Semester V
Name of the Programme: Electronics and Computer Science
Course Code: ECS510
Title of the Course: Electronic Communication Systems
Number of Credits: 04
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Basics of Signal Processing, Analog and Digital Electronics</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. An understanding of fundamental concepts of analog and digital modulation techniques.
2. Knowledge about the sampling process, pulse modulation and multiplexing.
3. An introduction to noise theory and its impact on performance of modulation schemes.
4. An understanding of the functions of a communication transmitter and receiver.
5. An introduction to the underlying theory behind optimum receiver design.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS510.1</td><td>Explain fundamental concepts of analog and digital communication</td></tr>
<tr><td>ECS510.2</td><td>Classify and compare different analog and digital modulation schemes</td></tr>
<tr><td>ECS510.3</td><td>Analyze the performance of a communication system in presence of noise and impairments</td></tr>
<tr><td>ECS510.4</td><td>Model and design basic sub-systems of a typical analog and digital communication link</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>
<table>
<tr><td>UNIT- I</td><td></td></tr>
<tr><td>An Overview of Electronic Communication Systems: Block Diagram Representation, Analog vs. Digital Communication, Need for Frequency Translation - Modulation and Multiplexing, Types of Transmission Media. Signal Multiplexing: Frequency Division Multiplexing & Time Division Multiplexing
Analog Modulation: Amplitude Modulation (AM) – Mathematical Representation of AM signal, Modulation Index, Double Side-band Suppressed Carrier (DSB-SC)-Balanced Modulator, Coherent detection, DSB with Carrier (DSB-C)-Envelope Detector, Single Sideband Suppressed Carrier (SSB-SC) Generation: Filter Method, Phase Shift Method, The Third Method, Coherent Detection, Comparison based on Spectrum (Modulation Bandwidth) and Power Efficiency</td><td>15 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Angle Modulation: Frequency Modulation (FM) - Mathematical Representation of FM signal, Modulation Index, Tone Modulated FM Signal, FM Spectrum, Bandwidth, Carson’s Rule, Narrowband</td><td>15 Hrs</td></tr>
</table></td></tr>
</table>

	and Wideband FM (Classification). Phase Modulation (PM) – Mathematical Representation, Relationship between FM and PM. Noise in FM – Calculation of SNR, Comparison with AM. **Sampling:** Low Pass Sampling Theorem, Natural Sampling, Flat-top sampling, Signal Recovery through holding. **Pulse Modulation Techniques:** PAM, PPM and PWM **Quantization of Signals:** Quantization Error, Mid-rise & Mid-tread quantizers, Uniform & Non-uniform quantizers, Companding- μ-Law and A-Law.	
	UNIT-3	
	Pulse digital modulation techniques: Pulse code modulation; Differential Pulse Code Modulation, Delta modulation, Adaptive Delta Modulation. **Digital Modulation:** Keying Techniques – Mathematical Representation, Generation and Reception Scheme (Block Level), and Spectrum (Nominal Bandwidth) of: Amplitude Shift Keying (ASK), Binary Phase Shift Keying (BPSK), Differential PSK (DPSK), Quadrature Phase Shift Keying (QPSK), M-ary PSK, Binary Frequency Shift Keying (BFSK), Quadrature Amplitude Shift Keying: 16-QASK.	**15 Hrs**
	UNIT-4	
	Principle and block level representation of Super heterodyne Receiver, Choice of Intermediate Frequency, Image Frequency and its rejection. **Optimum Receiver:** Baseband Signal Receiver (Integrate-and-Dump) –Peak SNR, Probability of Error, Maximum Likelihood Detector and Bayes' Receiver, Optimum Receiver for Baseband and Pass band, Calculation of Optimum Filter Transfer Function, Realization using Matched Filter and Correlator	**15 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Taub, H., Schilling, D., Saha, G., "Principles of Communication Systems", Third Edition, Tata McGraw Hill. 2. Kennedy, G., Davis, B., Prasanna, S.R.M., "Electronic Communication Systems", Fifth Edition, Tata McGraw Hill. **REFERENCE BOOKS:** 1. Singh, R.P., Sapre, S.D., "Communication Systems: Analog and Digital", Third Edition, Tata McGraw Hill. 2. Haykin, S., "Communication Systems", Fourth Edition, John Wiley & Sons. 3. Proakis, J., Salehi, M., "Fundamentals of Communication Systems", Pearson Education, 2007.	

Name of the Programme: Electronics and Computer Science
Course Code: ECS520
Title of the Course: Database Systems Concepts
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Fundamental Programming Skills, Understanding of Data Structures and Algorithms, Operating System Concepts, Mathematical and Logical Reasoning</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
Introduction of basics of database management system like SQL, ER model, transaction processing- concurrency control for effective database design
Fundamentals of NoSQL</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to:<table><tr><td>ECS 520.1</td><td>Explain data modeling concepts and apply relational algebra and SQL queries effectively in database management tasks.</td></tr><tr><td>ECS 520.2</td><td>Analyze database designs, perform normalization, and create ER/EER diagrams for efficient representation of real-world scenarios.</td></tr><tr><td>ECS 520.3</td><td>Analyze transaction processing and concurrency control mechanisms, and compare relational and NoSQL databases to evaluate their suitability for different applications.</td></tr><tr><td>ECS 520.4</td><td>Evaluate SQL queries for efficiency and assess the performance implications of concurrency control mechanisms, fostering critical thinking in database management decisions.</td></tr></table></td></tr>
<tr><td rowspan="4">Content:</td><td>UNIT- 1</td><td></td></tr>
<tr><td>Databases and Database Users :Introduction, Characteristics of the Database Approach, Advantages of Using the DBMS Approach When Not to Use a DBMS
Database System Concepts and Architecture: Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages, The Database System Environment
Data Modelling Using the Entity-Relationship (ER) Model: Using High-Level Conceptual Data Models for Database Design, Entity Types, Entity Sets, Attributes, and Keys Relationship Types, Relationship Sets, Roles, and Structural Constraints Weak Entity Types, ER Diagrams, Naming Conventions, and Design Issues</td><td>11 Hrs</td></tr>
<tr><td>UNIT- 2</td><td></td></tr>
<tr><td>Relational Model Concepts: Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations
The Relational Algebra and Relational Calculus: Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations.</td><td>12 Hrs</td></tr>
</table>

	Basic SQL:SQL Data Definition and Data Types, Specifying Constraints in SQLM, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL, Additional Features of SQL **More SQL:** Complex Queries, Triggers, Views, and Schema	
	UNIT- 3	
	The Enhanced Entity-Relationship (EER) Model: Subclasses, Super classes, and Inheritance Specialization and Generalization, Constraints and Characteristics of Specialization, and Generalization Hierarchies, Modelling of UNION Types Using Categories **Relational Database Design by ER and EER-to-Relational Mapping:** Relational Database Design Using ER-to-Relational Mapping, Mapping EER Model Constructs to Relations **Basics of Functional Dependencies and Normalization for Relational Databases:** Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms-First, Second and Third, Boyce-Codd Normal Form **Relational Database Design Algorithms and Further Dependencies** : Inference Rules, Equivalence, and Minimal Cover	**12 Hrs**
	UNIT- 4	
	Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability **Concurrency Control Techniques:** Two-Phase Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering, Multiversion Concurrency Control Techniques, Validation (Optimistic) Concurrency Control Techniques **Getting started with NoSQL:** NoSQL, why NoSQL? SQL vs NoSQL, ACID vs BASE, CAP theorem.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Elmasri, R., Navathe, S., "Fundamentals of Database Systems", 7th Edition, Pearson, 2018. 2. Silberschatz, A., Korth, H.F., Sudarshan, S., "Database System Concepts", 6th Edition, McGraw Hill, 2013. **REFERENCE BOOKS:** 1. Ramkrishnan, R., Gehrke, J., "Database Management Systems", 3rd Edition, McGraw-Hill, 2002. 2. Archarya, S., "Demystify NoSQL", 1st Edition, Wiley.	

Name of the Programme: Electronics and Computer Science
Course Code: ECS531
Title of the Course: Open Source Software Development
Number of Credits: 3
Effective from AY: 2024-25

Pre-requisites for the Course:	Basic knowledge of Programming		
Course Objectives:	The subject aims to provide the student with: 1. Knowledge of Open Source and Proprietary software and Licensing 2. Understanding of various Open-Source Technologies, methodologies, Project and ethics 3. Various case studies in open-source technology 4. Understanding of Version Control Systems and project management using GitHub		
Course Outcomes:	Upon completion of the course, students will be able to		
	ECS 531.1	Differentiate between Open Source and Proprietary software and Licensing	
	ECS 531.2	Recognize the applications, benefits and features of Open-Source Technologies, methodologies, Project and ethics	
	ECS 531.3	Reflect on various case studies in open-source technology	
	ECS 531.4	Interpret the Version Control Systems and project management using GitHub	
	UNIT 1		
Content:	**Introduction to Open-Source:** Need for Open-Source, Open Source & its principles; Open Standards Requirements for Software and its Success. Free Software & its examples, Free Software License Provider, Free Software Vs. Open-Source Software, Public Domain, FOSS, Proprietary Vs. Open-Source Licensing Model, Companies usage with respect to Open-source software.		**11 Hrs**
	UNIT 2		
	Open-Source Methodology: Open-Source Initiatives, Open standard principles, Methodologies, Philosophy, software freedom, Open-source software development, Licenses, Copyright, Copyleft, Patent, Zero-marginal cost, Income-generation opportunities, Internationalization. **Open-Source Project**: Starting, Maintaining, Open-Source Hardware, Design **Open-Source Ethics**: Open Vs Closed Source, Government, Ethics, Impact of Open-source Technology, Shared Software, Shared Source		**12 Hrs**
	UNIT 3		
	Case Studies: APACHE – history, features, usage, licenses, licensing of distributions, Berkeley Software Distribution (BSD) Technology and its significant descendants Linux – Introduction, popularity, history, current applications, user interface, Future of Linux, properties, Linux flavors, Basic Linux		**12 Hrs**

	commands GCC – history, languages, processors, structure, front end, optimization, backend, debugging. Open Office – features, platforms, components, file formats, MS interoperability, Star office, development, Graphical Presentation Version Wise.	
	UNIT 4	
	Version Control Systems: Need, choices, Git, Installation and Setting up Git **Getting started with Git**: Repositories, Working directory, Staging area, Commits;Remote Git. **GitHub Primer:** Overview, GitHub and Open Source, Personal Use, GitHub forbusinesses. **Quick Start with GitHub:** Project management, Remote repositories, linking repositories, Pushing to remote repositories.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Vadera, K., Gandhi, B., "Open-Source Technology", 1st Edition, Laxmi Publications Pvt Ltd, 2012. 2. Tsitoara, M., "Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", 1st Edition, Apress, 2020. **REFERENCE BOOKS:** 1. Deek, F.P., McHugh, J.A.M., "Open Source: Technology and Policy", Cambridge University Press, 2007.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP532
Title of the Course: Software Engineering
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Object Oriented Programming using Java, Database Management system</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An understanding of the current issues and practices in software engineering with an emphasis on the software development process.
2. An ability to understand the software planning and management.
3. Ability to plan software requirements specifications, system modelling, quality specifications, and program specifications.
4. An understanding of software design approaches.
5. An understanding of the requirements of software project management.
6. An ability to recognize social, ethical, cultural, and safety issues in software deployment.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 532.1</td><td>Plan a design of software system as per the specification.</td></tr>
<tr><td>ECOMP 532.2</td><td>Implement a software system with readable, reusable, modular and object oriented techniques.</td></tr>
<tr><td>ECOMP 532.3</td><td>Design a test procedure for validity, correctness and completeness.</td></tr>
<tr><td>ECOMP 532.4</td><td>Implement a software maintenance schedule.</td></tr>
</table></td></tr>
<tr><td rowspan="6">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Scope of software engineering: Historical Aspects, Economic Aspects, Maintenance Aspects, Requirements, Analysis and Design Aspects, Team Development Aspects.
Software Life-Cycle Models: Code-and-Fix Life-Cycle Model, Waterfall Life- Cycle Model, Rapid-Prototyping Life-Cycle Model, Open Source Life-Cycle Model, Agile Processes, Synchronize-and-Stabilize Life-Cycle Model, Spiral Life- Cycle Model.
Software Process: The Requirements Workflow, The Analysis Workflow, The Design Workflow, The Implementation Workflow, The Test Workflow, Post-delivery Maintenance, Retirement Capability Maturity Models.</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>The Tools of the Trade: CASE, Taxonomy of CASE, Scope of CASE, Software Versions, Configuration Control.
From Modules to Objects: Cohesion, Coupling, Data Encapsulation.
More on UML: Class Diagrams, Use-Case Diagrams, Interaction Diagrams, State Charts, Activity Diagrams.</td><td>11 Hrs</td></tr>
<tr><td>UNIT -3</td><td></td></tr>
</table>

	Testing: Quality Issues, Non-Execution-Based Testing, Execution-Based Testing, Testing versus Correctness Proof and stopping criteria. Planning and Estimating: Planning and the Software Process, Estimating Duration and Cost. **Requirements:** Determining what the Client Needs, Overview of the Requirements Workflow, Understanding the domain, The Business Model, Initial Requirements, Metrics and Challenges for Requirement Workflow.	**12 Hrs**
	UNIT -4	
	Design and Abstraction: Operation Oriented Design, Data Flow Analysis, Data Oriented Design, Object-Oriented Design, Challenges and Metrics for Design. **Testing Techniques:** Test Case Selection, Black-Box Unit-Testing Techniques, Glass-Box Unit-Testing Techniques, Code Walkthroughs and Inspections, Integration Testing, Product Testing, Acceptance Testing. **Post-delivery Maintenance:** Development and Maintenance, Management of Post-delivery Maintenance. Reverse Engineering, Testing during Post-delivery Maintenance, Metrics and Challenges for Post-delivery Maintenance.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Stephen R. Schach, Object-Oriented and Classical Software Engineering; TMH, 8th Edition. 2. Edward Kit, Software Testing in the Real World: Improving the Process,1st Edition, Addison – Wesley Publishing company, 1995 3. Pankoj Jalote, Software Project Management in Practice, Addison-Wesley PEA 5. Ian Sommervilee, Software Engineering, 10th Edition Pearson. **REFERENCE BOOKS:** 1. Roger Pressman, Software Engineering: A Practitioner's Approach, 7th Edition,McGraw-Hill, 2010. 2. Ian Sommerville, Software Engineering,9th Edition, Addision-Wesley, 2016.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP533
Title of the Course: Soft Computing
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Engineering Mathematics, Basics of Algorithms</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An Introduction to Soft Computing Techniques and its applications
2. An Understanding of Neural Networks and its training methodologies
3. An Understanding of Fuzzy Logic and Fuzzy Inference Systems
4. An Understanding of Genetic Algorithms and Evolutionary Algorithms
5. An Introduction to Deep Learning, Expert Systems and Hybrid Systems</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to :
<table>
<tr><td>ECOMP 533.1</td><td>Explain different types of Soft Computing techniques and its applications</td></tr>
<tr><td>ECOMP 533.2</td><td>Design Neural Networks and understand deep neural networks and its applications</td></tr>
<tr><td>ECOMP 533.3</td><td>Design Fuzzy Inference Systems to solve Real-Life Problems</td></tr>
<tr><td>ECOMP 533.4</td><td>Apply Evolutionary Algorithms to optimization problems and explain types of hybrid systems</td></tr>
</table></td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Introduction to Soft Computing: Soft Computing versus Hard Computing, Soft-Computing Techniques: Artificial Neural Networks, Fuzzy Systems, Evolutionary Algorithms.
Types of Problems: Classification, Functional Approximations, Optimizations.
Neural Networks: Mc-Culloch Pitt’s neuron model, Activation functions, Basic gates.Neural learning, Training algorithms-Hebbian learning rule, Perceptron learning rule, Delta learning rule, Widrow-Hoff learning rule and related problems. Error back propagation algorithm or generalized delta rule.
Setting of parameter values and design considerations-Initialization of weights, Frequency of weight updates, Choice of learning rate, Momentum, Generalizability, Network size, Sample size.</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Fuzzy Logic: Introduction, Classical Set Theory (Crisp Set): Operations & Properties, Fuzzy Set Theory: Operations & Properties, Membership Functions and types, Fuzzy v/s Crisp Sets, Classical relations (Cartesian product) and Fuzzy relations: Cardinality, Operations, Properties and Composition, Tolerance and Equivalence Relations.
Crisp Logic vs Fuzzy logic, Fuzzy logic operations: AND, OR, NOT, Implication, Aggregation and Defuzzification, Lambda-cuts or</td><td>12 Hrs</td></tr>
</table>

