THIRD YEAR ELECTRONICS AND COMPUTER ENGINEERING PROGRAM
PROPOSED SYLLABUS

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP510 **Title of the Course:** Microcontrollers and Interfacing
Number of Credits: 03(L) + 01(T)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basic Computer Architecture</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An understanding the basic architecture and operation of 8051 microcontroller.
2. Knowledge about assembly language programs of 8051 microcontroller.
3. An understanding the importance of different peripheral devices & their interfacing to 8051 microcontroller.
4. An ability to design real world applications using microcontroller.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to<table><tr><td>ECOMP510.1</td><td>Explain the architecture of 8051 microcontroller.</td></tr><tr><td>ECOMP510.2</td><td>Analyze the instruction set of 8051 microcontroller.</td></tr><tr><td>ECOMP510.3</td><td>Interface the hardware with 8051 microcontroller for given applications.</td></tr><tr><td>ECOMP510.4</td><td>Create assembly level programs using 8051 microcontroller.</td></tr></table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><td>Microcontrollers-Comparison between microcontroller and microprocessor, criteria for choosing microcontroller, 8051 Architecture – 8051 microcontroller hardware, Input Output pins, ports and circuits, External memory, Counters and Timers, Serial data input/output, Interrupts.</td><td>12L+ 3THrs.</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Assembly Language Programming – 8051 data types and directives, Instructions for moving data, arithmetic operations, logical operations, rotate instructions, Jump and Call instructions, I/O Port Programming, instructions used to access memory.</td><td>11L+ 4T Hrs.</td></tr>
<tr><td></td><td>UNIT -3</td><td></td></tr>
<tr><td></td><td>8051 Microcontroller Design – Reset and clock circuits, Crystal test, ROM test, RAM test, Software time delay programming, Timer Programming, Counter Programming, Serial Communication Programming, Interrupt programming, Programming using Look Up Tables.</td><td>11L+ 4THrs.</td></tr>
</table>

	UNIT -4	
	Interfacing- LED and switch interfacing, Seven segment LED interfacing, LCD interfacing, Matrix Keyboard Interfacing, pulse width measurement, ADC (0808) and DAC (0808) interfacing, DC, Stepper and Servo motor Interfacing.	11L+ 4THrs.
Pedagogy:	Learner centric teaching	
References/ Readings:	**Text Books:** 1. Kenneth Ayala, 8051 Microcontroller, 3rd Edition, Cengage Learning. 2. Manish K. Patel, The 8051 Microcontroller Based Embedded Systems, McGraw Hill Education (India) Pte. Limited, 2014 **Reference book** 1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D McKinlay, The 8051 Microcontroller And Embedded Systems Using Assembly And C, 2nd Edition, Pearson	

TERM WORK
Students can be evaluated based on assignments/ class tests/ seminars/ quizzes/ viva etc.

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP520 **Title of the Course:** Operating System
Number of Credits: 03(L)+ 01(T)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Basic Computer Architecture</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An ability to describe control structures and techniques used in a typical operating system for process management.
2. The knowledge of approaches to deal with deadlocks and mechanisms to ensure the orderly execution of processes to maintain data consistency.
3. An ability to describe ways to manage memory, and implement virtual memory.
4. A general understanding of file management aspects of an operating system and various disk scheduling policies.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 520.1</td><td>Summarize the objectives of an Operating System, understand the process cycle and analyze the various CPU Scheduling algorithms.</td></tr>
<tr><td>ECOMP 520.2</td><td>Understand the classic problems of Process Synchronization and Resource Allocation in case of Deadlocks.</td></tr>
<tr><td>ECOMP 520.3</td><td>Identify and compare various memory management.</td></tr>
<tr><td>ECOMP 520.4</td><td>Apply various disk scheduling algorithms and understand file management systems.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><td>Introduction to Operating System:OS objectives and functions, Evolution of operating systems
Process description & control: Process, process states: creation & termination of processes, two & five model process model, process description: OS control structures, process control structures, process attributes, process control: modes of execution, creation of process, process switching, context switching, Threads: processes and threads, types of threads.
Process Scheduling: Basic concepts: CPU – I/O Burst Cycle, CPU Scheduler, Preemptive Scheduling, Dispatcher, Scheduling criteria, Scheduling Algorithms: FCFS, SJF, Priority, RR.</td><td>12L+ 4THrs.</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Process Synchronization: Background, The Critical – Section Problem,Peterson’s solution, Mutex locks, Semaphores, classic</td><td>11L+ 3THr</td></tr>
</table>

	problems of Synchronization: The Bounded Buffer Problem, the Readers-Writers Problem, The Dining- Philosophers Problem. **Deadlocks:** System model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.	s.
	UNIT -3	
	Memory: Memory Hierarchy, Cache Memory. **Memory Management:** Memory management requirements, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Paging and Segmentation. **Virtual Memory:** Background, Demand Paging, Page Replacement: Basic Scheme, FIFO, Optimal, LRU.	11L+ 4T Hrs.
	UNIT -4	
	I/O Management & Disk Scheduling: Organization of I/O function, Disk scheduling: Disk Performance parameter, Disk scheduling policies-FCFS, SSTF, SCAN, CSCAN, LOOK. **File Management:** Files, File Management systems, File organization and access, File directories, File sharing, Record blocking.	11L+ 4THrs.
Pedagogy:	Learner centric teaching	
References/ Readings:	**TEXT BOOKS:** 1. William Stallings, Operating Systems: Internal & design principles,7th Edition, PHI. 2. A. Silberschatz, P. Galvin, G. Gagne, Operating systems Concepts, 9th Edition, John Wiley & Sons Pte. Ltd. 3. Andrew S. Tanenbaum, Modern Operating Systems, 2nd Edition, Pearson education, Prentice Hall **REFERENCES:** 1. D.M. Dhamdhere, Operating Systems: A concept-based approach,TataMc Graw Hill 2. Milan Milenkovic, Operating Systems: Concepts and design, TataMc Graw Hill	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP531 **Title of the Course:** Computer Oriented Numerical Techniques
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Applied Mathematics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An understanding of sources of errors and problems in computation for very large data set.
2. An understanding of different numerical methods used for the solution of engineering problems.
3. An ability to develop algorithm for the numerical methods
4. An ability to implement a particular method for a realistic engineering problem</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP531.1</td><td>Explain sources and types of errors and approximations and its problems in computation.</td></tr>
<tr><td>ECOMP531.2</td><td>Solve non-linear equations, simultaneous linear algebraic equations, eigenvalue problems, using numerical methods.</td></tr>
<tr><td>ECOMP531.3</td><td>Apply various numerical methods to perform interpolation, numerical differentiation and integration.</td></tr>
<tr><td>ECOMP531.4</td><td>Solve ordinary and partial differential equations using appropriate numerical methods.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><td>Introduction, Approximation and errors of computation: Introduction, sources of errors, problems in computations, safeguards against errors, floating point arithmetic, absolute error, relative error, percentage error-calculations, Taylor’s series, Newton’s finite differences (forward, backward, central and divided differences) Difference, shift, differential operators.
Solutions of Algebraic & Transcendental Equations: Bisection method, Newton Raphson method, Regula Falsi method, Secant method, fixed point iteration method, Rate of convergence and comparisons of these methods.</td><td>12Hrs.</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Solution of system of linear algebraic equations: Direct Methods, Gauss elimination method with pivoting strategies, Gauss Jordan</td><td>11 Hrs.</td></tr>
</table>

	method, LU Factorization. Iterative methods (Jacobi, Gauss Seidal method), Eigen value and Eigen vector using Power method **Interpolation:** Newton's Interpolation (forward, backward), Lagrange's interpolation, Newton's Divided difference interpolation formula, Spline interpolation (cubic spline).	
	UNIT -3	
	Numerical Differentiation and Integration: Numerical differentiation formulae, Numerical Integration, Newton-Cote general Quadrature formula, Trapezoidal, Simpson's 1/3, 3/8 rule, Romberg's method. **Numerical Solution of ordinary differential equations:** Picard's method, Taylor series method, Euler's and modified Euler's method, Runge Kutta methods for 1^{st} and 2^{nd} order ordinary differential equations.	11 Hrs.
	UNIT -4	
	Numerical solution of partial differential equation: Classification of partial differential equation (Elliptic, parabolic and Hyperbolic), Solution of Laplace equation (standard five point formula with iterative method), Solution of Poisson equation (finite difference approximation), Solution of Elliptic equation by Relaxation method.	11 Hrs.
Pedagogy:	Learner centric teaching	
References/ Readings:	**TEXT BOOKS:** 1. E. Balaguruswamy, Numerical Methods, 1st Edition, TMH, 2012 2. Dr. B. S. Grewal, Numerical methods in Engineering & Science, 9th Edition, Khanna Publication, 2012 3. Dr. Sudhir K. Pundir, Numerical Methods in Science and Engineering, 1st Edition, CBS Publishers & Distributors Pvt. Ltd., 2017. **REFERENCES:** 1. Rajaraman, Computer Oriented Numerical methods, 3rd Edition , PHI, 2011 2. S. S. Sastry, Introduction methods of numerical analysis, 4th Edition, PHI, 2011	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP532 **Title of the Course:** Software Engineering
Number of Credits: 03(L)
Effective from AY: 2023-24

<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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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>12Hrs.</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>The Tools of the Trade: CASE, Taxonomy of CASE, Scope of CASE, Software Versions, Configuration Control.
From Modules to Objects: Cohesion, Coupling, Data</td><td>11 Hrs.</td></tr>
</table>

	Encapsulation. **More on UML:** Class Diagrams, Use-Case Diagrams, Interaction Diagrams, State Charts, Activity Diagrams.	
	UNIT -3	
	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.	11Hrs.
	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:	Learner centric teaching	
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. Pankoj Jalote, Software Project Management in Practice, Addison-Wesley PEA 5. Ian Sommervilee, Software Engineering, 10th Edition Pearson. **REFERENCES:** 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 Engineering
Course Code: ECOMP533 **Title of the Course:** Soft Computing
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Mathematical background, Proficiency with 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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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></td><td colspan="2">UNIT-2</td></tr>
</table>

	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 Alpha-cuts for fuzzy, Types of Defuzzification. Fuzzy Inference Systems and its design, Fuzzy Process, Type-2 fuzzy sets, Sugeno Fuzzy System.	11 Hrs.
	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:	Learner centric teaching	
References/ Readings:	**TEXTBOOKS:** 1. Anupam Shukla, Ritu Tiwari, Rahul Kala; Real Life Applications of Soft Computing; 2010, CRC Press. 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. 4. J. Zurada; Introduction to Artificial neural network; JaicoPublications2012. **REFERENCES:** 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 Engineering
Course Code: ECOMP534 **Title of the Course:** Design Analysis and Algorithms
Number of Credits: 03(L)
Effective from AY: 2023-24

<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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><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>11 Hrs.</td></tr>
<tr><td></td><td>UNIT -3</td><td></td></tr>
</table>

	Backtracking: General Method, 8-queens problem, Sum of subsets problem, graph coloring, Hamiltonian Cycles, knapsack problem. **Branch-and-Bound:** General Method, 0/1 knapsack, Travelling salesperson problem.	11Hrs.
	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:	Learner centric teaching	
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. **REFERENCES:** 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 ÉvaTardos, Algorithm Design, 1st Edition, Pearson.	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP535 **Title of the Course:** Computer Graphics
Number of Credits: 03(L)
Effective from AY: 2023-24

<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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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></td><td colspan="2">UNIT-2</td></tr>
<tr><td></td><td>Two Dimensional Geometric Transformations: Basic Transformations, Translation, Rotation, Scaling, Composite transformation, Translations, Rotations, Scaling, Other transformations- Reflection, Shear.</td><td>11 Hrs.</td></tr>
</table>

	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 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.	11Hrs.
	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.	11 Hrs.
Pedagogy:	Learner centric teaching	
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. **REFERENCES:** 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 Engineering
Course Code: ECOMP541 **Title of the Course:** CONTROL SYSTEM ENGINEERING
Number of Credits: 03(L)
Effective from AY: 2023-24

<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 541.1</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 541.2</td><td>Apply mathematical modelling and stability analysis techniques to mechanical and electrical systems.</td></tr>
<tr><td>ECOMP 541.3</td><td>Analyze performance and stability of mechanical and electrical systems using time and frequency domain techniques.</td></tr>
<tr><td>ECOMP 541.4</td><td>Perform state space analysis and explain need of compensators and controllers.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><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.</td><td>11Hrs.</td></tr>
</table>

	Stability: Stability concept, Location of poles on s-plane for stability, Routh- Hurwitz criterion, Root Locus	
	UNIT -3	
	Frequency-domain Analysis: Frequency Domain Specifications, Correlation between time and frequency response, Bode-plots, Polar-plots, Nyquist Stability Criterion and Nyquist-plots	11 Hrs.
	UNIT -4	
	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	11 Hrs
Pedagogy:	Learner centric teaching	
References/ Readings:	Textbook 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 Engineering
Course Code: ECOMP542 **Title of the Course: POWER ELECTRONICS**
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td>Basic Electronic Devices</td></tr>
<tr><td>Course Objectives:</td><td>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>Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 542.1</td><td>Explain the construction and characteristics of power semiconductor devices.</td></tr>
<tr><td>ECOMP 542.2</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 542.3</td><td>Explain and analyse thyristor firing circuits, commutation circuits and connections of SCR.</td></tr>
<tr><td>ECOMP 542.4</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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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</td><td>12 Hrs.</td></tr>
</table>

	Thyristors. **Other members of Thyristor Family**: DIAC, TRIAC, & GTO: structure, characteristics, applications. Operation and characteristics of UJT.	
	UNIT-2	
	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. **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.	11Hrs.
	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:	Learner centric teaching	
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 Engineering
Course Code: ECOMP543 **Title of the Course: DIGITAL SIGNAL PROCESSING**
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Applied mathematics</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The course aims to provide the student with:
1. Understanding of time-domain representation and analysis of signals and systems
2. An ability to perform frequency-domain representation and analysis using Fourier tools
3. An understanding of sampling, aliasing and Signal reconstruction
4. Ability to compute Discrete Fourier Transform and Fast Fourier Transform of a time domain signal
5. An understanding of the design and implementation techniques of Infinite Impulse Response filters and Finite Impulse Response filter</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table><tr><td>ECOMP 543.1</td><td>Classify & interpret different types of signals and illustrate the properties of various systems</td></tr><tr><td>ECOMP 543.2</td><td>Analyze CT and DT signals in Frequency domain using CTFT and DTFT</td></tr><tr><td>ECOMP 543.3</td><td>Appreciate the process of sampling and analyze discrete time signals using DFT and FFT</td></tr><tr><td>ECOMP 543.4</td><td>Understand and implement the design techniques for FIR and IIR digital filters</td></tr></table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><td>Introduction:
Definitions and concept of different types of signals;
Classification of signals: continuous time and discrete time signals; Causal and Non-Causal, Periodic and Non-periodic signals, Signal Energy and Power, Even and Odd Signals.
Basic signal types: Exponential and Sinusoidal signal; Unit impulse and Unit step, Unit Ramp functions, Sinc function.
Systems: Continuous time and Discrete time system.
Linear time invariant (LTI) systems: Introduction, Discrete time LTI system, the convolution sum, Impulse Response of LTI system.</td><td>12 Hrs.</td></tr>
</table>

	UNIT-2	
	Continuous-Time Fourier Transform: Representation of aperiodic signals: Fourier transform of aperiodic signals. **Discrete-Time Fourier Transform:** Representation of aperiodic signals; Fourier transform of aperiodic signals. Properties. **Sampling of continuous time signals:** Periodic sampling, Frequency domain representation of sampling, Reconstruction of a Band limited Signal from its samples.	11 Hrs.
	UNIT -3	
	The Discrete Fourier transform (DFT): Introduction, Properties of Discrete Fourier Transform:- Linearity, periodicity, Complex Conjugate, Time shift, Frequency shift, Duality and Convolution in time domain is multiplication in frequency domain. Circular convolution using the DFT. Computation of the Discrete Fourier transform. **Fast Fourier Transform:** Efficient computation of DFT, Decimation-in- time FFT (in-place computations), Decimation-in-Frequency FFT (in-place computations) (Radix – 2 only) (upto 8 point DFT only,	11 Hrs.
	UNIT -4	
	IIR Filters: IIR Filter design techniques: IIR Filter design by impulse invariant method and bilinear transformation. **Design of IIR Filters:** Butterworth low pass filter design 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 FIR filters: Window techniques (Rectangular, Hamming).	11 Hrs
Pedagogy:	Learner centric teaching	
References/ Readings:	TEXT BOOKS 1. A. V. Oppenheim, A.V.Willsky, S. Hamid, Signals and systems, 2nd Edition PHI. 2. A. V. Oppenheim and R. W. Schafer, Discrete-Time Signal Processing, 3rd Edition, Pearson. 3. S. Salivahanan, Digital Signal Processing, 3rd Edition, McGraw Hill Education 4. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, Pearson, 2007. REFERENCE BOOKS	

	1. Sanjit K. Mitra, Digital Signal Processing - A Computer based approach, 2nd Edition; McGraw Hill Education. 2. S. Haykins, B. V. Veen, Signals and Systems, 2nd Edition, Wiley India. 2007 3. V. Krishnaveni, A. Rajeshwari, Signals and Systems, Wiley India 2012

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP544 **Title of the Course:** PRINCIPLES OF COMMUNICATION ENGINEERING
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The course aims to provide the student with:
1. An understanding of fundamental concepts of Analog and Digital Communication techniques;
2. Analysis of sampling, pulse modulation, and multiplexing.
3. Analysis and comparison of analog and digital modulation techniques.
4. Operation and analysis of communication transmitter and receiver.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 544.1</td><td>Explain the fundamental concepts of analog and digital communication.</td></tr>
<tr><td>ECOMP 544.2</td><td>Analyze and compare different analog and digital modulation techniques.</td></tr>
<tr><td>ECOMP 544.3</td><td>Analyze the performance of a communication system.</td></tr>
<tr><td>ECOMP 544.4</td><td>Model and design analog and digital communication system.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><td>An overview of Electronic Communication Systems: Bloc diagram representation, Analog vs Digital communication, Need for frequency translation, modulation, multiplexing, types of transmission media.
Amplitude modulation: Mathematical representation of AM signal, modulation index, double sideband suppressed carrier, Balanced modulator, coherent detection, Double sideband with carrier (DSB-C), Single sideband suppressed carrier (SSB-SC) generation: Filter method, Phase shift method, Coherent detection.</td><td>12 Hrs.</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Frequency modulation (FM): Mathematical representation of FM signal, Modulation Index, Tone modulated FM signal, FM spectrum, Bandwidth, Carson’s rule, Narrowband and wideband FM.
FM generation and Detection: Direct method, Armstrong method.</td><td>11 Hrs.</td></tr>
</table>

	Slope Detector,Foster-Seelay discriminator, Ratio detector. Principle and block level representation of Super heterodyne receiver, Choice of Intermediate frequency, Image frequency and its rejection.	
	UNIT -3	
	Pulse Modulation: Sampling, The Low pass sampling theorem, Pulse amplitude modulation (PAM), Pulse width modulation (PWM), Pulse time modulation (PTM). **Pulse Code Modulation:** Pulse Code Modulation, Electrical representation of binary digits, PCM system, Quantization Error, Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Adaptive Delta Modulation (ADM). Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing.	11 Hrs.
	UNIT -4	
	Digital Modulation Techniques: Amplitude Shift Keying, Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Offset Quadrature Phase Shift Keying (QPSK), M-ary PSK, Minimum Shift Keying (MSK), Gaussian MSK, Quadrature Amplitude Shift Keying (QASK), Binary Frequency Shift Keying (BFSK).	11 Hrs
Pedagogy:	Learner centric teaching	
References/ Readings:	**TEXT BOOKS** 1. Taub, Schilling, Saha, Principles of Communication Systems, 3rd Edition, Tata McGraw Hill Publishing Company 2. Singh & Sapre, Communication Systems: Analog & Digital, 3rd Edition, Tata McGraw Hill Publishing Company. **REFERENCE BOOKS** 1. George Kennedy, Bernard Davis and S.R.M. Prasanna, Electronic Communication Systems, 5th Edition, Tata McGraw Hill. 2. Dennis Roddy, John Coolen, Electronic Communication System, PHI 3. Wayne Tomasi, Electronic communications Systems, 3rd Edition, Pearson Education, 4. John Proakis, Digital Communications, 4th Edition, McGraw Hill International. 5. Bernard Sklar, Digital Communications: Fundamental & Applications, 2nd Edition, Pearson Education	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP545 **Title of the Course: CONSUMER ELECTRONICS**
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Nil</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>ECOMP 545.1</td><td>Explain the concepts related to sound recording and reproduction, TV systems, electrical appliances, marketing planning and strategy.</td></tr>
<tr><td>ECOMP 545.2</td><td>Demonstrate safety awareness and take precautionary measures while handling electronic equipments.</td></tr>
<tr><td>ECOMP 545.3</td><td>Analyze consumer electronic circuits for fault and performance degradation.</td></tr>
<tr><td>ECOMP 545.4</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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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>11 Hrs.</td></tr>
</table>

	UNIT-2	
	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.	12 Hrs.
	UNIT -3	
	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:	Learner centric teaching	
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. **REFERENCES:** 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 3. R G Gupta, Television engineering and video systems , Tata McGraw-Hill Education,2005 4. H S Kalsi, Electronic Instrumentation, TMH, Sixth reprint,2006

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP550 **Title of the Course:** Web technology Lab
Number of Credits: 01
Effective from AY: 2023-24

<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
(At least 8 experiments excluding the Mini Project should be conducted from the list of experiments. A certified journal reporting the experiments conducted should be submitted at the end of the term)
<table>
<tr><td>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 include 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.
Mini Project: Develop an application with front end and backend connection which will incorporate HTML5, CSS3, XML, XSLT, JavaScript, PHP, MySQL.</td><td>30 HRS</td></tr>
</table></td></tr>
</table>

Pedagogy:	Learner centric teaching
References/ Readings:	**TEXTBOOKS:** 1. N. P. Gopalan,J. Akhilandeswari; "Web Technology: A Developer's Perspective"; PHI.

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP560 **Title of the Course:** Microcontrollers and Interfacing Lab
Number of Credits: 01
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with
1. Ability to develop assembly language programming skills in students.
2. Ability to write 8051 Assembly level programs using 8051 instruction set
3. An ability to design real world applications using microcontroller
4. Ability to interface peripherals with 8051</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table><tr><td>ECOMP 560.1</td><td>Understand assembly language programming and use of simulation tool.</td></tr><tr><td>ECOMP 560.2</td><td>Write assembly language programs using data movement, arithmatic and logical instructions</td></tr><tr><td>ECOMP 560.3</td><td>Understand programming of 8051 using a development board</td></tr><tr><td>ECOMP 560.4</td><td>Interface different peripherals with 8051.</td></tr></table></td></tr>
<tr><td>Content:</td><td colspan="2">List of Experiments
Note: At least 10 experiments should be conducted from the following list of experiments</td></tr>
<tr><td></td><td>1. Assembly language program for block transfer of memory (in reverse order also)
2. Assembly program to find largest and smallest from a set of numbers in memory
3. Assembly program to find even and odd numbers in set of numbers in memory
4. Assembly program to count positive and negative numbers from a set of numbers
5. Assembly program to arrange the numbers in ascending and descending order
6. Interfacing of LEDs and Switches to 8051
7. Interfacing of seven segment display to 8051.
8. Interfacing of LCD to 8051
9. Interfacing of DC, Stepper and Servo Motor to 8051</td><td>30 HRS</td></tr>
</table>

	10. Measurement of pulse width using timers of 8051 11. Interfacing of ADC and DAC with 8051 12. Implementation of hardware interrupt using simple switch and led Serial port programming 13. Microcontroller based Mini Project.	
Pedagogy:	Learner centric teaching, Team work and collaboration	
References/ Readings:	1. Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rolin D McKinlay, The 8051 Microcontroller and embedded systems 2. Kenneth, J Ayala The 8051 Microcontroller, Architecture, Programming and Applications	

Name of the Programme: Electronics and Computer Engineering
Course Code:HM009 **Title of the Course:** Ethics and Entrepreneurship
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">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 colspan="2">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 colspan="2">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</td><td>11 Hrs.</td></tr>
</table>

	Ethical Theories, Factors influencing Ethical Behavior	
	UNIT-2	
	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 blowing	11 Hrs.
	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.	11Hrs

	Methods of project evaluation: Payback period, Net Present Value Index.	
Pedagogy:	Learner centric teaching	
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 REFERENCES 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.	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP610 **Title of the Course:** Fundamentals of VLSI Design
Number of Credits: 03(L)+1(T)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Digital System Design</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>Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to<table><tr><td>ECOMP 610.1</td><td>Explain the MOSFET operation, Current Voltage Equations, and CMOS Inverter Theory and to solve numerical based on MOSFET and CMOS inverter.</td></tr><tr><td>ECOMP 610.2</td><td>Explain the various MOSFET fabrication processes.</td></tr><tr><td>ECOMP 610.3</td><td>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>ECOMP 610.4</td><td>Design combinational circuits using Verilog.</td></tr></table></td></tr>
<tr><td>Content:</td><td colspan="3">UNIT- 1</td></tr>
<tr><td></td><td>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 - KN, VTO & γ.

Overview of MOSFET capacitances.</td><td>11L+ 4T Hrs.</td></tr>
</table>

	UNIT-2	
	CMOS inverter design: operation, DC characteristics, calculation of VIL, VIH, VTH, VOH and VOL. Noise margins power and area considerations. Latch up and its prevention. **Switching Circuit Characteristics:** Rise, fall and delay time, gate delays, transistor sizing, static and dynamic power dissipations CMOS logic gate design: Fan in and fan out Modeling of MOS transistor circuits using SPICE. (Level 1 model equations).	11L+ 4THrs.
	UNIT -3	
	MOS transistor switches: CMOS logic- Inverter, NOR, NAND and combinational logic, Compound gates, Multiplexers, Transmission gates, Latches and Registers. Implementation of Boolean Expressions using transmission gates and CMOS logic. Stick diagrams and Layout of Inverter, NOR and NAND. Complex logic gates and their layouts (Euler paths). MOSIS layout design rules, full-custom mask layout designs.	11L+ 4T Hrs.
	UNIT -4	
	Silicon semiconductor technology: Wafer processing, oxidation, epitaxy, deposition, etching, Photolithography, Ion-implantation, and diffusion. Silicon gate process. Chemical Vapor Deposition, Metallization. **Basic CMOS technology**: n-well and p-well CMOS process. Silicon on insulator. **Introduction to Verilog language**. Verilog Programs for Ripple Carry Adder, Subtractor, Decoder, Encoder, Multiplexer, Demultiplexer (using dataflow and gate level modeling)	12L+ 3THrs
Pedagogy:	Learner centric teaching	
References/ Readings:	1. Sung-Mo (Steve) Kang. Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis & Design, 3rd edition, McGraw-Hill Education 2. Neil Weste, David Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 3rd Edition, Pearson. 3. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, 2nd edition, Prentice Hall **REFERENCE BOOKS** 1. Wayne Wolf, Modern VLSI design (Systems on Silicon), 3rd edition, PHI.	

			2. Jan M. Rabaey, Digital Integrated Circuits - A Design perspective, Pearson Education

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP620 **Title of the Course:** Computer Networks
Number of Credits: 03(L)+1(T)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">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. An understanding of the routing algorithms, flow control & congestion control.
4. An understanding of Internet Protocols & Transport protocols.
5. Familiarization with various Networking Devices and their functions within a network.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP 620.1</td><td>Explain the functions of the various layers of OSI model, networking devices and protocols of data ommunication.</td></tr>
<tr><td>ECOMP 620.2</td><td>Apply the various line coding techniques, flow and error control techniques.</td></tr>
<tr><td>ECOMP 620.3</td><td>Classify and compare the services of the layers of the OSI model.</td></tr>
<tr><td>ECOMP 620.4</td><td>Analyze various networks based on their applications.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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.
LAN systems: Architecture: Bus, Ring, Tree, Star, Fast Ethernet, Token ring.
Ethernet: Contention Access, CSMA, CSMA/CD
The Physical Layer: Interface RS-232, DTE-DCE interface, Null modems.</td><td>12L+ 3THrs.</td></tr>
<tr><td></td><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,</td><td>11L+ 4THrs.</td></tr>
</table>

	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.	
	UNIT -3	
	Networking Devices: Repeaters, Bridges, Routers, 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 and token bucket algorithm) **Internet Protocols:** IPv4, CIDR, NAT, OSPF, BGP, IPv6.	11L+ 4THrs.
	UNIT -4	
	Transport Protocols: Transport service: services provided to the upper layer, connection establishment, connection release, multiplexing, flow control and buffering, crash recovery, Comparison of internet transport protocols (TCP and UDP) **The Application Layer:** **DNS--Domain Name System**:The DNS Name Space, Resource Records, Name Servers **Electronic Mail:** Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery **The World Wide Web:** Architectural Overview, The Client Side, The Server Side, URLs, Cookies. **HTTP:** Connections, methods, message headers, caching.	11L+ 4THrs.
Pedagogy:	Learner centric teaching	
References/ Readings:	**TEXTBOOKS:** 1. Andrew S. Tanenbaum ,Computer Networks, 4th Edition, Prentice Hall,2003. 2. Behrouz A. Forouzan , Data Communications and Networking,4th Edition, Tata McGraw-Hill, 2006. 3. Prakash Gupta, Data Communications and Computer Networks, 2nd Edition, PHI, 2014. **REFERENCES:** 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 Engineering
Course Code: ECOMP631 **Title of the Course:** Artificial Intelligence
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Logic Theory, Probability Theory, Numerical Analysis, Operations on Matrices</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">The subject aims to provide the student with:
1. An Introduction to AI Techniques for solving real world problems
2. An Understanding of search strategies, planning, logic and knowledge representation in AI
3. An Introduction to Game playing and Learning methods in AI
4. The fundamentals of Machine Learning techniques and its applications.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="2">Upon completion of the course, students will be able to
<table>
<tr><td>ECOMP631.1</td><td>Discuss the structure of an AI problem and apply various problem solving methods to solve related problems</td></tr>
<tr><td>ECOMP631.2</td><td>Apply concepts of planning, constraint satisfaction and game playing to solve AI problems.</td></tr>
<tr><td>ECOMP631.3</td><td>Develop solutions to AI problems using predicate logic, frames and semantic nets.</td></tr>
<tr><td>ECOMP631.4</td><td>Describe the concept of Learning and analyse the suitability of Machine Learning Algorithms for any application.</td></tr>
</table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><td>Introduction:What is Intelligence, future of Artificial Intelligence, Defining a problem, problem solving approach to typical AI problems

Problem Solving :
State Space Search: Depth First Search(DFS), Breadth First Search(BFS), Depth Bounded DFS, Depth First Iterative Deepening
Heuristic Search: Heuristic Functions, Hill Climbing, Variable Neighbourhood Descent
Optimal Search: A* Algorithm, Iterative Deepening A*</td><td>12 Hrs.</td></tr>
<tr><td></td><td colspan="2">UNIT-2</td></tr>
<tr><td></td><td>Problem Decomposition: Goal Trees, Rule Based Systems, Rule Based Expert Systems

Planning: The STRIPS Domain, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning</td><td>11 Hrs.</td></tr>
</table>

