed Syllabus:**

Module No.	Contents	Hours
<b>Module 1</b>	<b>Introduction to Machine Learning</b> Introduction to Machine Learning (ML), Types of ML: Supervised, Unsupervised, Reinforcement Learning; Linear Algebra review, Machine Learning workflow, Data in Machine Learning: Numerical, Categorical, Time-Series, Images, Introduction to Python Libraries for Machine Learning	<b>8</b>
<b>Module 2</b>	<b>Supervised Learning and Unsupervised Learning</b> Regression: Linear Regression- Cost Function, Gradient Descent with single and multivariable, Regularization Techniques (LASSO), Polynomial Regression Classification:- Logistic Regression-Hypothesis Representation, Decision boundary, Cost Function, Multi-class Classification Model evaluation: confusion matrix, precision, recall, F1-score, ROC. Clustering using K-Means, K-Means Issues, Dimensionality reduction using Principal Component Analysis.	<b>16</b>
<b>Module 3</b>	<b>Artificial Neural Networks</b> Introduction to neural networks, Simple Perceptron, Activation Functions, Training neural networks using backpropagation, Regularizing neural networks, Brief introduction to Convolution	<b>10</b>
<b>Module 4</b>	<b>Machine Learning Applications</b> Applications of Machine Learning across major engineering domains; Use cases from Mechanical, Civil, Electrical, Electronics, Chemical, and Materials	<b>6</b>

	Engineering; Problem identification, data sourcing, and model selection in domain-specific scenarios	
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**Books Recommended:**

1. Pattern Recognition and Machine Learning – Christopher M. Bishop
2. Machine Learning: A Probabilistic Perspective – Kevin P. Murphy
3. Understanding Machine Learning: From Theory to Algorithms – Shai Shalev-Shwartz and Shai Ben-David
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron