III semester core courses:

Course No.	Title of the Course	Course Structure	Pre-Requisite
ECMTC04	**Mathematics for Communication and Signal Processing**	**3L-1T-0P**	**None**

COURSE OUTCOMES (CO)

CO1: Know the concepts of Group theory, homomorphism and isomorphism and its applications, Rings
CO2: Know the concepts of Vector Spaces and Linear Transformations
CO3: To know the concepts of vector calculus such as gradient, curl, divergence and integral theorems such as Green's Theorem, Stoke's Theorem and Gauss Divergence Theorem and their applications in various fields
CO4: To know real integrals the concepts of functions of complex variables and its applications to evaluate
CO5: To know evolution of Partial Differential Equations and its methods of solutions for real life problems

COURSE CONTENT:

Abstract Algebra: Groups, definitions and examples, Abelian Group, Homomorphisms, Subgroups, Order of a Group, Cyclic Groups, Factor Groups, Simple Groups and Composition Series, Abelian Groups, Rings: Definitions and Examples, Homomorphisms, Integral domain, Fields.

Linear Algebra: Vector space, Vector spaces over Q, R and C, Subspaces, linearly dependent and linearly independence set of vectors, Basis and dimension of a vector space, vectors in plane and space, Linear Transformation.

Vector Calculus: Differentiation of a vector function, scalar and vector fields, Gradient, Divergence, Curl, line integral, independence of path, Green's theorem and applications. Surface Integral, Stoke's theorem and applications; Volume Integrals, Gauss Divergence theorem and applications.

Complex Variables: Functions of a complex variable, analytic functions, harmonic functions, Cauchy-Riemann equations (Cartesian and polar form). Linear fractional transformation, Conformal mapping, Mapping of elementary functions (exponential, trigonometric, hyperbolic and logarithm functions), Contour integration, Cauchy's integral theorem and formula, zeroes, Singularities, Poles, Residue theorem, Evaluation of real integrals (around unit circle, no singularity on real line, and singularity on real line).

Partial Differential Equations: Solution of first order equations- Lagrange, nonlinear first order, Charpit's method, higher order linear equations with constant coefficients. Separation of variables, Solutions of Heat and Wave equations (one dimensional only), Laplace equation.

Recommended Books:

1. I. N. Herstein, ``Topics in Algebra, ‘’ Wiley Publishing
2. J. B. Fraleigh, ``A First Course in Algebra,‘’ Narosa Publication
3. Jain and Iyenger, ``Advanced Engineering Mathematics,” Narosa Publication
4. Kreyszig, ``Advanced Engineering Mathematics,” Wiley Publication
5. Greenberg, ``Advanced Engineering Mathematics,” Pearson Education

Course Code	Course Name	Course Structure	
ECECC05	**Signal and Systems**	**3-1-0**	**L-T-P**

COURSE OUTCOME (CO):

CO1: To understand the concept of signals and systems and their classifications.

CO2: To understand the concept of convolution and its applications.

CO3: To analyze the spectral characteristics of continuous-time and discrete-time periodic and aperiodic *signals* using Fourier analysis.

CO4: To analyze continuous-time LTI systems in the time domain and s-domain

CO5: To analyze discrete-time LTI systems in the time domain and z-domain

COURSE CONTENT:

Unit-I:

Concept definition & classification of signals– Continuous time (CT) and Discrete Time (DT) signals, Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids, Properties of unit impulse in continuous and discrete domain, Concept of orthogonality, Transformation of independent variables, Classification of systems & their properties, Waveform synthesis.

Unit-II:

Convolution integrals and its properties, Properties of LTI System, impulse response, step response, convolution sum and its properties, graphical method.

Unit-III:

Fourier series representation of continuous time and discrete time signals and their properties. Magnitude and Phase spectrum of signals.

Continuous time Fourier Transform and its properties, Discrete time Fourier Transform and its properties. Magnitude and Phase representations of frequency response of LTI systems. Introduction to LP/BP/HP/All Pass systems. Relationship between discrete time signals and Sampled continuous time low pass signals.

Unit-IV:

Laplace Transform and its properties, concept of ROC and its properties. Inverse-Laplace transform. Unilateral Laplace transform and its applications. Computation of impulse response, total response (zero state and zero input response) & transfer function using Laplace transform. Stability and causality of continuous-time LTI Systems.

Unit-V:

Z-Transform and its properties, ROC and its properties, Inverse Z-transform; Power series expansion and partial fraction expansion. Relationship between Z-transform, Fourier transform and Laplace transform. Stability and causality of discrete-time LTI System. Unilateral Z transform and its applications. Computation of impulse response, total response (Zero state and Zero input response) & Transfer function using Z-Transform.

Text Books:

[T1] Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems Prentice Hall India, 2nd Edition, 2009.

Reference Books:

[R1] Simon Haykin and Barry Van Veen, “Signals and Systems”, John Willey & Sons, Inc, second edition 2013.

Tarun Kumar Rawat, Signals and Systems, Oxford University Press, 1st Edition, 2010.

Course Code	Course Name	Course Structure	
ECECC06	**Probability Theory and Random Process**	**L-T-P**	**3-1-0**

COURSE OUTCOME (CO):

CO1: To understand the probability theory and random variables for the analysis of random phenomena.
CO2: To characterize probability models and function of random variables based on single & multiples random variables.
CO3: To evaluate and apply moments & characteristic functions and understand the concept of inequalities.
CO4: To understand the concept of random processes and determine covariance and spectral density of stationary random processes.
CO5: To understand representation of low pass and band pass noise models.

COURSE CONTENT:

Unit-I:

Probability Theory: Introduction to Random Variables, PDF, CDF. Continuous/Discrete/Mixed type random variables. Normal, Exponential, chi-square, Rayleigh, Nakagami-m, uniform distributions, etc. Bernoulli, Binomial, Poisson distributions. Expectation, Variance, Moments, Characteristic functions.

Unit-II:

Joint Random variables and random vectors. Independent, uncorrelated random variables. Joint Expectation, co-variance, Joint Moments, joint characteristic functions, conditional distributions, conditional expectation. Multidimensional Gaussian law

Unit-III:

Functions of random variables of the type Y=g(X), Z=g(X,Y) and two functions of two random variables, Inequalities of Chebyshev and Schwartz. Chernoff Bounds.

Unit-IV:

Random processes. First-order stationary processes, second order and wide sense stationary process, Nth order and strict sense stationary process, Time averages and ergodicity, Mean ergodic process, Auto correlation function and its properties, Cross- correlation function and its properties, Covariance functions and their properties, discrete time processes and sequences,

Unit-V:

Power density spectrum and its properties, Linear systems with random inputs. Random signal response, Auto correlation functions of the response, Cross correlation functions of input and output system, Power density spectrum of the response, Spectral representation. Wiener- Khinchine theorem. Gaussian process, White process, Response of LTI systems to White Noise

Text Books:

[T1] H. Stark and J. W. Woods, Probability and Random Processes with Applications to Signal Processing, 3rd Edition Prentice Hall.

Reference Books:

[R1] A Papoulis and S. Pillai, Probability, Random Variables and Stochastic Processes, 4th Edition, PHI, 2002.
[R2] P.Z. Peebles, Probability, Random Variables and Random Signals, 4th Edition, TMH, 2001.

Course Code	Course Name	Course Structure		Pre-Requisite
ECECC07	**Microelectronics**	**L-T-P**	**3-0-2**	**EEE**

COURSE OUTCOME (CO):

After completing the course, the students should be able to:

CO-1 Understand the modelling and analysis of single-stage MOS and BJT amplifiers

CO-2 Analyse differential and multi-stage amplifiers using BJTs and MOSFETs

CO-3 Understand the basic parameters and analysis of bipolar and CMOS op-amps

CO-4 Understand the basic negative feedback amplifier topologies and their characteristics

CO-5 Understand the importance of positive feedback and the realisation of sinusoidal oscillators

CO-6 Understand power amplifiers realised from power BJT and MOSFETs and IC power amplifiers

Unit No.	Topics
Unit 1	Review of Small signal operation and models for MOSFET and BJT, high frequency models of MOSFET and BJT, Single stage integrated circuit (IC) amplifiers, Widlar, Wilson and Cascode Current mirrors, IC biasing, High frequency response of CS and CE amplifiers with passive and active loads, high frequency response of CG and CB amplifiers with active loads, CS and CE amplifiers with source de-generation, Source follower and emitter follower, Cascode amplifier.
Unit 2	Differential and multi stage amplifiers: MOS differential pair and its small signal operation. BJT differential pair, Non ideal characteristics of differential amplifiers, Differential amplifiers with active load; Multi-stage amplifiers using MOSFETs and BJTs.
Unit 3	Feedback amplifiers and Sinusoidal oscillators: General feedback structure, Properties of negative feedback, Four basic feedback topologies, Loop gain, Stability problem, Basic principle of sinusoidal oscillators, RC phase shift and Wien bridge oscillators, LC and crystal oscillators.
Unit 4	Typical architectures of internally-compensated-type Bipolar and CMOS op-amps: Input common mode range and output swing, DC voltage gain, CMRR, Frequency response, phase margin and gain margin, Slew rate and unity gain bandwidth, Power supply rejection ratio.
Unit 5	Output stages and power amplifiers: Class A, Class B, Class AB output amplifier stages, Class C amplifiers, Power BJTs, MOS power transistor, Discrete and IC power amplifiers.

References:

1. Adel S. Sedra and K. C. Smith, *Microelectronic Circuits,* New York: Oxford University Press, 1998.
2. P. R. Gray, P. J. Hurst, S. H. Lewis Meyer, *Analysis and Design of Analog Integrated Circuits, Fourth Edition* 2009.
3. Jacob Millman and Arvin Grabel. *Microelectronics,* McGraw-Hill, Inc., 1987.

List of Experiments:

1. Evaluation of the performance of BJT Wilson Current mirror
2. Evaluation of the performance of MOS Cascode Current mirror
3. Evaluation of the performance of a Cascode amplifier
4. BJT-based differential amplifier with active load (and current source biasing)
5. MOS differential amplifier
6. Evaluation of the performance of a two-stage CMOS op-amp
7. Study of the properties of negative feedback amplifiers (implementation of series-series, series-parallel, parallel-series and parallel-parallel topologies)
8. Study of class AB push-pull amplifier
9. BJT-based RC phase shift oscillator
10. Study of Colpitts and Hartley Oscillators

Note: Course teachers may design 3-4 new experiments/small projects in addition to the above suggested practical exercises.

Course Code	Course Name	Course Structure		Pre-requisites
ECECC08	Digital Circuits and Systems	L-T-P	3-0-2	EEE

COURSE OUTCOMES

After the completion of the course, the students should be able to:

CO1: Get familiarized with number systems, codes, logic gates and Boolean algebra
CO 2: Understand the properties and operation of contemporary logic families.
CO 3: Design and implement basic combinational and sequential circuits.
CO 4: Understand the motivation and need for modelling and synthesis using Hardware Description Languages.
CO 5: Understand system design processes using programmable logic devices, operation of building blocks of a digital computer system.

UNIT-1: Logic functions and operation of logic families

Digital design representations (e.g., truth table, equations, schematic, etc.), Different codes and their properties (e.g., Gray, BCD, 1-Hot etc.). Signed and unsigned Number representation and conversion. Binary addition and subtraction (unsigned and one's and two's complement). Boolean equations and terminology (SOP, POS, minterm, maxterm), Logic implementations of equations (2-level, AND/OR, NAND/NOR, etc.). Characteristics of TTL and CMOS logic families (i.e., logic thresholds, delay, Noise margin, fan-in and fan-out, power dissipation), TTL to CMOS and CMOS to TTL interfacing.

UNIT-2: Elements of Combination logic

Overview of Boolean algebra, Simplification of logic functions using (i) K-map up to 5 variables with don't care conditions (ii) Tabulation (Quine-McCluskey) method. Combinational logic design: half and full adder, half and full subtractor. Multiplexers, Encoders, Decoders, Priority encoders, Comparators, Magnitude comparator, Demultiplexer. Code converters: BCD to Seven Segment Display (SSD), Binary to SSD. Introduction to a PROM and its use for implementing arbitrary logic functions.

UNIT-3: Elements of sequential logic.

SR Latch, D Latch, Master-Slave operation of a latch. Latch versus flip-flop, Flip-Flops (D, SR, JK, and T), Registers, Shift registers (SISO, SIPO, PISO), Linear feedback shift registers. Ripple and synchronous counters. PWM generator. Binary multiplier. Synchronous and asynchronous sequential circuits. Mealy and Moore sequential models. Design of Finite state machine using state table, state diagram, state assignment (binary, Gray, one-hot), next state and output equations. Example FSM implementations.

UNIT-4: Hardware Description Language

Modern digital design methods. Motivation and need for hardware description language. Introduction to VHDL and important terminology. VHDL Library and packages. Entities, architecture and configurations. Signals and data types. Operators and processes. VHDL code examples of all combinational and sequential circuits from unit-2 and unit-3 including FSM.

UNIT-5: Digital System Design and Programmable Logic Devices

Digital system design using FSMD approach. Design of illustrative systems using VHDL, such as game of dual-dice, rock-paper-scissor, reaction timer, period counter etc. Elements of CPU - RAM and DRAM; ALU; control logic using FSM and microprogram control approach; register file. Introduction to programmable logic devices - PAL/PLA, GAL, CPLD and FPGA. Introduction to JTAG.

SUGGESTED READINGS

1. Donald D. Givone, “Digital Principles & Design’’, Tata McGraw Hill. ISBN: 978-0070529069.
2. M.M. Mano, M.D. Cilleti, “Digital Design’’, 6th edition, Pearson, 2018. ISBN: 978-9353062019
3. C. Roth, L. Kinney, “Fundamentals of Logic Design ”, 7th Edition Cengage Learning, 2014. ISBN: 978-8131526156.
4. Stephen Brown, Zvonko Vranesic, “Fundamentals of Digital Logic with VHDL Design”, McGraw Hill. ISBN: 978-1259025976.
5. Pong P. Chu, “FPGA Prototyping by VHDL” Wiley. ISBN: 978-1119282747

LIST OF EXPERIMENTS

1. Characterization of Logic Family (Use 74HC/LS/HCT04 on a breadboard)
a. Find out logic threshold values and noise margins.
b. Propagation Delay time measurement of inverter using ring oscillator with 3, 5, 7, 9 and 11 inverter elements.
2. Design, Implement and verify a: half-adder, (two numbers of 2-bits each) full-adder, half-subtractor, (two numbers of 2-bits each) Full-subtractor using Xilinx Design Suite (Schematic capture) and verify on a CPLD/FPGA Board
3. Design, implement and verify a 2-bit binary comparator using basic gates. Use unsigned binary numbers as inputs. The comparator should have three outputs – Equal, Greater than and Less than.
4. Design, Implement and verify a 3x8 decoder and 8x1 multiplexor using basic gates.
5. Design, implement and verify a circuit to implement any combinational circuit with 4-inputs using a 16x1 multiplexor library symbol in the Xilinx design suite library.
6. Design, implement and verify a using a 16x1 multiplexer: a BCD to Seven Segment Decoder and a Binary to Seven Segment decoder.
7. Design, implement and verify a 4-bit binary counter and a decimal counter using basic gates and DFFs. Demonstrate the output on LEDs.
8. Design, implement and verify using FSM, a D type flip-flop with an enable signal. If enable is ‘1’, the flip flop captures the input signal, if enable is ‘0’, the flip flop retains the previous value.
9. Design, implement and verify, using FSM approach, a 3-bit up-counter with an enable signal. If enable is ‘1’, the counter counts normally. If enable is ‘0’, the counter retains the last value.
10. Implement an electronic dice using FSM approach. The dice should display random numbers between 1 and 6. The input to the dice is an input ‘throw dice’ signal, apart from the clock.

Note:

1. Experiments 2-10 will be implemented on a CPLD/FPGA board.
2. **Course teachers may design 3-4 new experiments/small projects in addition to the above suggested practical exercises.**

IVth SEMESTER CORE COURSES

Course Code	Course Name	Course Structure		Pre-requisite
ECCOC09	**Machine Learning and Artificial Intelligence**	**L-T-P**	**3-0-2**	**Statistics, Calculus, Linear Algebra, Probability, Programming Knowledge**

COURSE OUTCOMES

CO1: Be able to develop an understanding of the fundamentals of machine learning and statistical pattern recognition.

CO2: Be able to understand the fundamentals of artificial intelligence, learning systems, their goal and applications.

CO3: Be able to gain an insight into the various components of machine learning such as supervised learning, unsupervised learning, learning theory, reinforcement learning and adaptive control.

CO4: Be able to understand and implement various machine learning algorithms and AI heuristic techniques.

CO5: Acquire skills that can be applied to various applications like robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

CONTENTS

UNIT-I

Introduction: Definition of learning systems, Goals and applications of machine learning.

Types of ML: Supervised, Unsupervised and Reinforcement learning

Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses, Bias, variance, comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

UNIT-II

Machine learning algorithms

Supervised learning algorithms: Classification, Regression Nearest neighbor, Naïve bayes, Decision Trees, Linear regression, Support Vector Machines, Neural networks

Unsupervised learning algorithms: Clustering, Association, K-means

Reinforcement Learning: Q-learning, Temporal Difference, Deep adversarial networks

UNIT-III

Introduction: Introduction to AI, Turing test

Reasoning, Logic & Theorem Proving: Review prepositional & predicate Calculus, Resolution

Unit –IV

Heuristics Searches: Best first search, depth first search, Hill Climbing, A*, AO*, Constraint Satisfaction, Means-ends analysis

Learning: Rote Learning, Learning by taking advice, Explanation based learning, Discovery, Analogy

UNIT-V

Case studies and Applications of AI and ML for real world problems

Practical Outline:

Implementation of ML algorithms: Nearest neighbour, Naïve bayes, Decision Trees, Linear regression, Support Vector Machines, Neural networks, K-means, Q-learning

Implementation of heuristics techniques: Best first search, depth first search, Hill Climbing, A*, AO*, Constraint Satisfaction, Means-ends analysis

TEXT BOOKS

1. Tom Mitchell, Machine Learning. McGraw-Hill
2. Elaine Rich and Kevin Knight, Artificial Intelligence, Tata. McGraw-Hill

REFERENCE BOOKS

1. Richard Duda, Peter Hart and David Stork, Pattern Classification, 2nd ed. John Wiley & Sons, 2001.
2. Richard Sutton and Andrew Barto, Reinforcement Learning: An introduction. MIT Press, 1998
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning. Springer, 2009
4. Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig

"Artificial Intelligence: A New Sythesis" by Nils J Nilsson.

Course Code	Course Name	Course Structure	
ECECC11	**Communication Engineering**	**L-T-P**	**3-0-2**

COURSE OUTCOME (CO):

CO1: To Gain the knowledge of components of analog communication system.
CO2: To understand the generation, transmission and reception of AM signals.
CO3: To understand the generation, transmission and reception of FM signals.
CO4: To evaluate the performance of AM/FM receivers in the presence of white noise
CO5: To understand the pulse modulation techniques and basic baseband digital communication system.

COURSE CONTENT:

Unit-I:

Introduction to communication system, Communication Channels, Electromagnetic spectrum, Need for modulation, Distortion less transmission; Hilbert transform; Pre-envelope, complex envelope and canonical representation of band pass signals.