	Constraint Satisfaction: N-Queens, Constraint Propagation. **Game Playing:** Min-Max Search Procedure**,** Alpha-Beta Pruning	
	UNIT -3	
	Knowledge based Reasoning: Agents, Facets of Knowledge **Logic and Inferences:** Formal Logic, Propositional Logic, Resolution method in Propositional Logic, First Order Logic, Resolution Refutation in FOL, Forward & Backward Chaining. **Knowledge Representation:** Frames, Semantic Nets	11 Hrs.
	UNIT -4	
	Learning: Introduction, Rote Learning, Learning by Taking Advice, Learning by Induction **Machine Learning:** Naïve Bayes Classifier, Decision Trees, The K-Means Clustering Algorithm, Support Vector Machines	11 Hrs.
Pedagogy:	Learner centric teaching	
References/ Readings:	**TEXTBOOKS:** 1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education (India) 2013. 2. Elaine Rich, Kevin Knight, Nair, Artificial Intelligence, TMH, 2010. 3. Ela Kumar, Artificial Intelligence, I.K. International Publishing House Pvt. Ltd.2008. **REFERENCES:** 1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson, 2003 2. Nilsson Nils J, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. 3. Patrick Winston, Artificial Intelligence, Pearson Education	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP632 **Title of the Course:** Augmented Reality & Virtual Reality
Number of Credits: 03(L)
Effective from AY: 2023-24

<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>ECOMP632.1</td><td>Understand how VR systems work and describe the input and output devices used</td></tr><tr><td>ECOMP632.2</td><td>Understand the various representations in VR and describe systems for rendering and interaction</td></tr><tr><td>ECOMP632.3</td><td>Understand and analyse the hardware requirement of AR.</td></tr><tr><td>ECOMP632.4</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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><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</td><td>11 Hrs.</td></tr>
</table>

	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 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:	Learner centric teaching	
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 Engineering
Course Code: ECOMP633 **Title of the Course:** Mobile Phone Programming
Number of Credits: 03(L)
Effective from AY: 2023-24

<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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Building User Interfaces: Fundamental UI design, Android UI fundamentals, Introducing Layouts, Fragments, Creating new views and Introducing adapters.</td><td>11 Hrs.</td></tr>
</table>

	Intents, Broadcast Receivers, Adapters, and the Internet: Introducing Intents, Introducing Adapters, Using Internet Resources, Introducing Dialogs, Creating an Earthquake Viewer.	
	UNIT -3	
	Data Storage, Retrieval, and Sharing: Saving Simple Application Data, Creating and Saving Shared Preferences, Retrieving Shared Preferences , Creating a Settings Activity for the 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.	12 Hrs.
	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.	11 Hrs.
Pedagogy:	**Learner centric teaching**	
References/ Readings:	**TEXT BOOKS** 1. Reto Meier; Professional Android Application Development; Wiley Publishing Inc. 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. 2. Jerome DiMarzio; Android: A Programmer's Guide; McGraw Hill Inc. 3. Rich Ling; Mobile Phones and Mobile Communication; Polity Press. 4. Ed Burnett; Hello, Android: Introducing Google's Mobile Development Platform; Pragmatic Bookshelf. 5. Rick Rogers, John Lombardo, Zigurd Mednieks; Android Application Development: Programming with the Google SDK; O'Reilly Media. 6. Sayed Y Hashimi, Satya Komatineni; Pro Android: Developing Mobile Applications for G1 and Other Google Phones; Apress Publications. 7. Chris Haseman; Android Essentials; Apress Publications.	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP634 **Title of the Course:** Software testing and Quality Assurance
Number of Credits: 03(L)
Effective from AY: 2023-24

<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>ECOMP634.1</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>ECOMP634.2</td><td>Apply different testing approaches to all stages of software development</td></tr>
<tr><td>ECOMP634.3</td><td>Prepare test plans, strategy, specifications, procedures and controls to provide a structured approach to testing.</td></tr>
<tr><td>ECOMP634.4</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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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>11 Hrs.</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><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,</td><td>12 Hrs.</td></tr>
</table>

	Usage based statistical testing with Musa's operational profiles.	
	UNIT -3	
	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 WinRunner, SilkTest, SQA Robot ,Loadrunner.	11 Hrs.
Pedagogy:	Learner centric teaching	
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. **REFERENCES:** 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 Engineering
Course Code: ECOMP635 **Title of the Course:** Introduction to Formal Languages and Automata
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Discrete Structures.</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to provide the student with:
1. Conceptual understanding of fundamentals of grammars and languages.
2. Understanding of concepts of theoretical design of deterministic and non-deterministic finite automata and push down automata.
3. Understanding of different types of Turing machines and applications.
4. Understanding of the concept of Undecidability.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to<table><tr><td>ECOMP635.1</td><td>Explain the techniques to transform between equivalent deterministic and Non-deterministic finite automata</td></tr><tr><td>ECOMP635.2</td><td>Explain regular languages and grammars and Apply the properties of regular expressions.</td></tr><tr><td>ECOMP635.3</td><td>Formulate grammars and automata (recognizers) for different language classes. Perform the simplification of automata and Context free grammars.</td></tr><tr><td>ECOMP635.4</td><td>Explain the concepts of Turing machines.</td></tr></table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><td>Introduction: Languages, Grammars and Automata.
Finite Automata: Deterministic Finite Accepters, Nondeterministic Finite Accepters, Equivalence of Deterministic and Nondeterministic Finite Accepters, Reduction of the Number of States in Finite Automata.</td><td>11 Hrs.</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Regular Languages and Regular Grammars: Regular Expressions, Connection Between Regular Expressions and Regular Languages, Regular Grammars, Properties of Regular Languages: Closure properties of Regular languages, Elementary questions about regular languages, Identifying non regular languages.</td><td>11 Hrs.</td></tr>
<tr><td></td><td>UNIT -3</td><td></td></tr>
<tr><td></td><td>Context-Free Languages: Examples of Context Free Languages, Leftmost and Rightmost Derivations, Derivation Trees, Parsing and Ambiguity.
Simplification of Context Free Grammars and Normal Forms:</td><td>12 Hrs.</td></tr>
</table>

	Methods for Transforming Context Free Grammars, Chomsky Normal Form, and Greibach Normal Form. Nondeterministic Pushdown Automata, Pushdown Automata and Context-Free Languages, Pumping Lemma for Context-Free Languages. Closure of Context Free languages.	
	UNIT -4	
	Turing Machine: Standard Turing Machine, Combining Turing `s for Complicated Tasks, Turing's Thesis. **Other Models of Turing Machines:** Turing Machines with More Complex Storage. Nondeterministic Turing Machines. A Universal Turing Machine. Linear Bounded Automata.	11 Hrs.
Pedagogy:	Learner centric teaching	
References/ Readings:	**TEXTBOOKS:** 1. Peter Linz; An introduction to Formal Languages and Automata; 5th edition , Jones & Bartlett Learning, 2006,. 2. John C Martin; Introduction to languages and the theory of computation; Tata McGraw Hill, 4th Edition, 2010. **REFERNCES:** 1. John E. Hopcraft , Jeffery D. Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House. 2. K.L.P Mishra, N. Chandrasekaran, Theory of Computer Science – Automata, languages and Computation, PHI Publications, 3rd Edition, 2008. 3. Michael Sipser, Introduction to Theory of Computation, PWS Publishing Company. 4. A.A Puntambekar, Formal Languages and Automata Theory, Technical Publications Pune.	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP641 **Title of the Course:** Digital Image Processing
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Applied mathematics</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">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 colspan="3">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 colspan="3">UNIT- 1</td></tr>
<tr><td></td><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>
</table>