	Alpha-cuts for fuzzy, Types of Defuzzification. Fuzzy Inference Systems and its design, Fuzzy Process, Type-2 fuzzy sets, Sugeno Fuzzy System.	
	UNIT -3	
	Genetic Algorithms: Concept, Solution, Initial Population, Genetic Operators, Fitness Function, Stopping Condition. Fitness Scaling, Selection, Mutation, Crossover, Other Genetic Operators, Algorithm Working, Diversity. **Other Evolutionary Algorithms:** Particle Swarm Optimization, Differential Evolution, Artificial Bee Colony & Cuckoo Search Algorithm, Ant Colony Optimizations, Travelling Salesman Problem.	**11 Hrs**
	UNIT -4	
	Artificial Intelligence: What is AI? Problem Solving in AI. **Expert Systems:** Architecture, Expert System Design. **Deep Neural Networks:** Introduction & Necessity of deep neural networks (DNN), Auto Encoder DNN, Convolutional neural networks: Convolution operation, Motivation and Pooling. **Hybrid Systems:** Sequential, Auxiliary and Embedded Hybrid Systems, Types of Hybrid Systems: Neuro-Fuzzy, Neuro-Genetic, Fuzzy Genetic Hybrid Systems- Advantages and Applications	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Anupam Shukla, Ritu Tiwari, Rahul Kala; Real Life Applications of Soft Computing; 2010, CRC Press,1st Edition, 2. Rajasekaran, G. A. Vijayalakshmi Pai; Neural Networks, Fuzzy Logic and Genetic Algorithm, PHI Learning Pvt, Ltd June 2013. 3. S. N. Sivanandan and S. N. Deepa, Principles of Soft Computing, 3rd Edition, WileyIndia,3rd Edition 4. J. Zurada; Introduction to Artificial neural network; JaicoPublications2012,1st Edition **REFERENCE BOOKS:** 1. Kishan Mehrotra, Chilukuri Mohan, Sanjay Ranka; Elements of Artificial Neural Network; Penram Publications. 2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press. 3. Charu C. Aggarwal, Neural Networks and Deep learning, Springer Publications. 4. Timothy J. Ross; Fuzzy Logic with Engineering Applications, 3 rd Ed., Wiley-India	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP534
Title of the Course: Design and Analysis of Algorithms
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Data structure concepts, Discrete structures</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An understanding to analyze the asymptotic performance of algorithms.
2. Ability to write rigorous correctness proofs for algorithms.
3. Ability to demonstrate a familiarity with major algorithms and data structures.
4. An understanding to apply important algorithmic design paradigms and methods of analysis.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 534.1</td><td>Demonstrate how Divide and Conquer algorithm are used to solve various classes of engineering problems and compute their time and space complexities.</td></tr>
<tr><td>ECOMP 534.2</td><td>Apply the different algorithm design techniques like greedy approach, dynamic programming for problem solving.</td></tr>
<tr><td>ECOMP 534.3</td><td>Demonstrate how backtracking and branch and bound approaches are used to solve various real-time problems.</td></tr>
<tr><td>ECOMP 534.4</td><td>Describe the different algorithm classes P, NP, and NP-Complete, Randomized, Probabilistic and Approximation.</td></tr>
</table></td></tr>
<tr><td rowspan="6">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Algorithm Analysis & Complexity: Algorithm Definition and Specification, Performance analysis (Space complexity, Time complexity, Asymptotic Notations), Solving Recurrence – Iteration, recursion tree and master method.
Divide and Conquer: General method, Binary Search, Merge sort, Quick sort, Finding Min-Max, Finding kth smallest element, Strassen’s matrix multiplication</td><td>11 Hrs</td></tr>
<tr><td colspan="2">UNIT-2</td></tr>
<tr><td>Greedy Method: General Method, Knapsack Problem, Minimum cost Spanning tree, Single source shortest path.
Dynamic Programming: General Method, Multistage Graphs, All pair shortest paths, Single source shortest path with General weights, Optimal Binary Search Tree, 0/1 knapsack problem, Travelling salesperson problem.</td><td>12 Hrs</td></tr>
<tr><td colspan="2">UNIT -3</td></tr>
<tr><td>Backtracking: General Method, 8-queens problem, Sum of subsets problem, graph coloring, Hamiltonian Cycles, knapsack problem.</td><td>11 Hrs</td></tr>
</table>

	Branch-and-Bound: General Method, 0/1 knapsack, Travelling salesperson problem.	
	UNIT -4	
	String and Pattern Matching Algorithms :Brute Force, KMP, Boyer Moore, Tries **Text compression:** Huffman Coding. **Text similarity testing:** LCS. **NP-Hard and NP-Complete Problems:** Basic concepts, NP-Hard Graph Problems: Clique Decision Problem , Randomized, Probabilistic and Approximation Algorithms. Management of Post-delivery Maintenance. Reverse Engineering, Testing during Post-delivery Maintenance, Metrics and Challenges for Post-delivery Maintenance.	**12 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. E. Horowitz, S. Sahini, S. Rajasekaran; Fundamentals of Computer Algorithms; Galgotia publication, 2nd Edition. 2. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest Clifford Stein, Introduction to Algorithms, 3rd Edition, MIT Press/McGraw-Hill. **REFERENCE BOOKS:** 1. Michael T Goodrich and Roberto Tamassia , Algorithm Design: 2. Foundations, Analysis, and Internet Examples, 2nd Edition, Wiley. 3. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, PHI. 4. Jon Kleinberg and Éva Tardos, Algorithm Design, 1st Edition, Pearson.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP535
Title of the Course: Computer Graphics
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Knowledge of C Programming and Basic Mathematics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. Introduce fundamental concepts and theory of Computer Graphics.
2. Knowledge about computer graphics hardware and software used.
3. Understanding of drawing algorithms, polygon filling, clipping and transformation both in 2D and 3D graphics.
4. Ability to understand methods used in modeling motion in the real world.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP 535.1</td><td>Identify and apply various graphic primitives used in generating computer graphics.</td></tr><tr><td>ECOMP 535.2</td><td>Application of 2d and 3d transformation and clipping used in graphical applications.</td></tr><tr><td>ECOMP 535.3</td><td>Discuss the basics of curves and surfaces used to represent graphical models.</td></tr><tr><td>ECOMP 535.4</td><td>Explain techniques involved in visible surface detection, color models and computer animation.</td></tr></table></td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Introduction to Computer Graphics: characteristics of Computer Graphics, components of a computer Graphics System, Classification of Computer Graphics system.
Display Devices: LCD, Plasma Panel, LED and OLED displays.
Overview of graphics systems: Raster scans systems, Random scan systems.
Output Primitives: Points and lines, Line drawing algorithms, DDA, Bresenham’s line algorithm, Circle generating algorithms, Properties of circles, Midpoint circle algorithm, Ellipse generating algorithm, Properties of Ellipses, Midpoint ellipse algorithm.
Filled area primitives: Scan line polygon Fill algorithm, Inside – outside tests, Scan line fill of curved boundary, Boundary fill algorithm, Flood fill algorithm, Fill area functions.</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Two Dimensional Geometric Transformations: Basic Transformations, Translation, Rotation, Scaling, Composite transformation, Translations, Rotations, Scaling, Other transformations- Reflection, Shear.
Two-Dimensional Viewing: The viewing pipeline, Viewing coordinate reference frame, Window to viewport coordinate transformation, 2-D viewing functions.
Clipping operations: Point Clipping, Line clipping, Cohen-Sutherland Line Clipping, Polygon Clipping, Sutherland Hodgeman</td><td>11 Hrs</td></tr>
</table>

	Polygon clipping, Weiler- Atherton Polygon Clipping, Curve clipping, Text clipping.	
	UNIT -3	
	Three Dimensional Concepts: 3-Dimensional display methods, Parallel projections Perspective projection, Depth cueing, Surface rendering, Exploded and cutaway views. Three-Dimensional Object representations- Polygon surfaces, Polygon tables. **Three Dimensional Geometric and Modeling transformations**: Translation Rotation, Coordinate Axes, rotations, Scaling, Reflections, Shears Three- Dimensional Viewing, **Curves and Surfaces**: Shape Description Requirements, Parametric Functions, Bezier Methods. B-Spline Methods.	**11 Hrs**
	UNIT -4	
	Visible – surface detection algorithms: Back – Face detection, Depth buffer method, A – Buffer method, Scan – Line method, Depth Sorting method, BSP- Tree method, Area Sub-division method. **Color Models and Color Applications**: Properties of light, Standard primaries and the, Chromaticity Diagram, XYZ Color model, CIE Chromaticity Diagram, RGB color model, YIQ Color Model, CMY Color Model, HSV Color Model, HLS Color Model**.** **Computer Animation**: Design of animation sequences, General computer animation functions, Raster Animations, Computer animation languages, Motion specification, Direct motion specification, Goal directed systems Kinematics and dynamics.	**12 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Donald Hearn, M. P. Baker, Computer Graphics, 2nd Edition; Prentice Hall of India Pvt. Ltd. 1999. 2. William Newman, Robert Sproull, Principles of Interactive Graphics, 2nd Edition, Tata McGraw hill publishing company Ltd.1979. **REFERENCE BOOKS:** 1. Er. Rajive Chopra, Computer Graphics (A Practical Approach), S. Chand publications, Revised Edition. 2. N. Krishnamurthy, Introduction to Computer Graphics, Tata McGraw Hill 3. Steven Harrington, Computer Graphics, 2nd Edition, Tata McGraw Hill. 4. Foley, Van Dam, Feiner, Hughe, Computer Graphics: Principles and Practice, 2nd Edition, Addison- Wesley Publishing Company, 1997	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP541
Title of the Course: Control System Engineering
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basic Knowledge of Engineering Mathematics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The course aims to provide the student with:
1. An understanding of basic control system components, signal flow graphs, and transfer functions.
2. An ability to perform time domain analysis and evaluate stability of any given system model
3. An ability to perform frequency domain stability analysis.
4. An ability to design compensators and controllers for a given application</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 535.1</td><td>Explain the types and applications of control systems and approaches towards their time, frequency, stability analysis and design.</td></tr>
<tr><td>ECOMP 535.2</td><td>Apply mathematical modelling and stability analysis techniques to mechanical and electrical systems.</td></tr>
<tr><td>ECOMP 535.3</td><td>Analyze performance and stability of mechanical and electrical systems using time and frequency domain techniques.</td></tr>
<tr><td>ECOMP 535.4</td><td>Perform state space analysis and explain need of compensators and controllers.</td></tr>
</table></td></tr>
<tr><td rowspan="8">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Introduction to control systems: Types of control systems, Examples of Control systems, basic concept of open-loop and closed-loop control systems; Mathematical models of Control System: Mechanical translational and electrical systems.
Conversion of mechanical to analogous electrical systems (force-voltage and force- current analogy);
Block diagrams; Signal flow graph</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Time Response Analysis: Test Signals, Impulse Response, Order and Type of System, Transient response of first and second order systems; Time Domain Specifications, Type -0, -1 and –2 control systems. Steady state error and error constants.
Stability: Stability concept, Location of poles on s-plane for stability, Routh- Hurwitz criterion, Root Locus</td><td>11 Hrs</td></tr>
<tr><td>UNIT -3</td><td></td></tr>
<tr><td>Frequency-domain Analysis: Frequency Domain Specifications, Correlation between time and frequency response, Bode-plots, Polar-plots, Nyquist Stability Criterion and Nyquist-plots</td><td>11 Hrs</td></tr>
<tr><td>UNIT -4</td><td></td></tr>
</table>

	State space variable Analysis: State-Space formulation, state model of linear system, state diagram, State-space representation for mechanical translational and electrical systems. Concepts of Controllability and Observability (Kalman's Method of Testing) **Compensators:** Concept and types of compensators; Realization of Lead, Lag and Lead-Lag compensators using electrical networks **Controllers:** P, I, PI, PD and PID controllers. Response with P, PI, PD and PID Controllers	**12 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Nagoor Kani, Control Systems, RBA Publications, 3rd Edition, Chennai 2. J. Nagrath and M. Gopal, Control Systems Engineering, 7th Edition The New Age International. **REFERENCE BOOKS:** 1. K. Ogata, Modern Control Engineering, 5th Edition, Pearson, 2015. 2. Anand Kumar, Control Systems, 2nd Edition, PHI Learning Pvt. Ltd. 3. K. Jairath, Problems and Solutions of Control Systems with Essential Theory, 5th Edition, CBS Publishers and Distributors 4. U. A. Bakshi, V. U. Bakshi, Control Systems, Technical Publications 5. Salivahanan S., et al, Control Systems Engineering, Pearson Education	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP542
Title of the Course: Power Electronics
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basic Electronic Devices</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The course aims to provide the student with:
1. An Introduction to various power semiconductor devices, their characteristics and operation.
2. An understanding of Thyristor protection, Thyristor firing circuits and Thyristor commutation techniques.
3. Ability to analyse and explain AC-DC converters, DC-DC converters and their operation.
4. An understanding of inverter types, AC voltage controllers and cycloconverters.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP 535.1</td><td>Explain the construction and characteristics of power semiconductor devices.</td></tr><tr><td>ECOMP 535.2</td><td>Explain the thyristor turn on methods, thyristor protection and application of power electronics, different thyristor firing circuits, commutation circuits and connection of SCR.</td></tr><tr><td>ECOMP 535.3</td><td>Explain and analyse thyristor firing circuits, commutation circuits and connections of SCR.</td></tr><tr><td>ECOMP 535.4</td><td>Analyse and explain the AC-DC converters, DC-DC converters, inverters, AC voltage controllers and Cycloconverters</td></tr></table></td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Power Semiconductor Devices: Construction and characteristics of Power diodes, Power Transistors, Power MOSFET, Insulated Gate Bipolar transistors (IGBTs).
Introduction to Thyristor family: Structure, Symbol, V.I. Characteristics of SCR. Two Transistor analogy,Thyristor Turn-on methods, switching characteristics of Thyristor during Turn on & Turn OFF, Thyristor Gate characteristics. Mounting of Thyristor, Series and parallel operation of Thyristor and equalisation circuits. String efficiency problems on series, parallel operation of Thyristors.
Other members of Thyristor Family: DIAC, TRIAC, & GTO: structure, characteristics, applications. Operation and characteristics of UJT.</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Thyristor trigger circuits: R and RC firing circuits (half wave and full wave), Ramp triggering, Ramp and pedestal trigging.
Thyristor commutations: Class A, B, C, D, E and F.
Thyristor protection: over voltage protection, suppression of over voltages, over current protection, di/dt protection, dv/dt protection, crowbar protection, gate protection, snubber circuits.</td><td>12 Hrs</td></tr>
</table>

	AC to DC converters: Principle of phase control, single phase half-wave Thyristor rectifier with R Load, RL load and RLE load. Effect of Free- wheeling diode. Single phase full-wave mid-point & bridge Thyristor converters.	
	UNIT -3	
	DC to DC converters (choppers): principle of operation, Step down, Step up chopper, Control Schemes: Constant frequency scheme, variable frequency scheme, current limit control. Operation of Class A, B, C, D, & E choppers. Problems on basic choppers. **Flyback converters (switching regulator):** Principle of operation of Step-down (Buck), Step-up (Boost), Step up/down (Buck- Boost), Switch mode regulator. **AC Voltage Controllers**: Types, Single Phase Voltage controllers with R and RL Load	**11 Hrs**
	UNIT -4	
	Inverters: Classification, Basic and modified parallel inverter, Basic and modified series inverter. Single phase voltage source inverters: half bridge & full bridge (mathematical analysis). **Cycloconverters:** Principle of cycloconverter operation. Single phase to Single phase cycloconverter. **Applications (Block diagram):** Switched mode Power supply, UPS.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. P. S. Bhimbra, Power Electronics,5th edition, Khanna Publications 2. M. D. Singh, K. B. Khanchandani, Power electronics, 2nd Edition, TMH 3. V. Jagannathan, Introduction to Power Electronics, 1st edition Prentice Hall of India. **REFERENCE BOOKS:** 1. Mohammed H. Rashid, Power Electronics circuits, Devices & application, Prentice Hall 2. M. S. Berde, Thysistor Engineering, Khanna Publications 3. P. C. Sen, Power Electronics. McGraw-Hill Education 4. Vedam Subramanyam. Power Electronics –Devices, Converters and Applications, 2nd Edition, New Age International Publishers Pvt. Ltd	

Name of the Programme: Electronics and Computer Science
Course Code: ECS 543
Title of the Course: Digital Signal Processing and Applications
Number of Credits: 3
Effective from AY: 2024-2025

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Signal systems</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The course aims to provide the student with:
1. Comprehend the principles of signal sampling and its significance.
2. Learn the fundamentals of multi-rate signal processing.
3. Develop the ability to apply DFT to analyse signals in the frequency domain.
4. Understand the design and characteristics of Finite Impulse Response (FIR) and Infinite Impulse response (IIR) filters.
5. Introduce the architecture and features of Digital Signal Processors.
6. Explore the various applications of Digital Signal Processing.</td></tr>
<tr><td rowspan="5">Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to</td></tr>
<tr><td>ECS 543.1</td><td colspan="2">Apply uniform sampling to accurately represent continuous signals in a discrete form.</td></tr>
<tr><td>ECS543.2</td><td colspan="2">Analyse techniques to efficiently process signals at different rates</td></tr>
<tr><td>ECS543.3</td><td colspan="2">Appreciate DFT and apply FFT algorithms to signals and analyse signals in the frequency domain</td></tr>
<tr><td>ECS543.4</td><td colspan="2">Design and analyse both FIR and IIR filters (LPF) to meet specified requirements along with their realisations</td></tr>
<tr><td></td><td colspan="3">UNIT 1</td></tr>
<tr><td rowspan="3">Content:</td><td colspan="2">Digital Signal Processing: Block diagram of a DSP system, advantages and limitations of DSP. Applications of DSP.
Sampling of continuous time signals: Periodic sampling, Frequency domain representation of sampling, Reconstruction of a Band limited signal, Discrete-time processing of Continuous time signals.
Changing the sampling rate using Discrete time processing: Increasing and reducing sampling rate reduction by an integer factor, changing the sampling rate by a non-integer factor.</td><td>10 Hrs</td></tr>
<tr><td colspan="2">UNIT 2</td><td></td></tr>
<tr><td colspan="2">The Discrete Fourier transforms (DFT): Frequency domain sampling, Computation of DFT using classical formula method, and matrix method. Properties of DFT, Computation of Circular convolution using circle method, matrix method and DFT-IDFT method. Deriving Linear Convolution from circular convolution.
Fast Fourier Transform: Efficient computation of DFT, Comparison between direct computations and FFT for finding DFT of a sequence, computational complexity, memory requirement and in-place computations and bit reversal(shuffling), Radix – 2 Decimation-in-time FFT, Decimation-in-Frequency FFT (No derivations expected)</td><td>11 Hrs</td></tr>
</table>

	UNIT 3	
	Filters: Introduction to IIR and FIR filters. Comparison **Realization of Discrete Structures for filters:** FIR Filters: Direct Form, Linear phase and cascade structures, IIR Filters: Direct Form I, Direct Form II, cascade and parallel, Signal flow graphs. **IIR Filters**: IIR Filter design techniques: Design of Discrete-time IIR filters from continuous-time filters. IIR Filter design by impulse invariant method and bilinear transformation. Design of Butterworth and Chebyshev Type-1 low pass filters using impulse invariance and bilinear transformation. **FIR Filters:** Magnitude and phase response of digital filters, frequency response of linear phase FIR filters. Design techniques for low pass FIR filters: Window techniques (Rectangular, Hanning, Hamming, and Blackman).	**13 Hrs**
	UNIT 4	
	Applications of Digital Signal Processing: Introduction, Speech Processing, analysis, and coding; subband coding, channel vocoder, homomorphic vocoder, digital processing of audio signals, radar signal processing, DSP based measurement system **Introduction to Programmable DSP's:** Multiplier and Multiplier Accumulator (MAC), modified bus structure and memory access schemes, pipelining special addressing modes, on-chip memory, on-chip peripherals.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS**: 1. A. V. Oppenheim and R. W. Schafer; Discrete-Time Signal Processing; 3rd Ed.; Pearson. 2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications, 4th Ed., Pearson, 2007 **REFERENCE BOOKS:** 1. P. Ramesh Babu; Digital Signal Processing; 4th Edition; Scitech Publications (India) Pvt Ltd 2. S. Salivahanan; Digital Signal Processing, 3rd Ed.; McGraw Hill Education 3. Sanjit K. Mitra; Digital Signal Processing - A Computer based approach, 2nd Ed.; McGraw Hill Education. 4. Poornachandra, Sasikala; Digital Signal Processing; 3rd Edition; Tata McGraw Hill Education Pvt Ltd.	

Name of the Programme: Electronics and Computer Science
Course Code: ECS544
Title of the Course: Transmission Lines and Antennas
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Mathematics Proficiency, Basic Circuit Theory, Electromagnetics</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to provide the student with:
1. An Ability to explain different coordinate systems, laws of electrostatics and Electromagnetics, Transmission line theory and Antenna concepts.
2. An Ability to analyse Electrostatics and Magneto static fields and propagation of guided waves.
3. Ability to Apply Electromagnetic wave equations in real world problems.
4. An ability to handle design issues in Electromagnetics, Transmission Lines and Guided waves.
5. The knowledge of the basics of memory system, its types, and input-output functionalities</td></tr>
<tr><td rowspan="5">Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to</td></tr>
<tr><td>ECS 544.1</td><td colspan="2">Demonstrate proficiency in explaining and applying coordinate systems, transformations, and vector calculus concepts in diverse physical scenarios</td></tr>
<tr><td>ECS 544.2</td><td colspan="2">Analyze and compute electric and magnetic fields using fundamental laws and equations, including Gauss's Law and Maxwell's equations.</td></tr>
<tr><td>ECS 544.3</td><td colspan="2">Analyse and design transmission lines, understand impedance matching techniques, and utilize tools such as the Smith Chart for practical applications.</td></tr>
<tr><td>ECS 544.4</td><td colspan="2">Explain the principles underlying antenna radiation patterns, analyse the characteristics and configurations of antenna arrays and apply principles of antenna design to optimize linear arrays for efficient electromagnetic radiation</td></tr>
<tr><td rowspan="4">Content:</td><td colspan="3">UNIT- I</td></tr>
<tr><td colspan="2">Review of coordinate systems and transformation: Cartesian, Circular and Spherical coordinates, Circular. Transformation from Cartesian to cylindrical and spherical coordinate system.
Vector Calculus: Differential length, area and volume, Line, surface and volume integrals, Gradient, Divergence of a vector, Divergence Theorem, Curl of a vector, Stoke’s theorem, Laplacian of a scalar, Vector Fields Classification
Electrostatics: Coulomb’s Law and field intensity, Electric Field due to continuous charge distributions (a line charge, a surface charge, a volume charge)</td><td>12 Hrs</td></tr>
<tr><td colspan="2">UNIT-2</td><td></td></tr>
<tr><td colspan="2">Electrostatics: Electric Flux density, Gauss’s law and its Applications Electric Potential, Relationship between E and V –</td><td>11 Hrs</td></tr>
</table>

	Maxwell's equation, electric dipole and flux lines. **Magnetostatics:** Biot Savart Law, Ampere's circuit law, Magnetic Field density, Maxwell's Equations for Static EM fields, Analogy between Electric and Magnetic Circuits	
	UNIT-3	
	Transmission Lines: Transmission Line Parameters & Equations, Expressions for Attenuation constant, Phase constant, velocity of propagation, Lossless Line, Terminated Lossless Line, Lossy Transmission Lines (Low-Loss Line, Distortion less Line, Terminated Lossy Lines), concept of infinite line, Input Impedance, SWR, and Power, Open- and short-circuited lines **The Smith Chart:** Applications of Transmission Lines: Quarter Wave Matching, Single-Stub Matching, Slotted Line (Impedance Measurement)	**12 Hrs**
	UNIT-4	
	Basic Antenna Concepts:– Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front -to-back Ratio. Friss transmission formula. Introduction of point sources, Power patterns and Power theorem. **Antenna Arrays**: Various forms of Antenna arrays, Arrays of point sources: Isotropic point sources of: (i) same amplitude and phase (ii) same amplitude but opposite phase. **Linear array:** Linear array with n isotropic point sources with equal amplitude and spacing, Broadside case, End-fire case	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning.	
References/ Readings:	**TEXTBOOKS**: 1. M. Sadiku; Elements of Electromagnetics, 4th edition; Oxford University Press.2006 2. J.D. Kraus; Antennas and Wave Propagation; McGraw Hill Education. 2010,5th Edition **REFERENCE BOOKS:** 1. Nathan Ida; Engineering Electromagnetics, 2nd Edition; Springer International Edition.2007 2. K. D. Prasad; Antenna & Wave Propagation; Satya Prakashan 2009J.D. Ryder; Networks, Lines and Fields; 2nd Edition, Pearson. 2015	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP545
Title of the Course: Consumer Electronics
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basic Physics and Electronics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An understanding of basic characteristics of sound, microphones, loudspeakers, sound recording with its reproduction and public address systems.
2. An understanding of signal generation to test various sections of TV receiver.
3. An introduction to various electronic household and office appliances.
4. An understanding of the concepts and techniques in marketing.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP545.1</td><td>Explain the concepts related to sound recording and reproduction, TV systems, electrical appliances, marketing planning and strategy.</td></tr><tr><td>ECOMP545.2</td><td>Demonstrate safety awareness and take precautionary measures while handling electronic equipments.</td></tr><tr><td>ECOMP545.3</td><td>Analyze consumer electronic circuits for fault and performance degradation.</td></tr><tr><td>ECOMP545.4</td><td>Design sound recording and reproduction circuits and formulate a marketing plan including marketing objectives, marketing mix, strategies.</td></tr></table></td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Electro acoustical Transducers: Microphones, Loudspeakers, Pick-up characteristics, specifications and applications.
Sound Recording and Reproduction: Principle and Block schematic of disc recording system, magnetic recording system, optical recording system, compact disc and video recording.
Audio Amplifier and subsystems: Audio mixers, tone controls, Graphic equalizers, Features of Hi-Fi and stereo systems, Dolby system, Public Address systems.</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Testing, Alignment and Servicing of Television Receivers: Testing and Alignment of TV receivers, TV Wobbuloscope, Video Pattern Generators, Colour bar generator, Vectroscope, Tuners.
Cable Television: Modern cable TV system, cable TV converter, Cable systems, Satellite Television, Direct to home TV, LED TV.
Digital television: Digital Television Systems, Digital TV Signals, Digitized video parameters.
High-Definition television systems: HDTV Systems, HDTV standards and compatibility.</td><td>12 Hrs</td></tr>
<tr><td colspan="2">UNIT -3</td></tr>
</table>

	Modern home appliances with electronic control: Microwave oven, washing machine, Air-conditioner, DVD, Digital Camera, Remote control, Refrigerator, Iron, working principle of photocopying, fax machine, risograph, solar water heater and solar cooling. **Maintenance and safety measures**: Electricity in home: electric lighting, electric heating. Dangers of Electricity and Safety Precautions.	**11 Hrs**
	UNIT -4	
	Marketing planning: Importance of marketing planning, steps involved in marketing planning process scanning the marketing environment and spotting the business opportunities, setting the market objectives. **Marketing strategy**: the meaning and significance of marketing strategy, formulating the marketing strategy. Techniques and Practices for mass production for reliable production. **Costing**: Overview of costing and marketing communication. Entrepreneurship Awareness. **Patents**: Introduction to patents.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. B.R.Gupta, V. Singhal, Consumer Electronics, S. K. Kataria & Sons, 5th ed, 2006 . 2. R G Gupta, Audio and video systems,Tata McGraw-Hill Education, 2nd ed, 2010. 3. S.P. Bali, Consumer Electronics, Pearson Educatio, India, 1st ed,2004. **REFERENCE BOOKS:** 1. V S Ramaswamy, J Namakumari, Marketing management planning, implementation and control, Macmillan (2007). 2. Tom Duncan, Electronics for Today and Tomorrow, Trans-Atlantic Publications Inc.;2 edition 4. R G Gupta, Television engineering and video systems , Tata McGraw-Hill Education,2005 2. H S Kalsi, Electronic Instrumentation, TMH, Sixth reprint,2006	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP550
Title of the Course: Web technology Lab
Number of Credits: 01
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Knowledge of DBMS and Software Engineering.</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Ability to design and implement static and dynamic website.
2. Illustration of the implementation of JavaScript for dynamic effects.
3. Ability to choose best technologies for solving web client/server problems.
4. Implementation aspects of server-side technologies like PHP and MySQL.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP550.1</td><td>Understand, analyze and apply the role of languages like HTML and CSS to solve real world problems.</td></tr>
<tr><td>ECOMP550.2</td><td>Analyze and create XML documents and XML Schema.</td></tr>
<tr><td>ECOMP550.3</td><td>Understand, analyze and design the role of JavaScript and JSON for dynamic web pages.</td></tr>
<tr><td>ECOMP550.4</td><td>To design interactive web pages using PHP.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments
(Following experiments and a Mini Project should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)
1. Create a web page using HTML: basic Tags, Table Tags, List Tags, Image Tags and frames.
2. Design forms using HTML and CSS.
3. Create a web page with all types of Cascading style sheets.
4. Implementation of XML
5. Develop and demonstrate a HTML file that includes different JavaScript functions for validation.
6. Implementation of PHP. (Creation and connection)
7. Implementation of PHP. (Update and Search)
8. Implementation of PHP. (View and Delete)
9. Implementation of cookies and sessions using PHP.
10. Mini Project: Develop an application with front end and backend connection which will incorporate HTML5, CSS3, XML, XSLT, JavaScript, PHP, and MySQL.</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments</td></tr>
<tr><td>References/ Readings:</td><td>TEXTBOOKS:
1. N. P. Gopalan,J. Akhilandeswari; “Web Technology: A Developer’s Perspective”; PHI.</td></tr>
</table>

Name of the Programme: Electronics and Computer Science
Course Code: ECS560
Title of the Course: Database Systems Lab
Number of Credits: 01
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Fundamental Programming Skills, Understanding of Data Structures and Algorithms, Operating System Concepts, Mathematical and Logical Reasoning</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Familiarization to basic database concepts, applications, data models, schemas and instances
2. Training in Database designing and implementation considering application requirement</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to<table><tr><td>ECS560.1</td><td>Apply the basic concepts of Database Systems and Applications</td></tr><tr><td>ECS560.2</td><td>Use the basics of SQL and construct queries using SQL in database creation and interaction.</td></tr><tr><td>ECS560.3</td><td>Design and implement backend storage for semi structured and unstructured data using MongoDB</td></tr><tr><td>ECS560.4</td><td>Implement Aggregation, Indexing and querying techniques and to connect MongoDB given an application</td></tr></table></td></tr>
<tr><td>Content:</td><td>List of Experiments
(Following experiments and a Mini Project should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)
1. Introduction to SQL
2. SQL Queries and Clauses
3. Aggregate Functions in SQL
4. Set Operations in SQL
5. SQL Joins
6. Designing ER Diagrams and converting to Relational Schema
7. Views, Triggers, and Procedures
8. Database Design and Normalization
9. MongoDB Setup and CRUD Operations
10. Semi-Structured and Unstructured Data Handling in MongoDB
11. Aggregation and Indexing in MongoDB
12. Indexing and Query Optimization in MongoDB
13. NoSQL Data Modeling</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments</td></tr>
<tr><td>References/ Readings:</td><td>TEXTBOOKS:
1. “Fundamental of Database systems”, Elmasri Ramez, Navathe Shamkant 7th Edition Pearson 2018 ISBN:-978-8131716250
2. “Database system concepts”, Abraham Silberschatz, Henry F.korth, S. Sudarshan 6th edition, McGraw Hill, 2013</td></tr>
</table>

Name of the Programme: Electronics and Computer Science
Course Code: ECS570
Title of the Course: Professional Elective Lab - I
Number of Credits: 01
Effective from AY: 2024-25
Students will take ECS 570A, 570B, 570C, 570D, 570E if they have taken ECS531, ECOMP 532, ECOMP 533, ECOMP 534, ECOMP 535 respectively.