Unit-II:

Definition, Time domain and frequency domain description - AM, DSB-SC, single tone modulation, power relations in AM waves, Generation of AM waves (square law, Switching), Envelop detector, Generation of DSB-SC Waves (Balanced, Ring), Coherent detection of DSB-SC Modulated waves, COSTAS Loop, SSB Modulation: Time domain, Frequency domain description, Frequency discrimination, Demodulation of SSB Waves, Frequency Division Multiplexing, Vestigial sideband modulation and demodulation, I-Q representation of all modulation formats. Comparison of AM Techniques. AM broadcasting Techniques: Super heterodyne Receivers.

Unit-III:

Basic concepts, Frequency and Phase Modulation, Relation between phase and frequency modulation, Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave, Generation of FM Waves. FM demodulation (Slope detector, PLL). FM broadcasting Techniques.

Unit-IV:

Representation of Band Pass white Noise, Thermal Noise, Noise equivalent temperature, Noise figure of cascaded communication System, Equivalent Noise BW, Effect of White Noise on Amplitude Modulation/Demodulation systems: SNR/FOM calculations for coherent and envelope detection. Effect of Noise on Angle Modulation – Signal to Noise Ratio; Threshold Effect; Pre emphasis & De-emphasis in FM.

Unit-V:

Sampling Theorem, Sampling of Low Pass Signals, Reconstruction of Sampled Signals, Interpolation, Aliasing Effects, Aperture Effect; Requirements of a line encoding format, various line encoding formats- Unipolar, Polar, Bipolar etc. and their spectrum. PAM, PWM, PPM, Modulation and Demodulation; Pulse Code Modulation (PCM), TDM, Quantization Noise, Optimal Linear Prediction, Differential PCM (DCPM), Delta Modulation, Adaptive DM.

Text Books:

[T1] Simon Haykin, Communication Systems, 5th Edition John Wiley.

Reference Books:

[R1] JG Proakis, Communication Systems, 2nd Edition, Pearson Education.
[R2] B.P. Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, 4th Edition, Oxford University Press.

Course Code	Course Name	Course Structure	
ECECC12	**Microprocessors and Computer Architecture**	**L-T-P**	**3-0-2**

COURSE OUTCOME (CO):

CO1: To comprehend the instruction set architecture of 8085 microprocessor, instruction cycle and concept of interfacing

CO2: To understand instruction set architecture of 8086 microprocessor.

CO3: To familiarize students with processor architecture, instruction set architecture and assembly language programming in general

CO4: To develop understanding and operation of memory system and different memory types.

UNIT-1

8086 PROCESSOR: Von-Neumann & Harvard CPU architecture and CISC & RISC CPU architecture 8086 CPU Architecture. Addressing modes. Physical memory Organization, General Bus operation cycle, I/O addressing capability, Special processor activities, Minimum mode 8086 system and Timing diagrams, Maximum Mode 8086 system and Timing diagrams.

INSTRUCTION SET OF 8086: Data transfer and arithmetic instructions. Control/Branch Instructions, Logical Instructions, String manipulation instructions, Flag manipulation and Processor control instructions, Illustration of these instructions with example programs. Assembler Directives and Operators, Assembly Language Programming and example programs

UNIT-2

Introduction to stack, Stack structure of 8086, Programming for Stack. Interrupts and Interrupt Service routines, Interrupt cycle of 8086, NMI, INTR, Interrupt programming, Passing parameters to procedures, Macros, Timing and Delays.

Basic Peripherals and their Interfacing with 8086**:** Static RAM Interfacing with 8086 (5.1.1), Interfacing I/O ports, PIO 8255, Modes of operation – Mode-0 and BSR Mode, Interfacing ADC-0808/0809, DAC-0800, 8259.

UNIT-3

CPU structure and functions, processor organization, ALU, datapaths, internal registers, status flags; System bus structure: Data, address and control buses, Processor control, micro-operations, instruction fetch, hardwired vs. microprogrammed control, microinstruction sequencing and execution,

Unit-4

Instruction set principles, machine instructions, types of operations and operands, encoding an instruction set, assembly language programming, addressing modes and formats. Pipelining: basic concepts of pipelining, throughput and speed, pipeline hazards, Comparison between CISC and RISC architecture, Introduction to RISC-V and domain specific architectures

UNIT-5

Memory system, internal and external memory, memory hierarchy, cache memory and its working, virtual memory concept, I/O organization; I/O techniques: interrupts, polling, DMA; Synchronous vs. asynchronous I/O.

Text Books:

[T2] Hall, D.V., "Microprocessors and Interfacing", 2nd Ed., Tata McGrawHill. 2006

[T3] D.A. Patterson, J.L. Hennesey, "Computer Architecture: A Quantitative Approach", Sixth Edition, Morgan Kaufmann, 2017.