	UNIT-2	
	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. **Different Image Transforms:** Discrete cosine transform (DCT), HADAMARD, WALSH, KL (PCT) transform, DWT. **Colour image processing:** Colour fundamentals, Colour models (RGB, CMYK, HSI).	11 Hrs.
	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)	11 Hrs.
Pedagogy:	Learner centric teaching	
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 Engineering
Course Code: ECOMP642 **Title of the Course:** Information Theory & Coding
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to provide the student with:
1. An understanding of information theoretic behavior 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="3">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>Content:</td><td colspan="3">UNIT- 1</td></tr>
<tr><td></td><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>11Hrs.</td></tr>
<tr><td></td><td>UNIT-2</td><td></td></tr>
<tr><td></td><td>Shannon’s theorem, Capacity of a Gaussian Channel: Shannon - Hartley theorem, bandwidth–S/N tradeoff, Shannon limit.</td><td>11Hrs.</td></tr>
</table>

	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.	
	UNIT -3	
	Error Control Coding: Types of codes, error probability with repetition in the binary symmetric channel, parity check bit for 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.	11Hrs.
	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, Viterbi algorithm. Comparison of error rates in coded and uncoded transmission. **Turbo codes:** Encoding and Decoding of Turbo Codes.	12 Hrs.
Pedagogy:	Learner centric teaching	
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 **REFERENCES** 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 Engineering
Course Code: ECOMP643 **Title of the Course:** Advanced Microcontroller
Number of Credits: 03(L)
Effective from AY: 2023-24

<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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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>11 Hrs.</td></tr>
</table>

	UNIT-2	
	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. Elementary assembly level programs. **Thumb state:** Thumb Programmers model, Thumb exceptions, Implementation and applications. Thumb Instruction set in brief.	12 Hrs.
	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:	Learner centric teaching	
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 Engineering
Course Code: ECOMP644 **Title of the Course:** Mobile Communication
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to provide the student with:
1. An understanding of the cell theory and the different types of handoffs.
2. An ability to calculate the Co-channel Interference reduction factor, received power at the mobile using the different types of propagation models, parameters of the mobile multipath channels and classify the different types of fading channels.
3. An understanding of the different types of equalization and diversity techniques.
4. An understanding of the GSM and CDMA standards for mobile communication.</td></tr>
<tr><td>Course Outcomes:</td><td colspan="3">Upon completion of the course, students will be able to<table><tr><td>ECOMP644.1</td><td>Explain the operation and propagation mechanisms of a cellular communication system.</td></tr><tr><td>ECOMP644.2</td><td>Analyse and quantify the effect of interference, multi-path propagation on the operation of a cellular communication system.</td></tr><tr><td>ECOMP644.3</td><td>Explain, analyse and evaluate the methods to overcome fading in cellular communication systems.</td></tr><tr><td>ECOMP644.4</td><td>Explain and analyse the architecture and performance of cellular networks based on GSM and CDMA standards.</td></tr></table></td></tr>
<tr><td>Content:</td><td colspan="2">UNIT- 1</td><td></td></tr>
<tr><td></td><td colspan="2">Wireless transmission terminology: Frequencies for the radio transmission, signals, Antennas, Signal propagation, path loss of radio signals, multiplexing, modulation, spread spectrum.
The Cellular Concept: Introduction, Block diagram of Cellular System, Concept of Frequency Reuse, Hexagonal shaped cells.
Handoff Strategies: Handoffs, Types of handoff, handoff initiation, delaying handoff, forced handoff, Power Difference Handoffs, Mobile assisted Handoff (MAHO) and Soft Handoff, Cellsite Handoff, Intersystem Handoff.
Co-channel Interference: Cochannel Interference Reduction Factor, Desired C/I for a normal case in an Omnidirectional Antenna System.
Mobile Radio Propagation, Large -Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, The Three</td><td>12 Hrs.</td></tr>
</table>

	Basic Propagation Mechanisms	
	UNIT-2	
	Small -Scale Fading and Multipath: Small- Scale Multipath Propagation, Impulse Response Model of a Multipath Channel:Relationship between bandwidth and received power. **Mobile Multipath channels:** Parameters of Mobile Multipath Channels, Types of Small -Scale Fading, Rayleigh and Ricean Distribution.	11 Hrs.
	UNIT -3	
	Equalization: Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communications Receiver, Linear Equalizers, Nonlinear Equalization **Diversity Techniques:** Practical Space Diversity Considerations	11 Hrs.
	UNIT -4	
	Global System for Mobile Communication (GSM): GSM Services and Features, GSM System Architecture, GSM Radio Subsystem, GSM Channel Types, Example of a GSM Call, Frame Structure for GSM. **Code Division Multiple Access (CDMA):** CDMA Digital Cellular Standard (IS-95): Frequency and Channel Specifications, Forward CDMA Channel, Reverse CDMA Channel.	11 Hrs.
Pedagogy:	Learner centric teaching	
References/ Readings:	**TEXTBOOKS** 1. Theodore Rappaport; Wireless Communication : Principles and 2. Practice, 2nd Ed.; Pearson Education. 3. William Lee; Mobile Cellular Telecommunications; 2nd edition,Tata McGraw Hill. **REFERENCES** 1. David Tse and Pramod Vishwanathan; Fundamentals of Wireless 2. Communications; Cambridge University Press. 3. Jochen Schiller; Mobile Communications, 2nd Edition; Addison Wesley.	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP645 **Title of the Course:** Robotics
Number of Credits: 03(L)
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">The subject aims to provide the student with:
1. An understanding of all the subsystems and components of a robot.
2. An ability to select appropriate sensors, actuators and end effectors for robots
3. An ability to analyze the kinematics and motion planning of robotic systems.
4. An understanding of control strategies employed in robot platforms</td></tr>
<tr><td>Course Outcomes:</td><td colspan="3">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>Content:</td><td colspan="2">UNIT- 1</td></tr>
<tr><td></td><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></td><td colspan="2">UNIT-2</td></tr>
</table>