ECS 570A	Open Source Software Development Lab
ECS 570B	Software Engineering Lab
ECS 570C	Soft Computing Lab
ECS 570D	Design and Analysis of Algorithms Lab
ECS 570E	Computer Graphics Lab

<table>
<tr><td>ECS570A</td><td>Open Source Software Development Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Programming Proficiency</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
• Knowledge of Open Source and Proprietary software and Licensing
• Understanding of various Open-Source Technologies, methodologies, Project and ethics
• Case studies in open-source technology
• Understanding of Version Control Systems and project management using GitHub</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS570A.1</td><td>Recognize the applications, benefits and features of Open-Source Technologies, methodologies, Project and ethics</td></tr>
<tr><td>ECS570A.2</td><td>Work on various open source software</td></tr>
<tr><td>ECS570A.3</td><td>Reflect on case studies in open-source technology</td></tr>
<tr><td>ECS570A.4</td><td>Interpret the Version Control Systems and project management using GitHub</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments
(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)
1. Open Source Operating Systems
A. Open Source OS Familiarization: Learn the following open source OS of your choice: Linux, Android, FreeBSD, Open Solaris etc.
B. Installation and Feature Identification
2. Libre Office
3. GIMP Photo Editing Tool /Shotcut Video Editing Tool/Blender Graphics and Animation Tool
4. Apache Web Server
5. WordPress CMS
6. Github:
i. Create and Publish Projects/Version Control and</td></tr>
</table>

	Branching/Collaboration on GitHub /Contribution to Live Projects 7. Virtualization: Open Source virtualization technologies such as VirtualBox, Zen, and KVM. i. Installation and Configuration /Virtual Machine Management 8. Containerization Technologies such as Docker/ Rocket/ LXD i. Installation and Configuration ii. Create and use containers using it 9. Linux Kernel i. Understanding Linux Kernel ii. Operating and Licensing Models iii. Development Workflow iv. Practical Tasks 10. Contributing to Open Source A. Identifying any Open Source project (of personal interest) B. Contributing to the project in various ways: i. Testing ii. Reporting bugs iii. Coding iv. Helping in documentation v. Participating in discussions vi. Participating in pre-release testing programs vii. UI development. viii. Or any other important area.
Pedagogy:	Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments
References/ Readings:	**TEXTBOOKS:** 1. Kailash Vadera, Bhavyesh Gandhi, "Open-Source Technology", Laxmi Publications Pvt Ltd 2012, 1st Edition. 2. Mariot Tsitoara, "Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Apress, 2020, 1st Edition. **REFERENCE BOOKS:** 1. Fadi P. Deek and James A. M. McHugh, "Open Source: Technology and Policy", Cambridge Universities Press 2007.

<table>
<tr><td>ECS 570B</td><td>Software Engineering Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Programming Proficiency, Data Structures and Algorithms</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Familiarization of software engineering principles for building robust, scalable, and maintainable software systems.
2. Illustration of software development methodologies from requirements gathering to deployment.
3. Insight to software testing
4. Understanding of project management techniques for successful software development project execution.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS 570B.1</td><td>Apply the phases of the Software Development Life Cycle (SDLC) in practical scenarios.</td></tr>
<tr><td>ECS 570B.2</td><td>Conduct effective requirement gathering through interviews or surveys.</td></tr>
<tr><td>ECS 570B.3</td><td>Design software architecture using appropriate methodologies.</td></tr>
<tr><td>ECS 570B.4</td><td>Implement quality assurance techniques to improve software quality.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments:
(Following experiments are to be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Software Development Life Cycle (SDLC):
1: Study and analyze different phases of the SDLC (Requirement Analysis, Design, Implementation, Testing, Deployment, and Maintenance).
Requirement Analysis and Specification:
2: Gather requirements for a software project and Create a Software Requirements Specification (SRS) document based on gathered requirements.
Software Design:
3: Design the architecture of a software system using appropriate design principles and methodologies (e.g., UML diagrams, Design Patterns).
4: Implement design concepts such as modularity, abstraction, and encapsulation in a software project.
Implementation:
5: Implement a software solution based on the designed architecture using a suitable programming language and development environment.
Software Testing:
6: Develop test cases and perform unit testing on individual components/modules of the software.
7: Conduct integration testing to ensure proper interaction between different modules/components.
8: Perform system testing to validate the entire software system against specified requirements.
Software Maintenance:
9: Enhance the functionality of a software system based on new</td></tr>
</table>

	requirements or user feedback. **Software Quality Assurance:** 10: Implement quality assurance techniques such as code reviews, static analysis, and software metrics to improve software quality. 11: Perform regression testing to ensure that new changes do not affect existing functionality.
Pedagogy:	Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments
References/ Readings:	**TEXTBOOKS:** 1. Stephen R. Schach, Object-Oriented and Classical Software Engineering; TMH, 8th Edition. 2. Edward Kit, Software Testing in the Real World: Improving the Process, Addison – Wesley Publishing company, 1995 3. Pressman, Roger S. "Software Engineering: A Practitioner's Approach", 7th Edition, McGraw-Hill Education.

<table>
<tr><td>ECS 570C</td><td>Soft Computing Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Basics of Mathematics and Python/MATLAB/Octave</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Proficiency in implementing various neural network models and training algorithms for solving computational problems.
2. Familiarization and development of fuzzy inference systems
3. Mastery in employing optimization techniques for solving optimization problems efficiently.
4. Competence in implementing advanced soft computing techniques like auto encoders, convolutional neural networks, and hybrid systems</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS 570C.1</td><td>Implement various neural network models and training algorithms.</td></tr>
<tr><td>ECS 570C.2</td><td>Develop and apply fuzzy inference systems for real-world decision-making tasks, demonstrating understanding of fuzzy logic operations and relations.</td></tr>
<tr><td>ECS 570C.3</td><td>Analyze and apply optimization techniques such as genetic algorithms, particle swarm optimization, and ant colony optimization for solving optimization problems efficiently.</td></tr>
<tr><td>ECS 570C.4</td><td>Implementing advanced soft computing techniques like auto encoders, convolutional neural networks, and hybrid systems.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments
(Following experiments are to be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)

Neural Networks:
1. Implement McCulloch Pitt's/ Perceptron Neuron Model for basic Logic Gates
2. Activation Functions in Neural Networks
3. Implement various training algorithms such as Hebbian learning rule, Perceptron learning rule, Delta learning rule
4. Implement Error backpropagation algorithm
Fuzzy Systems:
5. Implementation of Fuzzy Logic Operations
6. Fuzzy Relations, Compositions and Implications
Optimization Techniques:
7. Genetic Algorithm Optimization/Particle Swarm Optimization Algorithm/Ant Colony Optimization Algorithm/Differential Evolution Algorithm
Hybrid Systems & Deep Neural Networks
8. Implementation of Autoencoder
9. Implementation of Convolutional Neural Network</td></tr>
</table>

	10. Genetic-Neuro Hybrid System
Pedagogy:	Inquiry based learning ,Constructive planning of experiments ,Collaborative approach in performing experiments
References/ Readings:	**TEXTBOOKS:** 1. Sivanandam, S.N., Deepa, S.N. "Principles of Soft Computing", Second Edition, Wiley Publication. 2. Rajasekaran, S., Vijayalakshmi Pai, G.A. "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI Learning. 3. Hagan, M.T., Demuth, H.B., Beale, M.H. "Neural Network Design", Cengage Learning, India Edition. 4. Kumar, Satish. "Neural Networks – A Classroom Approach", Second Edition, TMH.

<table>
<tr><td>ECS 570D</td><td>Design and Analysis of Algorithms Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Data Structures, Programming Skills, Algorithm Analysis</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Analysis the time and space complexity of algorithms using asymptotic notations.
2. Comparison of performance of classic divides and conquers algorithms such as Merge Sort and Quick Sort.
3. Familiarization of Dynamic Programming and Greedy algorithms to solve optimization problems efficiently.
4. Exploration advanced topics including string matching, text compression, and NP-Hard problem-solving techniques.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to<table><tr><td>ECS 570D.1</td><td>Analyze algorithmic complexity using big O notation and recurrence relations.</td></tr><tr><td>ECS 570D.2</td><td>Implement and compare performance of divide and conqu algorithms.</td></tr><tr><td>ECS 570D.3</td><td>Develop greedy algorithms for optimization problems and analyze their efficiency.</td></tr><tr><td>ECS 570D.4</td><td>Implement and evaluate dynamic programming algorithms optimization tasks.</td></tr></table></td></tr>
<tr><td>Content:</td><td>List of Experiments:
(Following experiments should be conducted. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Algorithm Analysis & Complexity:
1: Analyze the time and space complexity of various algorithms (e.g., linear search, binary search, bubble sort, selection sort, etc.)/ Demonstrate the use of asymptotic notations (Big O, Omega, Theta) to describe the time and space complexity of algorithms./ Solve recurrence relations using iteration, recursion tree, and the master method.
Divide and Conquer:
4: Implement and analyze algorithms like Binary Search/ Merge Sort/ Quick Sort. Compare their performance in terms of time complexity/ Implement algorithms for finding the minimum and maximum elements, finding the kth smallest element, and performing Strassen's matrix multiplication.
Greedy Method:
5: Implement and analyze Greedy algorithms for solving problems like the Knapsack Problem, Minimum Cost Spanning Tree, and Single Source Shortest Path.
Dynamic Programming:
6: Implement and analyze Dynamic Programming algorithms for solving problems like Multistage Graphs, All Pair Shortest Paths, Optimal Binary Search Tree, 0/1 Knapsack Problem, and Traveling Salesperson Problem.</td></tr>
</table>

	Backtracking: 7: Implement and analyze Backtracking algorithms for solving problems like the 8-Queens Problem, Sum of Subsets Problem, Graph Coloring, Hamiltonian Cycles, and Knapsack Problem. **Branch-and-Bound:** 8: Implement and analyze Branch-and-Bound algorithms for solving problems like the 0/1 Knapsack Problem and Traveling Salesperson Problem. **String and Pattern Matching Algorithms:** 9: Implement and analyze various string and pattern matching algorithms such as Brute Force, Knuth-Morris-Pratt (KMP), Boyer-Moore, and Tries. **Text Compression:** 10: Implement Huffman Coding algorithm for text compression and analyze its effectiveness in terms of compression ratio and speed. **Text Similarity Testing:** 11: Implement Longest Common Subsequence (LCS) algorithm for testing text similarity and analyze its efficiency. **NP-Hard and NP-Complete Problems:** 12: Study basic concepts of NP-Hard and NP-Complete problems, and implement algorithms for NP-Hard Graph Problems such as the Clique Decision Problem/Management of Post-delivery Maintenance: Study the principles of reverse engineering and testing during post-delivery maintenance.
Pedagogy:	Inquiry based learning ,Constructive planning of experiments ,Collaborative approach in performing experiments
References/ Readings:	**TEXTBOOKS:** 1. E. Horowitz, S. Sahini, S. Rajasekaran; Fundamentals of Computer Algorithms; 2nd Edition, Galgotia Publications. 2. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest Clifford Stein, Introduction to Algorithms, 3rd Edition, MIT Press/McGraw-Hill. **REFERENCE BOOKS:** 1. Michael T Goodrich and Roberto Tamassia , Algorithm Design: 2. Foundations, Analysis, and Internet Examples, 2nd Edition, Wiley. 3. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, PHI. 4. Jon Kleinberg and Éva Tardos, Algorithm Design, 1st Edition, Pearson.

<table>
<tr><td>ECS570E</td><td>Computer Graphics Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Programming Skills, Mathematical Foundations, Computer Graphics Concepts</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Understanding of Graphics Environment Setup
2. Skills of Graphics Primitive Functions
3. Proficiency in 2D and 3D object transformations
4. Exploration of Polygon filling, clipping and widowing techniques</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS570E.1</td><td>Set up a basic graphics environment, including understanding hardware and software requirements for graphics programming</td></tr>
<tr><td>ECS570E.2</td><td>Skills of basic graphics primitive functions such as displaying points, lines, and polygons</td></tr>
<tr><td>ECS570E.3</td><td>Apply geometric transformations (2D and 3D) to manipulate and animate objects in a graphical environment.</td></tr>
<tr><td>ECS570E.4</td><td>Apply advanced topics such as polygon filling using boundary fill and flood fill algorithms, clipping and windowing techniques</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>Introduction to Graphics Systems:
1. Set up a basic graphics environment
2. Display simple geometric shapes (points, lines, and polygons) on the screen.
Study Basic Graphics Primitive Functions:
3. DDA Line Drawing Algorithm/Bresenham's Line Drawing Algorithm/Midpoint Circle Algorithm/Midpoint Ellipse Algorithm
Geometric Transformations:
4. 2D Object Transformation
5. 3D Object Transformation
Polygon Filling:
6. Boundary Fill Algorithm/Flood Fill Algorithm
Clipping and Windowing:
7. Cohen-Sutherland line clipping algorithm
8. Sutherland-Hodgman polygon clipping algorithm
Animations:
9. Basic animation techniques like keyframe animation or skeletal animation.
10. Creating animated sequences by interpolating between keyframes and controlling the timing of animation.
(Experiments should be conducted from the list. A certified journal reporting the experiments conducted should be submitted at the end of the term)</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments</td></tr>
<tr><td>References/</td><td>TEXTBOOKS:</td></tr>
</table>

Readings:	1. Donald Hearn, M. P. Baker, Computer Graphics, 2nd Edition; Prentice Hall of India Pvt. Ltd. 1999. 2. William Newman, Robert Sproull, Principles of Interactive Graphics, 2nd Edition, Tata McGraw hill publishing company Ltd.1979.

Name of the Programme: Electronics and Computer Science
Course Code: HM009
Title of the Course: Ethics and Entrepreneurship
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Nil</td></tr>
<tr><td>Course Objectives:</td><td>The course aims to provide student with:
1. Acquaint to standard concepts of ethics that they will find useful in their professional life.
2. An understanding of the various concepts in Ethics.
3. Familiarization to the basic principles of entrepreneurship.
4. Acquaint to standard concepts of entrepreneurship that they will find useful in their profession or during the process of starting their own enterprise</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>HM009.1</td><td>Appreciate and assimilate ethics and interpersonal behavior. Also to Understand the use of ethical theories.</td></tr>
<tr><td>HM009.2</td><td>Understand code of ethics in various fields, safety responsibility and rights as an engineer.</td></tr>
<tr><td>HM009.3</td><td>Understand the concept of entrepreneurship and demonstrate the skills for project identification, development and implementation.</td></tr>
<tr><td>HM009.4</td><td>Understand the basics of financing a project. From the options of choosing the project and source of finance, to finding ways of Sustaining the project.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>UNIT- 1</td></tr>
<tr><td></td><td>Introduction: What is Ethics? Ethics and Rights, Ethics and Responsibility, Why Study Ethics, Attributes of an ethical personality, Case Study Work Ethics, Integrity, Honesty
Engineering Ethics : History, Engineering Ethics Professional Roles to be played by an engineer, Functions of an Engineer, Self-Interest, Customs and Religion, Professional Ethics, Types of Inquiry, Engineering and Ethics, Kohlberg’s Theory
Theories of Ethics :Moral issues, Moral dilemmas, Theories, Uses of Ethical Theories, Factors influencing Ethical Behavior 11 Hrs</td></tr>
<tr><td></td><td>UNIT-2</td></tr>
<tr><td></td><td>Code of Ethics: Safety Responsibility and Rights: Responsibility of Engineers, Risk-Benefit Analysis, Ethical issues in Cost-benefit Analysis, Ethics and Risk Management, Reducing Risk., Conflict of Interest, Occupational Crime, Intellectual property
Environmental Ethics: Introduction, Affecting Environment, Engineers as Managers, Role of Engineers, IEEE code of Ethics.
Rights of Engineers :Professional Rights, Employees Rights , Whistle 11 Hrs</td></tr>
</table>

	blowing	
	UNIT -3	
	Definition and clarification of concept of entrepreneurship: Qualities and Skills required for entrepreneurship, Functions of an entrepreneur, Importance of entrepreneur in economic development. **Theories of Entrepreneurship:** Economic theory, Sociological theory, Psychological theory. Types of entrepreneurs: Based on type of business, Based on use of technology, Based on motivation, Based on stages of development, Based on motive, Based on capital ownership, Danhof s classification. **Project identification:** External environment analysis, Meaning and characteristics of a project, Classification of projects, Project life-cycle, Sources and screening of project ideas. **Project formulation:** Meaning and significance, Feasibility analysis, Techno- economic analysis, Input analysis, Financial analysis, Social cost benefit analysis. Project feasibility, **Pre-feasibility study:** Project feasibility report - Meaning, Importance and Contents.	**12 Hrs**
	UNIT -4	
	Project financing and institutional finance: Classification of capital, Fixed Capital -Meaning, Factors governing fixed capital requirements **Working capital:** Meaning and concepts, Types, Factors determining working capital requirements. Sources of finance — Share capital, Debenture capital, Lease finance and term loans from commercial banks. Financial aspects: Break even analysis, Income statement, Balance sheet, Fund flow statement, Ratio analysis — Liquidity, leverage and profitability ratios. Capital budgeting — Need, Importance, Process. **Methods of project evaluation:** Payback period, Net Present Value Index.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS** 1. A. Alavudeen, R. Kalil Rahman, M. Jayakumaran, Professional Ethics and Human Values, Firewall Media, 2008. 2. Jayshree Suresh, B. Raghavan, Professional Ethics: Values and Ethics of Profession, S. Chand Co. Ltd (2005) 3. C.B.Gupta and N.P.Srinivasan, Entrepreneurship, Sultan Chand and Sons,4th Edition,1997 4. Prassanna Chandra, Fundamentals of Financial Management, Tata McGraw Hill 3rd Edition, 2001 **REFERENCE BOOKS:** 1. Charles B. Fleddermann, Engineering Ethics, Pearson, 4th Edition (August 2011) 2. C.B. Gupta and S.S. Khanka, Entrepreneurship and Small Business	

	Management, Sultan Chand and Sons; 1997, 2nd Edition. 3. Richard M. Lynch, Robert W. Williamson, Accounting for Management, Planning and Control, 3rd Edition, Tata McGraw-Hill, New Delhi.