[T4] Brey, B.B., "The Intel Microprocessors", 6th Ed., Pearson Education. 2003

[T5] Mano, M.M., "Computer System Architecture" 3rd Ed., Prentice-Hall of India. 2004

[T6] Mano M. M., Cilleti M. D., " Digital Design"5th Edition, Pearson 2013

[T7] Rajaraman, V. and Radhakrishnan, T., "Computer Organization and Architecture", Prentice-Hall of India. 2007

[T8] Govindrajalu, B., "Computer Architecture and Organization", Tata McGraw-Hill. 2004

[T9] Stallings, W., "Computer Organization and Architecture", 5th Ed., Pearson Education. 2001

[T10] John E. Uffenbeck," 8086/8088 Design programming and interfacing,'' Prentice Hall of India 1997.

<u>List of Experiments</u>

Basic Exercise 1:

To understand the operation of the kit, the various components on the kit and their functions.

List out the major components that you see on the kit. Find out the function of these components and classify these components into the various broad categories of components

Write a suitable report.

Basic Exercise 2:
Read the manual supplied with the Vinytics kit. The keyboard on the kit has two groups of keys: red keys and black keys. Understand the operation of all the red keys. The red keys are function keys and the black keys are data keys.
Power up the kit and using the function keys store a few arbitrary numbers in the SRAM chip of the kit. Now power off the kit for a few minutes and power it up again. Inspect the SRAM locations again and verify that the contents of these SRAM locations have not changed even after you powered down the Kit. Find out why. Give your suggestions for the implementation of a circuit that would help retain the contents of the SRAM even if the main power is turned off. Can you replace the SRAM chips with any other type of chip and still be able to modify the contents of those chips? What would be the advantages or disadvantages of those alternatives? Write a report.

Basic Exercise 3:
At this point you are familiar with the basic operation of the kit..
Write a program to add a series of 10 numbers. These numbers are stored in consecutive memory locations in the SRAM. The result should be stored in the memory locations following the input data. What should be the size of the result location? What if you were to add a series of 1000 numbers? How much result storage space would be sufficient? Write a report.

Experiments:

1. Write a program to arrange the 10 numbers in SRAM memory in ascending order. Repeat you experiment to arrange the data in descending order.
2. Develop a subroutine for Multiply and divide operations.
3. Write routines to convert Binary to ASCII, ASCII to binary, binary to BCD, BCD to binary.
4. Write a program to test the RAM on the Kit.
5. Study the operation of 8255 Interface Card. As outlined in the 8255 Study Card Manual.
6. Study of 8259 Interface Card. As outlined in the 8259 Study Card Manual.
7. Move a block of data from a source address location to target address location using assembly language programming in 8086
8. Design, model and test using HDL (hardware description language), a Sign magnitude adder, BCD incrementor, Gray Counter and LFSR based random number generator.
9. Design model and test using HDL a PWM based LED Dimmer
10. Design model and test using HDL a single switch and keypad matrix de-bouncing system.
11. Design and model using HDL, the following LED multiplexing schemes: regular LED
multiplexing, Charlieplexed LED multiplexing.

12. Design, model and test using HDL, a multi-stage Dice game.
13. HDL behavioral model for a 32-bit MIPS ALU

Note: Course teachers may design 3-4 new experiments/small projects in addition to the above suggested practical exercises.

Course Code	Course Name	Course Structure	
ECECC13	**Electromagnetics**	**L-T-P**	**3-0-2**

COURSE OUTCOMES (COs):

CO1: To understand the concept of Electric and Magnetic Field Component of the RF signals.

CO2: To understand the Electromagnetic wave generation, their behaviour in different media.

CO3: To understand the basic concept of low and high frequency circuit transmission line for various RF circuitry of communication system.

CO4: To understand the basic concept of guided waves, their mode characteristics in different shapes of waveguides.

CO5: To understand the basic concept of planar transmission lines for RF circuits.

COURSE CONTENT:

UNIT-I Static-Fields :

Introduction to the need of Electromagnetics and Electromagnetic spectrum, concepts of electrostatic and magnetostatic fields, Poisson's and Laplace's equations, Uniqueness Theorem. Properties of Dielectric and magnetic Materials, Polarization in Dielectrics, Magnetization in Materials, Continuity equation and relaxation time, Electric and magnetic Boundary conditions, Resistance, Capacitance, and Inductance.

UNIT-II Electromagnetic wave:

Time Varying Fields and Maxwell's Equation: Faraday's Law, Displacement Current, Maxwell's equations in Point Form and Integral Form with its physical significance, Wave Equation, Auxiliary Potential function. Electromagnetic Wave in Lossy Dielectrics, Free Space and in good Conductors, Poynting Theorem, Electromagnetic Energy and Power flow, Reflection of a plane wave at Normal and Oblique incidence, Field equivalence Principles, Lotrentz reciprocity theorem.

UNIT-III Transmission Lines:

Need and Types of Transmission Lines, lumped parameter analysis of transmission line, Characteristic impedance, Propagation, attenuation constant, phase constant, Voltage standing wave ratio, input impedance of transmission line terminated with any load, distortion less Transmission Lines, Smith chart and its applications, Transient analysis of Transmission Lines for resistive, inductive, capacitive and complex loads.