	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.	11 Hrs.
	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, Imagingdevices, Lightingtechniques, 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:	Learner centric teaching	
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. **REFERENCES** 1. Peter Corke, Robotics Vision and Control, Springer. 2. Mittal & Nagrath, Robotics and Control, McGrawHill 3. John J. Craig, Introduction to Robotics, Mechanics & Control, 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 Engineering
Course Code: ECOMP650 **Title of the Course:** VLSI Design Lab
Number of Credits: 01
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="3">Digital System design</td></tr>
<tr><td>Course Objectives:</td><td colspan="3">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 colspan="3">Upon completion of the course, students will be able to
ECOMP650.1 Simulate combinational circuits using Verilog HDL
ECOMP650.2 Implement digital circuits using FPGAs
ECOMP650.3 Implement and verify Layouts for combinational circuits
ECOMP650.4 Model MOSFET circuits using SPICE.</td></tr>
<tr><td>Content:</td><td colspan="3">List of Experiments
Note: At least 10 experiments should be conducted from the following list of experiments</td></tr>
<tr><td></td><td colspan="2">1. SPICE program for NMOS and PMOS Characteristics.
2. SPICE program for channel length modulation in MOSFET
3. SPICE program for CMOS Inverter VTC.
4. SPICE program for Transmission Gate.
5. Verilog programs for Combinational circuits. Verify with Test benches
6. Verilog programs for sequential circuits. Verify with Test benches
7. Layout for Inverter and parameter extraction in SPICE.
8. Layout for NAND & NOR and parameter extraction in SPICE.
9. Layout for XOR & XNOR and parameter extraction in SPICE.
10. Layout for Boolean function and parameter extraction in SPICE.
11. Layout for 2x1 MUX in Transmission Gates.
12. Sequential/ Combinational circuit design using FPGA</td><td>30HRS</td></tr>
<tr><td>Pedagogy:</td><td colspan="3">Learner centric teaching, Team work and collaboration</td></tr>
</table>

References/ Readings:	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	

Name of the Programme: Electronics and Computer Engineering
Course Code: ECOMP660 **Title of the Course:** Computer Networks Lab
Number of Credits: 01
Effective from AY: 2023-24

<table>
<tr><td>Pre-requisites for the Course:</td><td colspan="2">Nil</td></tr>
<tr><td>Course Objectives:</td><td colspan="2">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 colspan="2">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
A minimum of 10 experiments to be conducted from the following list:
1. Implement Unipolar NRZ & NRZ-L and NRZ-I encoding techniques using software like MATLAB/Octave.
2. Implement RZ and Biphase (Manchester and Differential Manchester) encoding techniques using software like MATLAB/Octave.
3. Implement Bipolar encoding schemes (AMI, Pseudoternary) using software like MATLAB/Octave.
4. Implement Multilevel Encoding Schemes (2BIQ, 8B6T) using software like MATLAB/Octave.
5. Implement Scrambling Techniques (B8ZS and HDB3) using software like MATLAB/Octave.
6. Create, name a VLAN using switch and to transfer range of ports at a time to verify its functionality and delete the VLAN using Hardware/ software like Network Simulator/ Cisco Packet Tracer
7. Connect two switches to increase the number of ports in a VLAN by trunking using Hardware/ software like Network Simulator/ Cisco Packet Tracer.
8. Set up a network to exchange data between two PC's working on different networks using Hardware/ software like Network</td><td>30 HRS</td></tr>
</table>

	Simulator/ Cisco Packet Tracer. 9. To build and configure a network using Static Routing using Hardware/ software like Network Simulator/ Cisco Packet Tracer. 10. To build and configure a network using Default routing using Hardware/ software like Network Simulator/ Cisco Packet Tracer 11. Set up a network to study various Topologies in a Computer Network using software like Network Simulator/ Cisco Packet Tracer. 12. Study of various Data communication protocols (Eg. ICMP, ARP, UDP, HTTP) using LAN trainer kit/actual setup/ software like Network Simulator/ Cisco Packet Tracer. 13. To build and configure a network using static IPv6 routing using Cisco Packet Tracer Software/Hardware. 14. To implement telnetting in networking devices using Cisco Packet Tracer Software/Hardware.	
Pedagogy:	Learner centric teaching, Team work and collaboration	
References/ Readings:	**TEXTBOOKS:** 1. Andrew S. Tanenbaum ,Computer Networks, 4th Edition, Prentice Hall,2003	

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

Pre-requisites for the Course:	Nil	
Course Objectives:	The course aims to provide the student with: 1. An introduction to understanding the concept of cybercrime and the laws that deal with it. 2. An understanding of the legal issues related to defamation, harassment and Email abuse 3. An awareness regrading 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	
Course Outcomes:	Upon completion of the course, students will be able to 1. HM006.1: Describe and analyze cyber crime and understand jurisdictional aspects of cyber law. 2. HM006.2: Explain the concept of copyright, protection , computer piracy and relevant laws to deal with aspects related to infringement on the issues 3. HM006.3: Explain the concept of Intellectual Property rights , principles of enforcement and methods of protection 4. HM006.4: Describe to the concept of patents and legal issues related to enforcement of Intellectual Property Rights	
Content:	**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 cyber crime and trends, Criminal justice in India and Implications on Cyber crime. **Contracts in the Infotech World:** Contracts in the Infotech world, Click-wrap and Shrink-wrap contracts, Contract formation under the Indian	12 Hrs.

	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 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 ChipsObjectives 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 CopyrightObjectives, 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.	11 Hrs
Pedagogy:	Learner centric teaching	
References/ Readings:	**TEXTBOOKS** 1. Vivek Sood, Cyber Law Simplified, Tata McGraw-Hill 2. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, Cengage Learning India Private Limited(2019). 3. Neeraj, P., Khusdeep, D. . Intellectual Property Rights. India, IN: PHI learning Private Limited(2014) **REFERENCES** 1. IPR and Cyber Law , Sunil Shah, Himalaya Publishing house. 2. W. Cornish & Llewelyn – Intellectual Property: Patent, Copyrights, Trade Marks & Allied Rights", London Sweet & Maxwell. 3. Nard Madison- The Intellectual Property, Aspian Publication 4. Carlosm Correa- Oxford commentaries on GATT/ WTO Agreements trade related aspects of Intellectual Property Rights, Oxford University Press. 5. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.	