Semester VI

Name of the Programme: Electronics and Computer Science

Course Code: ECS 610 Title of the Course: VLSI Design and Technology

Number of Credits: 4

Effective from AY: 2024-2025

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Basic Electrical & Electronics Engineering, Programming C</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The course aims to provide the student with:
1. An in-depth knowledge of the MOSFET operation and the ability to derive the threshold voltage & current equations.
2. An understanding of the theory of CMOS Inverter and Switching characteristics and the capability to write SPICE programs for various circuits.
3. The capability to design combinational circuits in CMOS logic and draw Layouts for the same.
4. An understanding of the various processes involved in VLSI technology and chip fabrication and design circuits using Verilog.</td></tr>
<tr><td rowspan="5">Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to</td></tr>
<tr><td>ECS610.1</td><td colspan="2">Explain the MOSFET operation, Current Voltage Equations, and CMOS Inverter Theory and to solve numerical based on MOSFET</td></tr>
<tr><td>ECS610.2</td><td colspan="2">Explain the various MOSFET fabrication processes.</td></tr>
<tr><td>ECS610.3</td><td colspan="2">Write the SPICE programs for modelling of MOSFET circuits and to implement complex combinational functions in CMOS logic and draw the layout.</td></tr>
<tr><td>ECS610.4</td><td colspan="2">Design combinational circuits using Verilog and explain overview of advance FPGA</td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT 1</td><td></td></tr>
<tr><td colspan="2">Introduction to VLSI: VLSI Design Flow.
MOS transistors: Structures, MOS system under external bias, operation of MOS transistor (MOSFET), MOS transistors: Threshold voltage MOSFET current-voltage characteristics (CGA), channel length modulation, substrate bias effect. Measurements of parameters - K_N, V_{TO} & γ.
Overview of MOSFET capacitances.
CMOS inverter design:- Operation, DC characteristics, Calculation of VIL, VIH, VTH, VOH and VOL. Noise margins, power and area considerations.</td><td>15 Hrs</td></tr>
<tr><td colspan="2">UNIT 2</td><td></td></tr>
<tr><td colspan="2">Switching Circuit Characteristics: Rise, fall and delay time, gate delays, transistor sizing, Static and Dynamic Power Dissipations.
Modelling of MOS transistor circuits using SPICE. (Level 1 model equations).
CMOS transistor switches: CMOS logic-Inverter, NOR, NAND and Combinational logic, Compound gates, Boolean Expressions using CMOS logic.
Transmission gates: Multiplexers, Basic logic gates, Latches and</td><td>15 Hrs</td></tr>
</table>

	Registers. Implementation of Boolean Expressions using transmission gates.	
	UNIT 3	
	Stick diagram and Layout: Inverter, NOR, NAND, OR and AND gates. MOSIS layout Design rules. Complex logic gates and their Optimized layouts (Euler paths). **Silicon semiconductor technology**: Wafer processing, Oxidation, Epitaxy, Deposition, Etching, Photolithography, Ion-implantation, and Diffusion. Chemical Vapour Deposition, Metallization. Basic CMOS technology: N-well and P-well CMOS process. Silicon on insulator. Basic Structure of FinFET and Cross Section of FinFET. List of VLSI Tech nodes (10um to 3nm)	**15 Hrs**
	UNIT 4	
	Introduction to Verilog language:. Verilog Programs and test benches for Adder, Subtractor, Decoder, Encoder, Multiplexer, Demultiplexer (using dataflow and gate level modelling). **Introduction to FPGA**: Basic FPGA Design Flow, FPGA Device Overview, FPGA types, SRAM –Based FPGA Architecture, FPGA Logic Block Structure, FPGA Routing Matrix and Global Signals, FPGA Clock Resources, FPGA Memory, Advance FPGA Features and Generic FPGA architecture.	**15 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS**: 1. Sung-Mo (Steve) Kang. Yusuf Leblebici; CMOS Digital Integrated Circuits Analysis & Design; McGraw-Hill Education ,3rd Edition 2. Neil Weste, David Harris; CMOS VLSI Design: A Circuits and Systems Perspective; Pearson, 3rd Edition 3. S. Palnitkar; Verilog HDL: A Guide to Digital Design and Synthesis; Prentice Hall,2nd Edition 4. R.C. Cofer and Ben Harding Rapid system Prototyping with FPGAs: Elesevier,, 1st Edition **REFERENCE BOOKS:** 1. Wayne Wolf; Modern VLSI design (Systems on Silicon); 2008, PHI 2. Jan M. Rabaey; Digital Integrated Circuits - A Design perspective;2003, Pearson Education 3. FinFET Devices for VLSI Circuits and Systems –Samar K.Saha, CRC Press, 2020.	

Name of the Programme: Electronics and Computer Science
Course Code: ECS620
Title of the Course: Introduction to Computer Networks
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Understanding of computer hardware</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to provide the student with:
1. An introduction to the concept of OSI model, TCP/IP, identifying different network topologies and protocols.
2. An understanding of Data Link layer protocols and technologies.
3. To help students to acquire knowledge of address in the configuration of various scales of networks
4. An understanding of Internet Protocols & Transport protocols.
5. Familiarization with various Networking Devices and their functions within a network.</td></tr>
<tr><td rowspan="6">Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to</td></tr>
<tr><td>ECS620.1</td><td colspan="2">Explain the functions of the various layers of OSI model, networking devices and protocols of data communication.</td></tr>
<tr><td>ECS620.2</td><td colspan="2">Apply the various line coding techniques, flow and error control techniques.</td></tr>
<tr><td>ECS620.3</td><td colspan="2">Classify the routing protocols and analyse how to assign the IP addresses for a given network.</td></tr>
<tr><td>ECS620.4</td><td colspan="2">Explain the functions of Transport layer and Application layer their paradigms and Protocols.</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td rowspan="3">Content:</td><td colspan="2">UNIT- I</td></tr>
<tr><td>Reference Models: Layered architecture of OSI Model, TCP/IP architecture.
Data Communication concepts: Parallel and Serial transmission, Asynchronous and Synchronous transmission
Line coding: NRZ, RZ, Biphase (Manchester and Differential Manchester), AMI, HDB3, B8ZS, 2BIQ, 8B6T.
Modems: Types of modems, Null modem
LAN: LAN topologies: Bus, Ring, Tree, Star, Ethernet: Types, Contention Access, CSMA,CSMA/CD, Token ring LAN, FDDI
The Physical Layer: Interface RS-232, DTE-DCE interface.</td><td>11 Hrs</td></tr>
<tr><td colspan="2">UNIT-2</td></tr>
<tr><td></td><td>Data Link Layer: Frame design consideration, flow control, error control (stop- and-wait mechanism, sliding window), sequence numbering of piggybacking acknowledgement.
Data Link protocols: BISYNC- transmission frames, protocol operation, HDLC- flow and error control, framing, transparency, protocol operation, Comparison of BISYNC and HDLC.
Switching: Switching networks, circuit switching, space division switching, Time division switching, packet switching (datagram and virtual circuit –SVC and PVC), message switching.</td><td>12 Hrs</td></tr>
</table>

	UNIT-3	
	Networking Devices: Repeaters, Bridges, Hub, Switch, Routers, Gateways, Firewall. **Network Layer**: Services, virtual circuits and datagram subnet, routing algorithms (shortest path, flooding, flow based, distance vector, link state), congestion control, choke packets, load shedding, jitter control, flow specifications, traffic shaping (leaky bucket and token bucket algorithm) Internet Protocols: IPv4 (Classful and Classless Addressing) Sub-netting, VLAN, NAT, IPv6, Address Mapping: ARP, RARP, DHCP, ICMP	**11 Hrs**
	UNIT-4	
	Transport Protocols: Transport service: services provided to the upper layer, connection establishment, connection release, multiplexing, flow control and buffering **Application Layer**: Domain Name System: DNS Name Space, Resource Records, Name Servers; Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery; **World Wide Web:** Architectural Overview, Client and Server Side, URLs, Cookies; **HTTP**: Connections, methods, message headers, caching	**12 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Behrouz A. Forouzan , Data Communications and Networking,4th Edition, Tata McGraw-Hill, 2006. 2. Andrew S. Tanenbaum ,Computer Networks, 4th Edition, Prentice Hall,2003 3. Prakash Gupta, Data Communications and Computer Networks, 2nd Edition, PHI, 2014. **REFERENCE BOOKS:** 1. William Stallings ,Data and Computer Communications,8th Edition, Prentice Hall, 2006 2. Achyut S. Godbole ,Data Communications and Networks, Tata M. Graw Hill. 3. James Kurose, Keith Ross ,Computer Networking, 7th Edition, Pearson Publications, 2016.	

Name of the Programme: Electronics and Computer Science
Course Code: ECS631
Title of the Course: Neural Networks & Deep Learning
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Linear Algebra</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to equip the student with:
1. An introduction to important neural network algorithms, and learning rules.
2. An introduction to foundations of trainable decision making networks for classification of linearly separable and linearly non-separable classes of patterns.
3. The basic knowledge of associative models of artificial neural networks.
4. The knowledge of modern deep learning technologies and approaches.
5. The basic understanding of unsupervised pre-trained networks, recurrent and recursive neural networks</td></tr>
<tr><td rowspan="5">Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to</td></tr>
<tr><td>ECS631.1</td><td colspan="2">Apply neural network paradigms using the learning rules and related parameters of artificial neural networks to train artificial neural networks.</td></tr>
<tr><td>ECS631.2</td><td colspan="2">Design and implement the artificial neural networks in various applications using iterative and graphical methods.</td></tr>
<tr><td>ECS631.3</td><td colspan="2">Demonstrate the use of Auto encoders and Convolutional and recurrent neural networks for optimization of feed forward deep network models.</td></tr>
<tr><td>ECS631.4</td><td colspan="2">Explain the basic concepts of understanding of unsupervised pre-trained networks, recurrent and recursive neural networks</td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT- I</td><td></td></tr>
<tr><td colspan="2">Introduction: Introduction to neural networks, structure of biological neuron, Perceptron Model. Logic network realization by using Mc-Culloch Pitts neuron model, Neuron modelling for artificial neuron systems, Neural learning.
Learning Rules: Hebbian, perceptron, Delta, Widrow-Hoff, Correlation learning rules and associated problems.
Single layer network: Concept of linear seperability and non-linear separability, Discriminant functions, Minimum distance classification,
ADALINE. Setting of parameter values.</td><td>11 Hrs</td></tr>
<tr><td colspan="2">UNIT-2</td><td></td></tr>
<tr><td colspan="2">Winner-Take-All networks: Hamming Distance classifier, MAXNET.
Clustering: simple competitive learning algorithm, Learning Vector Quantization algorithm, Self-Organizing Feature Maps, Adaptive resonance theory.
Hopfield networks: Non-iterative procedures for association,</td><td>12 Hrs</td></tr>
</table>

	Matrix Association memories, Least square procedures, Discrete Hopfield networks, Brain-state-in-a-box network, Bi-directional associative memory.	
	UNIT-3	
	Multilayer Networks: Adaptive multilayer network, network pruning algorithm, Marchands algorithm, neural tree & tiling algorithm. Networks using Radial Basis Functions **Deep Learning:** What Is Deep Learning? Common Architectural Principles of Deep, Optimization Algorithms, How learning differs from pure optimization, Challenges in Neural networks. **Basic Algorithms:** Error back propagation algorithm, Stochastic Gradient Algorithm, AdaGrad, RMSProp, Adam.	**12 Hrs**
	UNIT-4	
	Auto encoders: Architecture and different types of Auto encoders **Convolutional Networks:** Convolution Operation, Pooling. **Unsupervised Pre-trained Networks:** Deep Belief Networks (DBNs), Generative Adversarial Networks (GANs). **Sequence Modelling:** Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Recursive Neural Networks. The Long Short-Term Memory.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	**Textbooks:** 1. Kishan Mehrotra, Chilukuri Mohan, Sanjay Ranka; Elements of artificial neural network; Penram Publications. 2. J. Zurada; Introduction to Artificial neural network; Jaico Publications 3. Ian Goodfellow, Yoshua Bengio, Aaron Courville; Deep Learning; MIT Press 4. Josh Patterson, Adam Gibson; Deep Learning: A Practitioner's; O'Reilly Media **Refrences:** 1. Daniel Groupe; Deep Learning Neural Networks Design and Case Studies; World Scientific 2. Li Deng, Dong Yu; Deep Learning Methods and Applications; Microsoft Research 3. Nikhil Buduma, Nicholas Locascio; Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms; O'Reilly Media. 4. Charu C. Aggarwal, Neural Networks and Deep learning, Springer Publications.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP632
Title of the Course: Augmented Reality & Virtual Reality
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Computer Graphics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. Understanding of the basic concepts of Virtual Reality (VR) and Augmented Reality (AR).
2. Knowledge of input and output devices of VR and AR.
3. Understanding of the interaction techniques of VR and AR.
4. Knowledge of applications of AR and VR in various industries.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP 632.1</td><td>Understand how VR systems work and describe the input and output devices used</td></tr><tr><td>ECOMP 632.2</td><td>Understand the various representations in VR and describe systems for rendering and interaction</td></tr><tr><td>ECOMP 632.3</td><td>Understand and analyse the hardware requirement of AR.</td></tr><tr><td>ECOMP 632.4</td><td>Describe the working of various AR tracking techniques – marker-based and markerless, and understand enhancing of visual perception in AR.</td></tr></table></td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Introduction to Virtual Reality
Introduction top VR- Four Key Elements of Virtual Reality Experience, Combining the Elements, Artificial Reality, Virtual, Virtual World, and Cyberspace. Augmented Reality, Telepresence, Virtual Reality, Telepresence, Augmented Reality, and Cyberspace.
Input: User Monitoring – Position Tracking Body Tracking Other Physical Input Devices World Monitoring - Persistent Virtual Worlds, Bringing the Real World Into the Virtual World
Output devices: Visual Displays- Visual Depth Cues, Properties of Visual Displays Aural Displays- Aural Localization Cues, Properties of Aural Displays Haptic Displays- Properties of Haptic Displays</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Visual Rendering, Perception and Interactive Technique Representation – Visual Representation in VR, Aural Representation in VR, Haptic Representation in VR
Rendering-Visual Rendering Systems -Visual Rendering Methods, Rendering Complex Visual Scenes Aural Rendering Systems: Methods of Aural Rendering, Rendering Complex Sounds Haptic Rendering Systems: Haptic Rendering Methods, Rendering Complex Haptic Scenes with Force Displays, Haptic Rendering Techniques
Interacting with the Virtual World-
Manipulating a Virtual World: Manipulation Methods Navigating</td><td>12 Hrs</td></tr>
</table>

	in a Virtual World: Wayfinding Interacting with Others: Collaborative Interaction.	
	UNIT -3	
	What Is Augmented Reality - Defining augmented reality, history of augmented reality, Examples, **Displays** - Audio Displays, Haptic Displays, Visual Displays, and Other sensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model. **Tracking & Sensors** - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.	**11 Hrs**
	UNIT -4	
	AR Techniques- **Marker-based tracking**: Marker detection- Marker detection procedure, Pre-processing, Fast acceptance/rejection tests for potential markers. Marker types and identification: Template markers- Template matching. Imperceptible markers- Image markers, Infrared markers, Miniature markers. Discussion on marker use- When to use marker-based tracking, When to use Marker-based tracking, How to select a marker type, Marker design, General marker detection application. **Markerless tracking/ Alternative visual tracking methods and hybrid tracking**- Visual tracking in AR, Feature-based tracking, Hybrid tracking, Initialization and recovery **Enhancing the augmented reality system**: Enhancing visual perception- Non-photorealistic rendering, Non-photorealistic rendering, Illumination and shadows, Motion blur, out-of-focus and other image effects	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. William R Sherman, Alan B Craig, Understanding Virtual Reality, Interface, Application and Design, The Morgan Kaufmann Series in Computer Graphics, Morgan Kaufmann Publishers, San Francisco, CA, 2002 2. Schmalstieg, Hollerer, Augmented Reality: Principles & Practice, Pearson Education India, 1st Edition (12 October 2016). 3. Sanni Siltanen, Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. **REFERNCES:** 1. Burdea, Grigore C,Philippe Coiffet, Virtual Reality Technolog", Wiley Inter science, India, 2003. 2. Alan B Craig, William R Sherman, Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann Publishers, 2009. 3. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP633
Title of the Course: Mobile Phone Programming
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Introduction to Computer programming, Introduction to computer architecture, Operating systems.</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An introduction to Android programming and app development.
2. An understanding of Android application and OS architecture.
3. An ability to write programs for Android OS.
4. An ability to design user interfaces for Android applications.
5. An ability to use maps and location-based services.
6. An ability to use wireless communication standards such as Bluetooth, NFC, Wi-Fi.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP633.1</td><td>Explain the features of Android OS and application development environment.</td></tr><tr><td>ECOMP633.2</td><td>Develop basic android applications. and build user interfaces for android applications.</td></tr><tr><td>ECOMP633.3</td><td>Develop android applications utilizing hardware sensors.</td></tr><tr><td>ECOMP633.4</td><td>Develop android applications incorporating location based services, Bluetooth, Wi-Fi, and NFC.</td></tr></table></td></tr>
<tr><td rowspan="6">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Google Android: Background, an Open Platform for Mobile Development, Native Android Applications, Android SDK Features, Introducing the Open Handset Alliance, Introducing the Development Framework.
Android Development: Developing for Android, Developing for Mobile Devices, Android Development Tools.
Creating Applications and Activities: What Makes an Android Application?, Introducing the Application Manifest, Using the Manifest Editor, The Android Application Life Cycle, Understanding Application Priority and Process States, Externalizing Resources, A Closer Look at Android Activities.</td><td>11 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Building User Interfaces: Fundamental UI design, Android UI fundamentals, Introducing Layouts, Fragments, Creating new views and Introducing adapters.
Intents, Broadcast Receivers, Adapters, and the Internet: Introducing Intents, Introducing Adapters, Using Internet Resources, Introducing Dialogs, Creating an Earthquake Viewer.</td><td>11 Hrs</td></tr>
<tr><td>UNIT -3</td><td></td></tr>
<tr><td>Data Storage, Retrieval, and Sharing: Saving Simple Application Data, Creating and Saving Shared Preferences, Retrieving Shared Preferences , Creating a Settings Activity for the</td><td>12 Hrs</td></tr>
</table>