UNIT-IV Waveguides:

General Wave behaviors along uniform Guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates. Modes, power and losses analysis in rectangular and cylindrical waveguides. Rectangular and Circular cavity resonators.

UNIT-V Planar transmission Lines:

Symmetrical Strip line, Microstrip transmission Line, Types of Microstrip line structures, quasi-TEM mode analysis, implementation of Resistance, Capacitance and Inductance using microstrip line, substrate selection in RF circuits, Microstrip Line matching network. Basic concepts of Coplanar waveguide, Slot line, Surface integrated transmission line.

Text Books:

[T2] M.N.O. Sadiku, "Principles of Electromagnetics", 4th international Version, Oxford University Press.
[T3] W.H. Hayt and J. A. Buck "Engineering Electromagnetics" Seventh Edition, McGraw Hill Education.
[T4] David M. Pozar, "Microwave Engineering", 4th Edition, Wiley.
[T5] Robert E. Collin, "Foundations for Microwave Engineering", 2nd Edition, Wiley.

Reference Book:

[R2] Constantine A. Balanis, "Advanced Engineering Electromagnetics", 2nd Edition, Wiley.
[R3] Bharathi Bhat, Shiban K. Koul, "Stripline-like Transmission Lines for Microwave Integrated Circuits", New Age International.

LIST OF EXPERIMENTS:

1. In the two-dimensional electrostatic boundary-value problem, consider the configuration of conductors and potentials shown in Fig. 1. Derive an expression for the voltage at any point (x, y) inside the conductors. Write a MATLAB program that plots the contours of the voltage and the lines of the electric field.

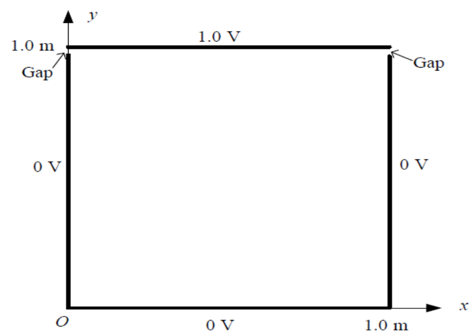

Fig.1

2. A current sheet **K** = 5.0 ay A/m flows in the region −0.15 m < x < −0.15 m (Fig.2). Compute **H** at P (0, 0, 0.25). Write a MATLAB program to verify your answer and plot the magnetic field in the x-y plane in the region −0.5m ≤ x ≤ 0.5m and −0.5m ≤ z ≤ 0.5m.

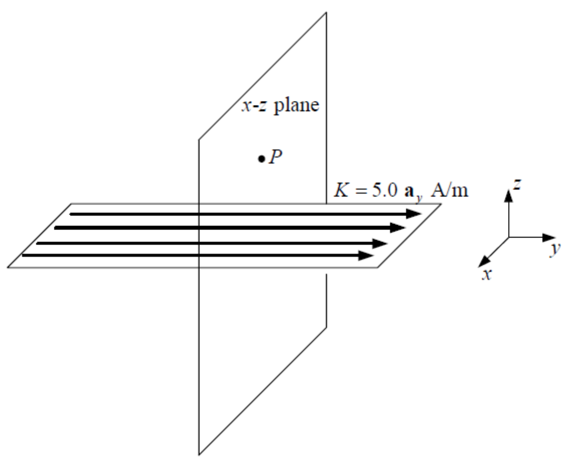

Fig.2

3. To investigate the electric and magnetic field components of electromagnetic signal in time and space domain for different medium conditions.
4. Determination of primary and secondary constants of a co-axial line.
5. To determine standing wave ratio (SWR) and Reflection coefficient of a co-axial line.
6. To design a single stub tuner to match any given load to a 50 Ω transmission line and measure the SWR before and after matching.
7. To excite a transmission line terminated by resistive, reactive and complex loads, Monitor the voltage at the input of the line over a period of time, using

a vector network analyzer in the time domain; also determine the magnitude and the nature of the load.

8. Measurement of frequency and wavelength of dominant TE mode in rectangular waveguide.
9. To design WR-90 Waveguide to obtain the Field patterns, intrinsic Impedance, propagation constants and wavelength for the first 4 modes.
10. To design a Circular dielectric waveguide with a high permittivity central core of radius a=1.1483m, and relative permittivity ε_r= 20 surrounded by air cladding. Compute the cut off frequency of the 6 modes and plot the propagation constant vs. frequency graph.
11. To design a rectangular cavity; a = 2.286 cm, b =1.016 cm and d = 3 cm filled with free space. Compute the first cut off frequency of the 3 modes.
12. To determine the dielectric constant of a material using electromagnetic signal.
13. To design a microstrip transmission line to obtain reflection coefficient, and input impedance varying Z_L and length '*l*' compare the analytical and simulated results.