	Earthquake Viewer, Introducing the Preference Framework and the Preference Activity, Creating a Standard Preference Activity for the Earthquake Viewer, Persisting the Application Instance State, Working with the File system. **Hardware Sensors**: Using Sensors and sensor manager, Monitoring a device's movement and orientation. Introduction to environment sensors.	
	UNIT -4	
	Maps, Geocoding, and Location-Based Services: Using Location-Based Services, Setting up the Emulator with Test Providers, Finding Your Location, Using the Geocoder, Creating Map Based Activities, Mapping Earthquakes Example. **Bluetooth, Wi-Fi and NFC**: Using Bluetooth, Managing Network and Internet connectivity, Managing Wi-Fi, Transferring data using Wi-Fi Direct, Near Field Communication.	**12 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXT BOOKS** 1. Reto Meier; Professional Android Application Development; Wiley Publishing Inc, 2009. 2. Saurabh Jain; Mobile Phone Programming; BPB Publications, 2007. **REFERNCES:** 1. Frank H.P. Fitzek, Frank Reichert; Mobile Phone Programming and its Application to Wireless Networking; Springer, 2007. 2. Jerome DiMarzio; Android: A Programmer's Guide; McGraw Hill Inc, 2008. 3. Rich Ling; Mobile Phones and Mobile Communication; Polity Press,2013. 4. Ed Burnett; Hello, Android: Introducing Google's Mobile Development Platform; Pragmatic Bookshelf,2009. 5. Rick Rogers, John Lombardo, Zigurd Mednieks; Android Application Development: Programming with the Google SDK; O'Reilly Media,2009.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP634
Title of the Course: Software testing and Quality Assurance
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Software Engineering</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. Knowledge to develop and implement an effective testing strategy.
2. Knowledge to plan and prepare appropriate tests for all phases of software development.
3. Ability to measure and control the quality of the testing.
4. Understanding of the significance of finding and resolving errors early.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 634.1</td><td>Manage, plan and prepare rigorous, formal, visible and repeatable tests that will fully exercise software, in the development of quality systems</td></tr>
<tr><td>ECOMP 634.2</td><td>Apply different testing approaches to all stages of software development</td></tr>
<tr><td>ECOMP 634.3</td><td>Prepare test plans, strategy, specifications, procedures and controls to provide a structured approach to testing.</td></tr>
<tr><td>ECOMP 634.4</td><td>Describe the different types of testing tools available and identify the appropriate types of tools for their needs.</td></tr>
</table></td></tr>
<tr><td rowspan="5">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Software Quality: Quality perspective and expectations, Quality framework and ISO 9126, Correctness and defects.
Quality Assurance: Classification, Defect prevention, Defect reduction, Defect containment. Quality Assurance in context: Handling discovered defects during QA activities, QA activities, Verification and validation perspective.
Quality Engineering: Activities & Process, Quality planning, Quality assessment & improvement.</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Testing: Concepts, Issues, and Techniques: Purpose, activities, process and context, issues and questions about testing, Functional v/s structural testing, Coverage based v/s usage based testing.
Test Activities, Management, and Automation: Test planning and preparation, Test execution, result checking and measurement, Analysis and follow up, Activities, people and management.
Coverage and Usage Testing Based on Checklists and Partitions: Checklist based testing and limitations. Testing for partition coverage, Usage based statistical testing with Musa’s operational profiles.</td><td>12 Hrs</td></tr>
<tr><td>UNIT -3</td><td></td></tr>
</table>

	Defect Prevention and Process improvement: Basic concepts and generic approaches, Root cause analysis for defect prevention, Training for defect prevention, Defect prevention techniques. **Control Flow, Data Dependency:** Basic Control Flow Testing, Loop Testing, CFT Usage, and Other Issues, Data Dependency and Data Flow Testing.	**11 Hrs**
	UNIT -4	
	Software testing tools and overview: Need for automated testing tools, Taxonomy of testing tools, Functional/Regression testing tools, Performance testing tools, Testing management tools, Source code testing tools, Selection of testing tools. **Case study:** Overview of Win Runner, Silk Test, SQA Robot, Load runner.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Jeff Tian , Software Quality Engineering – Testing, Quality Assurance and Quantifiable Improvement, Edition 2006. 2. Dr. K.V.K.K. Prasad ,Software Testing Tools, Dreamtech Press India Pvt. Ltd. 2004. **REFERENCE BOOKS:** 1. Kshirasagar Naik, Priyadarshi Tripathy, Software Testing and Quality Assurance: Theory and Practice, Wiley Publications. 2. William E. Perry,Effective methods for Software testing, 3rd edition.	

Name of the Programme: Electronics and Computer Science
Course Code: ECS635
Title of the Course: Introduction to Cloud Computing
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Operating Systems, Computer Networks</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to provide the student with:
1. An introduction to the fundamentals and essentials of Cloud Computing to the students.
2. To familiarize students with Cloud computing software security objectives, design principles and development practices.
3. To motivate the students to explore some important cloud computing driven commercial systems and applications.
4. To provide sufficient foundations to the students to enable further study and research.</td></tr>
<tr><td rowspan="5">Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to</td></tr>
<tr><td>ECS635.1</td><td colspan="2">To understand principals of cloud computing, architecture and management and its applications</td></tr>
<tr><td>ECS635.2</td><td colspan="2">Analyze the cloud deployment models and cloud service models</td></tr>
<tr><td>ECS635.3</td><td colspan="2">Analyze the performance, scalability, and availability of the underlying cloud technologies and software.</td></tr>
<tr><td>ECS635.4</td><td colspan="2">Summarize the different cloud service providers.</td></tr>
<tr><td rowspan="6">Content:</td><td colspan="3">UNIT- I</td></tr>
<tr><td>Cloud Computing Fundamental, Motivation for Cloud Computing, Defining Cloud Computing, 5-4-3 Principles of Cloud computing, Cloud Ecosystem, and Requirements for Cloud Services, Cloud Application, Benefits and Drawbacks.
Cloud Computing Architecture and Management , Cloud Architecture, Network Connectivity in Cloud Computing, Anatomy of the Cloud, Applications on the Cloud, Managing the Cloud, Migrating Application to Cloud</td><td>11 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Cloud Deployment Models: Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud.
Cloud Service Models: Introduction, Infrastructure as a Service, Platform as a Service, Software as a Service, Other Cloud Service Models.
Virtualization: Virtualization Opportunities, Approaches to Virtualization, Hypervisors, Types of Hypervisors, Security Issues and Recommendations, From Virtualization to Cloud Computing: IaaS, Paas, SaaS.</td><td>12 Hrs</td></tr>
<tr><td>UNIT-3</td><td></td></tr>
<tr><td>Technological Drivers for Cloud Computing: SOA and Cloud, Services architectural model of SOA, Benefits of SOA.</td><td>12 Hrs</td></tr>
</table>

	Open Source Support for Cloud Open Source in Cloud Computing: An Overview, Open Source Tools for IaaS, Open Source Tools for PaaS, Open Source Tools for SaaS, Reliability, availability and security of services deployed from the cloud. Cloud Computing Economics: Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)	
	UNIT-4	
	Cloud Service Providers Introduction, Google cloud platform, Amazon Web Services, Microsoft. Application Development Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App, How to decide if the cloud is right for your requirements, the total cost of ownership (TCO)	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Essentials of Cloud Computing, K. Chandrasekaran, 1st Edition, Chapman and Hall/CRC, 2014. 2. Enterprise Cloud Computing Technology Architecture Applications, Gautam Shroff, 1st Edition,Cambridge University Press, 2010. **REFERENCE BOOKS:** 1. Cloud Computing - A Practical Approach, Toby Velte, Anthony Velte, Robert Elsenpeter, First Edition, McGraw-Hill Education, 2009. 2. Cloud Computing: Implementation, Management and Security, John W. Rittinghouse, James F Ransome, First Edition, CRC Press, 2009. 3. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, First Edition, O'Reilly Media, 2009. 4. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, ShahedLatif, First Edition, O'Reilly Media, 2009.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP641
Title of the Course: Digital Image Processing
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Applied mathematics</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. An understanding of basics of visual perception, effects of image sampling and quantization
2. An ability to apply relevant filters for enhancing images
3. An understanding of image degradation and restoration process
4. An ability to apply various morphological operations on the images for the high level applications and compression techniques on images
5. An ability to apply the various edge detection algorithms to segment image into different regions</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP641.1</td><td>Explain general terminology of digital image processing and its applications.</td></tr>
<tr><td>ECOMP641.2</td><td>Apply image processing algorithms in practical applications and have the ability to design system using it</td></tr>
<tr><td>ECOMP641.3</td><td>Analyse basic image relationship functions, enhancement, restoration, compression, segmentation and representation Techniques</td></tr>
<tr><td>ECOMP641.4</td><td>Design and implement algorithms for advanced image analysis</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>
<table>
<tr><td>UNIT- 1</td><td></td></tr>
<tr><td>Introduction to image processing: Example of fields that uses image processing, Steps of image processing, Components, Applications, Image sensors and image formats, Brightness adaptation and discrimination, Image sampling and quantization, Zooming, Shrinking, Basic relationships between pixels
Spatial Domain Enhancement: Introduction, Some basic intensity transformation functions (thresholding, Contrast stretching, Gray level slicing, Log, Power-law, Negation, Bit plane slicing), Histogram equalization, matching, stretching, Enhancement using arithmetic and logical operations
Spatial filtering: Fundamentals of spatial filtering, Smoothing and Sharpening spatial filters, Point, Line, and Edge detection</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Enhancement in Frequency domain: Introduction, 2-D Discrete Fourier Transform, Properties of Fourier transform, Basic filtering in the frequency domain, Smoothing and Sharpening filters, Homomorphic filtering.</td><td>11 Hrs</td></tr>
</table></td></tr>
</table>

	Different Image Transforms: Discrete cosine transform (DCT), HADAMARD, WALSH, KL (PCT) transform, DWT. **Colour image processing:** Colour fundamentals, Colour models (RGB, CMYK, HSI).	
	UNIT -3	
	Image Restoration: Image degradation Model, Image restoration Techniques, Noise models, Mean Filters, Order Statistics, Adaptive filters, Inverse Filtering, Wiener filtering **Image Compression:** Fundamentals, Image Compression Models, Error free compression (VLC, LZW, Bit-Plane, Lossless Predictive Coding), Lossy compression techniques (Lossy predictive coding, IGS and Vector quantization, Transform coding)	**11 Hrs**
	UNIT -4	
	Morphological Image Processing: Introduction, Erosion and Dilation, Opening and Closing, The Hit-or-Miss transformation, Gray scale morphology **Segmentation:** Fundamentals, Edge linking and Boundary detection (Local and Global Processing via Hough transform) and Thresholding, Region based segmentation **Representation and Description:** Representation (chain codes) , Boundary Descriptors (Shape number, Fourier Descriptor)	**12 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXT BOOKS** 1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, 3rd Edition, 2010 2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002 **REFERENCES** 1. Kenneth R. Castleman, Digital Image Processing Pearson, 2006. 2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011. 3. William K. Pratt, Digital Image Processing, John Wiley, New York, 2002 4. Milan Sonka, et al, Image processing, analysis and machine vision, Brookes/Cole, Vikas Publishing House, 2nd Edition. 5. S. Jayaraman, S. Esakkirajan and T. Veerakumar, Digital Image Processing, McGraw Hill Education (India) Private Ltd. 11th reprint 2013 6. J.C. Russ, The Image Processing Handbook, 5th edition, CRC, 2006 7. S. Sridhar, Digital Image Processing, Oxford University Press	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP642
Title of the Course: Information Theory & Coding
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basics of Probability Theory, Digital Fundamentals</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An understanding of information theoretic behaviour of a communication system.
2. A perspective of problems associated with channel capacity of the different types of the communication channels.
3. An ability to calculate the efficiency of the source using the various source coding techniques.
4. An understanding of various channel coding techniques.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP642.1</td><td>Understand information, mutual information, channel capacity, source and channel coding, and comparison of error rates.</td></tr>
<tr><td>ECOMP642.2</td><td>Apply concepts of information theory, probability to source coding; and concepts of linear algebra to block codes.</td></tr>
<tr><td>ECOMP642.3</td><td>Analyze binary sources, communication channels, types of coding techniques</td></tr>
<tr><td>ECOMP642.4</td><td>Evaluate channel capacity, and various coding/decoding schemes.</td></tr>
</table></td></tr>
<tr><td rowspan="6">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Information Theory: Information content, unit of information, entropy, entropy of a binary source, rate of information, joint entropy and conditional entropy.
Mutual Information and Channel Capacity: Noise free channel, channel with independent input and output, symmetric channel, binary symmetric channel (BSC), binary erasure channel (BEC), cascaded channels.
Sources with Finite Memory: Markov sources.</td><td>11 Hrs.</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Shannon’s theorem, Capacity of a Gaussian Channel: Shannon - Hartley theorem, bandwidth–S/N tradeoff, Shannon limit.
Source Coding: Coding efficiency, Shannon’s first fundamental theorem, Lossless coding algorithm, Kraft’s inequality.
Variable length source coding: Shannon–Fano coding, Huffman coding, (d-ary compact codes), Lempel-Ziv (LZ) coding, Lossy data compression: Rate distortion theory.</td><td>12 Hrs.</td></tr>
<tr><td>UNIT -3</td><td></td></tr>
<tr><td>Error Control Coding: Types of codes, error probability with repetition in the binary symmetric channel, parity check bit for</td><td>12 Hrs.</td></tr>
</table>

	error detection, Hamming distance. Linear block codes, syndrome and error detection, standard array and syndrome decoding for error correction, probability of undetected error for linear block codes. Single parity check bit code, repeated codes, Hadamard code, Hamming codes, Reed-Muller codes, dual codes. **Cyclic Codes:** Encoding and Decoding of cyclic codes.	
	UNIT -4	
	Burst Error Correction: Block interleaving, convolutional interleaving, Reed- Solomon (RS) code, concatenated codes. **Convolutional Coding:** Code generation, generator matrix, code tree, state and trellis diagrams for convolutional codes. **Decoding Convolutional Codes:** using a code tree, decoding in the presence of noise, sequential decoding, and Viterbi algorithm. Comparison of error rates in coded and uncoded transmission. **Turbo codes:** Encoding and Decoding of Turbo Codes.	**11 Hrs.**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. Herbert Taub, Donald Schilling, Goutam Saha, Principles of Communication Systems, 4th Edition, Tata-McGraw Hill. 2. R. P. Singh, S. Sapre, Communication systems: Analog and Digital, 3rd Edition, Tata- McGraw Hill. 3. Ranjan Bose, Information Theory, Coding & Cryptography, 2nd Edition; Tata- McGraw Hill, 2008. 4. Salvatore Gravano, Introduction to Error Control Codes, 1st Edition, Oxford University Press, 2001 **REFERENCE BOOKS:** 1. J. Das, S. K. Mullick, P. K. Chatterjee, Principles of Digital Communication, John Wiley, 1986. 2. Bernard Sklar, Digital Communications: Fundamental & Applications, 2nd Edition, Pearson Education, 2009.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP643
Title of the Course: Advanced Microcontroller
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basic structure of Computers and microcontrollers</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. The ability to understand the architecture of ARM7TDMI processor and its internal functioning.
2. An in-depth understanding about instruction set and assembly level programming in ARM and THUMB State.
3. An understanding of how coprocessors are interfaced with ARM core and the VFP coprocessor implementation in particular.
4. An understanding of the details of AMBA bus, caches and Memory Management.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP643.1</td><td>Describe the architecture of the ARM7TDMI processor.</td></tr>
<tr><td>ECOMP643.2</td><td>Write embedded software using ARM7TDMI assembly instructions.</td></tr>
<tr><td>ECOMP643.3</td><td>Describe Vector floating point processors and its interface with ARM.</td></tr>
<tr><td>ECOMP643.4</td><td>Explain AMBA bus, Caches , memory management and exception handling in Arm.</td></tr>
</table></td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>ARM architecture and Processor fundamentals: Types of computer Architectures, ISA's and ARM History, RISC and ARM Design, architectural inheritance, ARM Programmer’s model, memory system, memory formats and data types, ARM core data flow model, Processor modes, registers: General purpose and Program status, flags, Overview of Endianness, unaligned access support.
Pipelines: ARM 3 and 5 stage Pipeline, hazards, efficiency, ARM family attribute comparison. Exceptions, interrupts and vector table, Core extensions, Jazelle extension ARM Development tools.ARM7TDMI block, core and functional diagrams, memory interface, bus Interface signals and bus cycle types.</td><td>12 Hrs.</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>ARM7TDMI assembly instructions and modes: Conditional execution, addressing modes: data processing operands, memory access operands, Load and store operands, Stack operations, Shift Operations.
ARM Instruction set: Branch, data processing, comparison, SIMD, Multiply, miscellaneous data processing, status register transfer, load store, coprocessor, exception-generating instructions.</td><td>12 Hrs.</td></tr>
</table>

	Elementary assembly level programs. **Thumb state:** Thumb Programmers model, Thumb exceptions, Implementation and applications. Thumb Instruction set in brief.	
	UNIT -3	
	Exception handling: ARM processor exceptions and modes, vector table, exception priorities, link offset registers. Interrupt handling: Assigning interrupts, interrupt latency, IRQ and FIQ exceptions, basic interrupt stack design, Interrupt handling schemes: non-nested, nested, reentrant and prioritized simple interrupt handler. ARM7TDMI Exception and abort model, instructions to improve exception handling. **Caches:** Memory hierarchy and cache memory, caches and memory management units, basic architecture of cache memory, set associativity. Relationship between cache and main memory, Cache policy.	**11 Hrs.**
	UNIT -4	
	ARM Coprocessor Interface: Coprocessor availability, interface signals, handshaking, connecting coprocessors. **Vector Floating Point Processor (VFP) architecture:** Overview, floating point model, registers, floating-point exceptions, compliance with IEEE 754 standard, VFP and ARM interactions. **Advanced Microcontroller Bus Architecture (AMBA):** Overview, Typical AMBA Based Microcontroller, AHB bus features, components, bus interconnection, AHB Bus transfers, APB bus transfers, APB Bridge	**11 Hrs.**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS** 1. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide, Designing and Optimizing System Software, 1st Edition, Elsevier 2. Steve Furber. ARM System-on-Chip Architecture, 2nd Edition, Pearson **REFERENCES** 1. ARM7TDMI-S Technical Reference Manual, ARM Inc.	

Name of the Programme: Electronics and Computer Science
Course Code: ECS644
Title of the Course: Industrial Automation and Control
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Basic Electronics and Digital Logic</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. An understanding of various process control principles and sensor technologies, including their applications, evaluation methods.
2. An understanding of analog signal conditioning, final control operations, power electronics, actuators, control elements, and controller principles, facilitating the design and optimization of process control systems across diverse industrial applications
3. Introduction to the automation systems using the programmable logic controllers.
4. An understanding of the different types of industrial interfacing standards</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS644.1</td><td>Explain the process control systems used in Industries</td></tr>
<tr><td>ECS644.2</td><td>Apply the knowledge of actuators and control effectively in process control applications for optimized system performance and operation</td></tr>
<tr><td>ECS644.3</td><td>Design and simulate various industrial control applications using the programmable logic controllers.</td></tr>
<tr><td>ECS644.4</td><td>Design and Implement Industrial automation solutions using various Industrial interfacing standards.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>
<table>
<tr><td>UNIT- 1</td><td></td></tr>
<tr><td>Introduction to Process Control: Introduction; control systems; process
control block diagram; servomechanisms; control system evaluation; on off control; analog and digital control.
Sensors: Sensor time response. Overview of Thermal sensors: RTD, thermistors, thermocouples. Overview of Mechanical sensors: Strain, motion, pressure, and flow. Optical sensors: Photo detectors, pyrometers, applications.</td><td>11 Hrs.</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Analog signal conditioning: Linearization, Conversion
Final Control: Introduction; final control operation; Signal conversion.
Actuators: Electrical, pneumatic, and hydraulic;
Control elements: mechanical; electrical; Fluid valves; Control valve type; Control valve sizing;
Controller Principles: Introduction; process characteristics, Control system parameters; continuous controller modes: proportional, integral, derivative control modes; composite</td><td>12 Hrs.</td></tr>
</table></td></tr>
</table>

	control modes: PI, PD, PID.	
	UNIT -3	
	Programmable Logic Controllers (PLCs): Parts of a PLC, Principles of Operation, PLCs versus Computers, PLC Size and Application, Selecting a PLC: Factors to be considered while selecting a PLC. **Basic PLC Programming**:Processor Memory Organization, Program Scan, PLC Programming Languages, Ladder Programming, Programming ON-OFF inputs to produce ON-OFF outputs, Concepts of latching, interlocking, jogging outputs via ladder programming. **PLC Timers:** Timer instructions, ON delay timer instruction, Off-Delay timer instruction, Retentive Timer **PLC Counters:** Counter Instructions, Up-counter, down counter, Up-Down counter, Cascading counters, Incremental encoder counter applications, Combining counter and timer functions, examples of timer and counter functions for industrial applications.	**12 Hrs.**
	UNIT -4	
	PLC data handling instructions: Move, Conditional Jump, Call Subroutine instructions. **SCADA systems**: Introduction and brief history of SCADA, Modern SCADA systems, SCADA software, Remote terminal units. Data logger basics, Advantages of data loggers, anatomy of a data logger, types of data loggers, factors to be considered in selecting a data logger. **Basic standards**: RS-232 and RS-485, Electrical signal characteristics, **Modbus:** General overview, Modbus protocol structure. **Fieldbus:** Introduction, General Fieldbus architecture, Basic requirements of Fieldbus standard.	**11 Hrs.**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS** 1. Curtis D. Johnson; Process Control and Instrumentation Technology, 7th Edition;Pearson Education 2. Programmable Logic Controllers, Frank Petruzzula; Tata Mc-Graw Hill Edition,2010. 3. John Webb, Ronal Weiss; Programmable Logic Controllers: Principles & Applications, 5th Edition; Prentice Hall of India **REFERENCES** 1. S. K. Singh; Industrial Instrumentation and control; TMH, 2009. 2. C. Rangan, G. Sarma, V. Mani;Instrumentation Devices and Systems, TMH, 2nd edition.. 3. Deon Reynders , Steve Mackay , Edwin Wright; Practical Industrial Data Communications: Best Practice Techniques; Newnes , An imprint of Elsevier,2004. 4. Clarke, G., Reynders, D., Wright, E.; Practical Modern SCADA Protocols	

	DNP3, 60870.5 and Related Systems, 1st Edition, Newnes , An imprint of Elsevier

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP645
Title of the Course: Robotics
Number of Credits: 03
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basic Mathematics and Physics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
• An understanding of all the subsystems and components of a robot.
• An ability to select appropriate sensors, actuators and end effectors for robots
• An ability to analyze the kinematics and motion planning of robotic systems.
• An understanding of control strategies employed in robot platforms</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP645.1</td><td>Explain working principle behind various types of actuation systems and sensors, different robot architectures and applications and control techniques used in robotic systems</td></tr>
<tr><td>ECOMP645.2</td><td>Evaluate appropriate end effectors, sensors and motion strategies for given robotic application</td></tr>
<tr><td>ECOMP645.3</td><td>Solve problems related to robot specifications, actuators, robot kinematics and control.</td></tr>
<tr><td>ECOMP645.4</td><td>Propose robotic solutions for a given application</td></tr>
</table></td></tr>
<tr><td rowspan="4">Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td>Basic Concepts in (Fundamentals of) robotics: Automation and robotics, Robot applications.
Different classifications of robot: By application, by coordinate system, by actuation system, by control method and by programming method.
Robot anatomy: links and joints, Joint notation scheme. Degree of Freedom. Robot resolution, accuracy and repeatability. Concept of workspace.
Drive systems: Pneumatic and hydraulic systems. Electric: Relation between torque and voltage. AC and DC Servo motors, Stepper motors, BLDC motors. Electronic control of motors.
Robot End Effectors: Grippers and Tools.</td><td>12 Hrs</td></tr>
<tr><td>UNIT-2</td><td></td></tr>
<tr><td>Kinematics: Coordinate frames, mapping and transforms, description of objects in space, transformation of vectors, fundamental rotation matrices,
Direct Kinematic model: Kinematic modelling of manipulator
Inverse Kinematics: Solvability of inverse kinematic models, solution techniques, closed form solution
Trajectory planning: Definitions and planning tasks, joint space techniques, cartesian space techniques, joint space v/s cartesian space.</td><td>12 Hrs</td></tr>
</table>

	UNIT -3	
	Manipulator Dynamics: Determination of Robotic Joint Torques, Langrage- Euler formulation two approaches, Example with 2 link Manipulator. **Control Scheme:** Partitioned control Scheme. **Analysis of wheeled robots and Biped robots:** Introduction, Staircase Ascending (SSP), Power Consumption, Dynamic Balances. **Sensors:** Characteristics of a sensor, Classification of Sensors, Touch sensors, Position Sensors: Potentiometer, LVDT, Optical Encoders, Force/Moment sensors, Range Sensor, Proximity Sensors- Inductive sensor, capacitive sensor, Hall effect sensor, Passive Sensor:RCC	**11 Hrs**
	UNIT -4	
	Machine Vision: Introduction, Sensing & Digitizing function, Imaging devices, Lighting techniques, Image storage, Image processing and analysis, Image Data reduction, Segmentation, Feature extraction, Object recognition, Training the vision system, Robotic applications. **Motion planning:** Gross/Free Space Motion Planning **Find path problems using:** Visibility Graph, Voronoi diagram, Cell Decomposition, Tangent-Graph Technique. **Dynamic Motion Planning Problems:** Path Velocity Decomposition, Accessibility Graph, Relative velocity scheme, Incremental planning, Artificial Potential field approach, reactive control scheme.	**11 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	
References/ Readings:	**TEXTBOOKS:** 1. S. K. Saha, Introduction to Robotics, 2nd Edition, McGrawHill 2. M. P. Groover, M. Weiss, R. N. Nagel, N. G. Odrey, Industrial Robotics Technology: programming and Applications, McGrawHill, 1986. **REFERENCE BOOKS:** 1. Peter Corke, Robotics Vision and Control, Springer, 2011. 2. Mittal & Nagrath, Robotics and Control, 1st Edition ,McGrawHill 3. John J. Craig, Introduction to Robotics, Mechanics & Control, 3e, Pearson Education Inc. 4. Roland Siegwart, Illah R. Nourbakhsh - Introduction to Autonomous Mobile Robots, MIT Press, 2nd Edition.	

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP650
Title of the Course: VLSI Design Lab
Number of Credits: 01
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Digital Electronics</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with
1. An ability to understand SPICE programming.
2. An ability to understand Verilog programming.
3. An ability to Draw Layouts for combinational circuits.
4. An understanding of designing using FPGAs.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP650.1</td><td>Simulate combinational circuits using Verilog HDL</td></tr>
<tr><td>ECOMP650.2</td><td>Implement digital circuits using FPGAs.</td></tr>
<tr><td>ECOMP650.3</td><td>Implement and verify Layouts for combinational circuits.</td></tr>
<tr><td>ECOMP650.4</td><td>Write the SPICE program for modeling MOSFET circuits.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments:
(Experiments should be conducted from the list. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Circuit Simulation and Characterization:
1. SPICE Program for NMOS and PMOS Characteristics
2. SPICE Program for Channel Length Modulation in MOSFET
3. SPICE Program for CMOS Inverter VTC/SPICE Program for Transmission Gate
Digital Logic Design and Verification:
4. Verilog Programs for Combinational Circuits with Test Bench Verification
5. Verilog Programs for Sequential Circuits with Test Bench Verification
Layout Design with Parameter Extraction:
6. Layout Design for Inverter with SPICE Parameter Extraction
7. Layout Design for NAND & NOR gates with SPICE Parameter Extraction /Layout Design for 2x1 MUX Using Transmission Gates
8. Layout Design for Boolean Function with SPICE Parameter Extraction
FPGA Design and Implementation:
9. Combinational Circuit Design and Implementation on FPGA
10. Sequential Circuit Design and Implementation on FPGA</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments</td></tr>
<tr><td>References/ Readings:</td><td>TEXTBOOKS:
1. W. Roberts, Adel S. Sedra, SPICE (The Oxford Series in Electrical and Computer Engineering) Paperback-Gordon
2. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall</td></tr>
</table>

Name of the Programme: Electronics and Computer Science
Course Code: ECOMP660
Title of the Course: Computer Networks Lab
Number of Credits: 01
Effective from AY: 2024-25

<table>
<tr><td>Pre-requisites for the Course:</td><td>Fundamental Networking Concepts and Programming Skills</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. An understanding of the various line coding schemes in communication networks.
2. An understanding of the working principle of various communication protocols with respect to the OSI model.
3. Analysis of the various data communication algorithms.
4. An understanding of the concept of data transfer between nodes in a network.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to<table><tr><td>ECOMP660.1</td><td>Implement line coding techniques for computer networks</td></tr><tr><td>ECOMP660.2</td><td>Implement various topologies in a computer network</td></tr><tr><td>ECOMP660.3</td><td>Analyze various data communication protocols</td></tr><tr><td>ECOMP660.4</td><td>Configure networking devices to set up communication between the same.</td></tr></table></td></tr>
<tr><td>Content:</td><td>List of Experiments:
(Eexperiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Encoding Techniques: (Using OCTAVE/PYTHON/MATLAB)
1. Implement Unipolar NRZ & NRZ-L and NRZ-I encoding techniques/Implement RZ and Biphase (Manchester and Differential Manchester) encoding techniques/Implement Bipolar Encoding schemes (AMI, Pseudo ternary, B8ZS and HDB3)/Implement Multilevel Encoding Schemes (2BIQ, 8B6T)
Networking Configuration: (Using Network Simulator/Cisco Packet Tracer)
2. Setting up a network to study various Topologies
3. Configuration of LAN
4. Configuring Networking and Internetworking Devices such as Hub, Switch, Router, Bridge,
5. Inter-Network Data Exchange Setup
6. VLAN Creation and Verification
7. Switch Connection for VLAN Expansion
8. Configuration of Address Resolution protocol and Routing Information protocol
9. Configuration of Open shortest Path First (OSPF) Algorithm
10. Network Configuration with Static Routing
11. Network Configuration with Default Routing</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning, Constructive planning of experiments,</td></tr>
</table>

	Collaborative approach in performing experiments
References/ Readings:	**TEXTBOOKS:** 1. Andrew S. Tanenbaum, Computer Networks, 4th Edition, Prentice Hall,2003

Name of the Programme: Electronics and Computer Science
Course Code: ECS670 Title of the Course: Professional Elective Lab- II
Number of Credits: 01
Effective from AY: 2024-25
Students will take ECS 670A, 670B, 670C,670D , 670E if they have taken ECOMP 641, ECOMP 642, ECOMP 643, ECS644 , ECOMP 645 respectively.

ECS 670A	Digital Image Processing Lab
ECS 670B	Information Theory and Coding Lab
ECS 670C	Advanced Microcontroller Lab
ECS 670D	Industrial Automation and Control Lab
ECS 670E	Robotics Lab

<table>
<tr><td>ECS670A</td><td>Digital Image Processing Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Knowledge of Mathematical Concepts, Basic Understanding of Image Processing Concepts, Proficiency in Programming.</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. proficiency in applying a wide range of image processing techniques
2. comprehensive understanding of color image processing, including the manipulation, correction, and enhancement of color images using various color models and spaces
3. practical skills in geometric image processing, enabling them to Apply acquired knowledge and skills to real-world scenarios</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS670A.1</td><td>Apply Basic Image processing techniques such as image sampling, quantization and enhancement.</td></tr>
<tr><td>ECS670A.2</td><td>Implement smoothing and sharpening filters in spatial and frequency domain</td></tr>
<tr><td>ECS670A.3</td><td>Apply advanced Image processing techniques such as image restoration, image segmentation, feature extraction, color image processing etc.</td></tr>
<tr><td>ECS670A.4</td><td>Perform tasks such as image transformation, warping, registration, and morphological operations for shape analysis and enhancement.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments
(Experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Basic Image Processing Techniques:
1. Image Sampling and Quantization
2. Image Enhancement (e.g., contrast stretching, histogram equalization)
3. Spatial Filtering (e.g., smoothing, sharpening)
Advanced Image Processing Techniques:
4. Frequency Domain Transforms(e.g., Fourier Transform)
5. Frequency Domain Filtering (e.g., smoothing, sharpening)
6. Image Restoration (e.g., denoising, deblurring)</td></tr>
</table>

	7. Image Segmentation (e.g., region-based segmentation, edge detection) 8. Feature Extraction (e.g., object detection, texture analysis) 9. Image Compression and Coding **Color Image Processing:** 9. Color Models and Spaces (e.g., RGB, HSI) 10. Color Manipulation and Correction 11. Color Image Enhancement **Geometric Image Processing:** 12. Image Transformation (e.g., scaling, rotation) and warping 13. Image Registration (e.g., alignment, fusion) 14. Image Morphological Operations (e.g., dilation, erosion)
Pedagogy:	Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments
References/ Readings:	**TEXTBOOKS:** 1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, 3rd Edition, 2010 2. S. Jayaraman, S. Esakkirajan and T. Veerakumar, Digital Image Processing, McGraw Hill Education (India) Private Ltd. 11th reprint 2013

<table>
<tr><td>ECS670B</td><td>Information Theory and Coding Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Probability theory and basic mathematical concepts, digital communication systems, Prior knowledge of coding theory and algorithms.</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Fundamental concepts of information theory, source coding, and channel coding techniques.
2. Proficiency in implementing various encoding and decoding algorithms for efficient data compression and error correction.
3. Skills to analyse and evaluate the performance of different coding schemes in terms of information transmission and error correction capabilities.
4. Application of theoretical knowledge to practical scenarios by designing and implementing error-correcting codes for reliable communication systems.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS670B.1</td><td>Determine the information content, marginal, joint and conditional entropies and information rate of a communication system.</td></tr>
<tr><td>ECS670B.2</td><td>Calculate the mutual information and channel capacity of a given channel.</td></tr>
<tr><td>ECS670B.3</td><td>Analyze the source coding techniques, encode the data using various source coding techniques and determine their efficiencies.</td></tr>
<tr><td>ECS670B.4</td><td>Code and decode the data using the various channel coding techniques and compare their performance.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments
(Experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Information Theory
1) Determination of Information, Entropies and Mutual Information.
2) Computation of Mutual Information and Channel Capacity for
a. Binary Symmetric Channel
b. Binary Erasure Channel
c. Noise Free Channel
Source Coding
3) Implementation of Shannon’s encoding Algorithm.
4) Implementation of Shannon-Fano Coding/Implementation of Huffman Coding.
5) Implementation of Lempel Ziv Coding
Channel Coding
6) Linear Block Code: Encoding and Decoding/Special Linear Block Codes: Encoding and Decoding
7) Cyclic Codes: Encoding and Decoding.
8) Convolutional Codes: Encoding and Decoding
9) Concatenated Codes: Encoding and Decoding
10) BER Performance of Error Correcting Codes</td></tr>
</table>

Pedagogy:	Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments
References/ Readings:	**TEXTBOOKS:** 1. Ranjan Bose, Information Theory, Coding & Cryptography, 2nd Edition; Tata- McGraw Hill, 2008. 2. R. P. Singh, S. Sapre, Communication systems: Analog and Digital, 3rd Edition, Tata- McGraw Hill.

<table>
<tr><td>ECS670C</td><td>Advanced Microcontroller Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Understanding of the Architecture of ARM7TDMI processor, C Programming</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. To develop in students programming skills and understanding of programming a advanced microcontroller (ARM7TDMI).
2. To interface peripherals with ARM7TDMI</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS670C.1</td><td>Explain embedded C programming and use of simulation tool for ARM7TDMI</td></tr>
<tr><td>ECS670C.2</td><td>Write programs for ARM7TDMI, to implement data transfer and other logical operations</td></tr>
<tr><td>ECS670C.3</td><td>Write programs for ARM7TDMI, to implement tasks involving counter, Timers and Code Conversion logic</td></tr>
<tr><td>ECS670C.4</td><td>Write programs to interface the different peripherals to the ARM7TDMI</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments:
(Experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Programming Fundamentals:
1. Writing programs using Data Transfer and arithmetic
2. Writing programs using logical and branch instructions
3. Writing Subroutines and passing parameters to subroutines
Interfacing:
5. Interfacing of LEDs
6. Interfacing Seven segment LED
7. Interfacing Stepper Motor
8. Interfacing ADC and DAC chips
Timing and Control:
9. Developing Counters and Time Delay Routines
10. Controlling the brightness of LED’s using PWM Module</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments</td></tr>
<tr><td>References/ Readings:</td><td>TEXTBOOKS
1. ARM Architecture Reference Manual
2. Andrew N. Sloss, Dominic Symes, Chris Wright; ARM System Developers Guide, Designing and Optimizing System Software; Elsevier
REFERENCES
1. Steve Furber; ARM System-on-Chip Architecture, 2nd Edition; Pearson</td></tr>
</table>

<table>
<tr><td>ECS670D</td><td>Industrial Automation and Control Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Fundamental knowledge of electrical circuits, logic design, basic control systems principles.</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. Introduction to principles and applications of thermal, optical and motion sensors
2. Familiarization of signal conditioning techniques for processing sensor data and preparing it for further analysis
3. Practical knowledge and skills in user interface design, data acquisition, visualization, and control using LabVIEW
4. Proficiency in designing, implementing, and configuring industrial control systems using Programmable Logic Controllers (PLC) and Supervisory Control and Data Acquisition (SCADA) systems.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to<table><tr><td>ECS670D.1</td><td>Integrate sensors effectively and condition signals for industrial applications.</td></tr><tr><td>ECS670D.2</td><td>Design intuitive virtual instruments for data acquisition and visualization.</td></tr><tr><td>ECS670D.3</td><td>Implement and tune various control systems, including PID controllers.</td></tr><tr><td>ECS670D.4</td><td>Program PLCs and configure SCADA systems proficiently for industrial automation.</td></tr></table></td></tr>
<tr><td>Content:</td><td>List of Experiments:
(Experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Sensors & Signal Conditioning
1. Experimenting with Thermal/Optical/Motion Sensors
2. Signal Conditioning
Virtual Instrumentation using LabVIEW
3. Creating Basic Virtual Instruments (VI) in LabVIEW
4. User Interface Design: Buttons, Sliders, Numeric Indicators, and Graphs
5. Data Acquisition and Visualization Using LabVIEW
6. Signal Processing and Analysis Using LabVIEW
Control Systems
7. Implementation of On-Off Control Systems/Continuous (P, I, D) and Composite (PI, PD, PID) Controller Modes
PLC Programming and SCADA
8. Latching, Interlocking and Jogging in PLC
9. Timer Applications in PLC
10. Counter Applications in PLC
11. PLC programs for sequential control applications
12. SCADA System Configuration</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning, Constructive planning of experiments, Collaborative approach in performing experiments</td></tr>
</table>

References/ Readings:	**TEXTBOOKS:** 1. Curtis D. Johnson; Process Control and Instrumentation Technology, 7th Edition;Pearson Education 2. Programmable Logic Controllers, Frank Petruzzula; Tata Mc-Graw Hill Edition. 3. John Webb, Ronal Weiss; Programmable Logic Controllers: Principles & Applications, 5th Edition; Prentice Hall of India 4. LabVIEW Graphical Programming: Practical Applications in Instrumentation and Control" by Gary W. Johnson, Pearson.

<table>
<tr><td>ECS670E</td><td>Robotics Lab</td></tr>
<tr><td>Pre-requisites for the Course:</td><td>Basics of Electrical and Electronics Engineering, Programming concepts</td></tr>
<tr><td>Course Objectives:</td><td>The subject aims to provide the student with:
1. An understanding of all the subsystems and components of a robot.
2. An ability to solve problems related to kinematics of a robot.
3. An ability to design and program simple robotic platforms.</td></tr>
<tr><td>Course Outcomes:</td><td>Upon completion of the course, students will be able to
<table>
<tr><td>ECS670E.1</td><td>Demonstrate proficiency in executing basic robot motions, including forward, backward, and rotational movements.</td></tr>
<tr><td>ECS670E.2</td><td>Implement algorithms for obstacle detection and avoidance to ensure safe navigation.</td></tr>
<tr><td>ECS670E.3</td><td>Effectively control robot velocity to maintain desired speeds and trajectories.</td></tr>
<tr><td>ECS670E.4</td><td>Design and program robots to follow predefined paths accurately, such as lines or trajectories for mapping and navigation.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td>List of Experiments:
(Experiments should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)
Basic Robot Control and Navigation:
1. Basic Robot Motion
2. Obstacle Detection and Avoidance in Robots
3. Velocity Control in Robots
4. Line Following Robot
5. Autonomous Mapping and Navigation
6. Robot Manipulation, Grasping, and Pick-and-Place Tasks
Kinematics and Control:
7. Forward Kinematics of a Robot
8. Inverse Kinematics of a Robot
9. Control and Programming of a 4 DOF Robotic Arm
Advanced Robotics Techniques:
10. Object Detection and Recognition
11. Robot Simulation Using ROS (Robot Operating System)
12. Trajectory Planning</td></tr>
<tr><td>Pedagogy:</td><td>Inquiry based learning ,Constructive planning of experiments ,Collaborative approach in performing experiments</td></tr>
<tr><td>References/ Readings:</td><td>TEXTBOOKS:
1. S. K. Saha, Introduction to Robotics, 2nd Edition, McGrawHill
2. M. P. Groover, M. Weiss, R. N. Nagel, N. G. Odrey, Industrial Robotics Technology: programming and Applications, McGrawHill, 1986</td></tr>
</table>

Name of the Programme: Electronics and Computer Science
Course Code: HM006 **Title of the Course:** Cyber Law and IPR
Number of Credits: 03
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td>Nil</td></tr>
<tr><td>Course Objectives:</td><td>The course aims to provide the student with:
1. An introduction to understanding the concept of cybercrime and the laws that deals with it.
2. An understanding of the legal issues related to defamation, harassment and Email abuse
3. An awareness regarding various aspects of copyright infringement.
4. An understanding of the fundamental aspects of Intellectual property Rights (IPR) and their role in development and management of innovative projects in industries.
5. An ability disseminate knowledge on copyrights, its related rights and registration aspects
6. An understanding of the issues related to trademarks and registration aspects of patents</td></tr>
<tr><td>Course outcomes</td><td>Upon completion of the course, students will be able to<table><tr><td>HM006.1</td><td>Describe and analyse cybercrime and understand jurisdictional aspects of cyber law.</td></tr><tr><td>HM006.2</td><td>Explain the concept of copyright, protection , computer piracy and relevant laws to deal with aspects related to infringement on the issues</td></tr><tr><td>HM006.3</td><td>Explain the concept of Intellectual Property rights , principles of enforcement and methods of protection</td></tr><tr><td>HM006.4</td><td>Describe to the concept of patents and legal issues related to enforcement of Intellectual Property Rights</td></tr></table></td></tr>
<tr><td>Content:</td><td>UNIT- 1
Power of Arrest without Warrant under the IT Act, 2000: A Critique: Section 80 of the IT Act 2000, Forgetting the line between Cognizable and NonCognizable Offences, Necessity of Arrest without warrant from any place, public or otherwise. Cyber Crime and Criminal Justice: Concept of Cyber Crime and the IT Act 2000, Hacking, Teenage web vandals, Cyber fraud and cyber cheating. Virus on the Internet. Defamation, harassment and E-mail abuse, Monetary penalties, adjudication and appeals under IT Act 2000, Nature of cyber criminality, strategies to tackle cybercrime and trends, Criminal justice in India and Implications on Cybercrime.
Contracts in the Infotech World: Contracts in the Infotech world, Click-wrap and Shrink-wrap contracts, Contract formation under the Indian Contract Act 1872, Contract formation on the Internet, Terms and Conditions of Contracts, Software product license.
Jurisdiction in the Cyber World: Civil law of Jurisdiction in India, Cause 12 Hrs.</td></tr>
</table>

	of action, Jurisdiction and the Information Technology Act 2000, Place of cause of action in contractual and IPR disputes, Exclusion clauses in Contracts, Abuse of exclusion clauses.	
	UNIT-2	
	Battling Cyber Squatters and Copyright Protection in the Cyber World: Concept of Domain name and reply to Cyber Squatters, Battle between freedom and control on the internet, Works in which copyright subsists and meaning of Copyright, Copyright Ownership and Assignment, License of Copyright, Copyright term and respect for foreign works, Copyright Infringement, Remedies and Offences, Copyright protection of content on the Internet, Copyright notice, disclaimer and acknowledgment, Napster and its Cousins, Computer Software Piracy. Digital signatures, Digital Signature Certificate, Certifying Authorities and Liability in the Event of Digital Signature Compromise, E-Governance in India. The Indian Evidence Act of 1872 v/s Information Technology Act, 2000: Status of Electronic Records as Evidence, Proof and Management of Electronic Records, Proving Digital Signature, Proof of Electronic Agreements, Proving Electronic Messages, Other Amendments in the Indian Evidence Act by the IT Act	**11 Hrs.**
	UNIT -3	
	Intellectual Property: Introduction, Protection of Intellectual Property — Copyright, Related Rights, Patents, Industrial Designs, Trademark, Unfair Competition Information Technology Related Intellectual Property Rights Computer Software and Intellectual Property — Objective, Copyright Protection, Reproducing, Defences, Patent Protection. Database and Data Protection-Objective, Need for Protection, UK Data Protection Act, 1998, US Safe Harbor Principle, Enforcement. Protection of Semiconductor Chips Objectives Justification of Protection, Criteria, Subject Matter of Protection, WIPO Treaty, TRIPs, SCPA. Domain Name Protection-Objectives, Domain Name and Intellectual Property, Registration of Domain Names, Disputes under Intellectual Property Rights, Jurisdictional Issues, and International Perspective.	**11 Hrs.**
	UNIT -4	
	Patents (Ownership and Enforcement of Intellectual Property) Patents - Objectives, Rights, Assignments, Defences in Case of Infringement Copyright Objectives, Rights, Transfer of Copyright, Work of Employment Infringement, Defences for Infringement, Trademarks - Objectives, Rights, Protection of good will, Infringement, Passing off, Defences. Designs - Objectives, Rights, Assignments, Infringements, Defences of Design Infringement. Enforcement of Intellectual Property Rights - Civil Remedies, Criminal Remedies, Border Security Measures. Practical Aspects of Licencing - Benefits, Determinative Factors, Important Clauses, Licensing Clauses.	**12 Hrs**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning , Constructive learning and Collaborative learning	

References/ Readings:	**TEXTBOOKS:** 1. Vivek Sood, Cyber Law Simplified, Tata McGraw-Hill 2. IPR and Cyber Law, Sunil Shah, Himalaya Publishing house. **REFERENCE BOOKS:** 1. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, Cengage Learning India Private Limited (2019). 2. Neeraj, P., Khusdeep, D. Intellectual Property Rights. India, IN: PHI learning Private Limited(2014) 3. W. Cornish & Llewelyn – Intellectual Property: Patent, Copyrights, Trade Marks & Allied Rights", London Sweet & Maxwell. 4. Nard Madison- The Intellectual Property, Aspian Publication 5. Carlosm Correa- Oxford commentaries on GATT/ WTO Agreements trade related aspects of Intellectual Property Rights, Oxford University Press. 6. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.