Note : Course teachers may design 3-4 new experiments/small projects in addition to the above suggested practical exercises.

Courses offered to Other Departments

Course Code	Name of Course	Course Structure		Pre-requisites
ICECC08/ EEECC08	**Digital Circuits and Systems**	**L-T-P**	**3-1-0**	**EEE**

COURSE OUTCOMES

After the completion of the course, the students should be able to:

CO1: Get familiarized with number systems, codes, logic gates and Boolean algebra
CO 2: Understand the properties and operation of contemporary logic families.
CO 3: Design and implement basic combinational and sequential circuits.
CO 4: Understand the motivation and need for modelling and synthesis using Hardware Description Languages.
CO 4: Understand system design processes using programmable logic devices, operation of building blocks of a digital computer system.

UNIT-1: Logic functions and operation of logic families.

Digital design representations (e.g., truth table, equations, schematic, etc.), Different codes and their properties (e.g., Gray, BCD, 1-Hot etc.). Signed and unsigned Number representation and conversion. Binary addition and subtraction (unsigned and one's and two's complement). Boolean equations and terminology (SOP, POS, minterm, maxterm), Logic implementations of equations (2-level, AND/OR, NAND/NOR, etc.). Characteristics of TTL and CMOS logic families (i.e., logic thresholds, delay, Noise margin, fan-in and fan-out, power dissipation), TTL to CMOS and CMOS to TTL interfacing.

UNIT-2: Elements of Combination logic

Overview of Boolean algebra, Simplification of logic functions using (i) K-map up to 5 variables with don't care conditions (ii) Tabulation (Quine-McCluskey) method. Combinational logic design: half and full adder, half and full subtractor. Multiplexers, Encoders, Decoders, Priority encoders, Comparators, Magnitude comparator, Demultiplexer. Code converters: BCD to Seven Segment Display (SSD), Binary to SSD. Introduction to a PROM and its use for implementing arbitrary logic functions.

UNIT-3: Elements of sequential logic

SR Latch, D Latch, Master-Slave operation of a latch. Latch versus flip-flop, Flip-Flops (D, SR, JK, and T), Registers, Shift registers (SISO, SIPO, PISO), Linear feedback shift registers. Ripple and synchronous counters. PWM generator. Binary multiplier. Synchronous and asynchronous sequential circuits. Mealy and Moore sequential models. Design of Finite state machine using state table, state diagram, state assignment (binary, Gray, one-hot), next state and output equations. Example FSM implementations.

UNIT-4: Hardware Description Language
Modern digital design methods. Motivation and need for hardware description language. Introduction to VHDL and important terminology. VHDL Library and packages. Entities, architecture and configurations. Signals and data types. Operators and processes. VHDL code examples of all combinational and sequential circuits from unit-2 and unit-3 including FSM.

UNIT-5: Digital System Design and Programmable Logic Devices
Digital system design using FSMD approach. Design of illustrative systems using VHDL, such as game of dual-dice, rock-paper-scissor, reaction timer, period counter etc. Elements of CPU - RAM and DRAM; ALU; control logic using FSM and microprogram control approach; register file. Introduction to programmable logic devices - PAL/PLA, GAL, CPLD and FPGA. Introduction to JTAG.

SUGGESTED READINGS

1. Donald D. Givone, “Digital Principles & Design’’, Tata McGraw Hill. ISBN: 978-0070529069.
2. M.M. Mano, M.D. Cilleti, “Digital Design’’, 6th edition, Pearson, 2018. ISBN: 978-9353062019
3. C. Roth, L. Kinney, “Fundamentals of Logic Design ”, 7th Edition Cengage Learning, 2014. ISBN: 978-8131526156.
4. Stephen Brown, Zvonko Vranesic, “Fundamentals of Digital Logic with VHDL Design”, McGraw Hill. ISBN: 978-1259025976.
5. Pong P. Chu, “FPGA Prototyping by VHDL” Wiley. ISBN: 978-1119282747

Course Code	Name of Course	Course Structure		Pre-requisites
CEECC08/ CAECC08	**Microprocessors and Microcontrollers**	**L-T-P**	**3-0-2**	**None**

COURSE OUTCOMES

CO1: Acquire knowledge of architecture and programming of microprocessors.
CO2: Understand the salient features of the x86 architecture.
CO3: Acquire hands-on knowledge of interfacing microprocessors with peripherals.
CO4: Understand the architecture and working of microcontrollers and their utility.
CO5: Acquire introductory knowledge about high-end microprocessors and microcontrollers.

COURSE CONTENT

Unit 1 -Basic concepts of microprocessor, microcomputer, microcontroller. CISC and RISC architectures. Intel 8086 Architecture (pins, bus interface unit, execution unit, register set, pipelining), memory addressing, segmentation,

Unit 2 - Intel 8086 instruction set (data transfer, arithmetic, logic, string, long and short control transfer and processor control), timing diagrams, operating modes, programming, assemblers, address-objects, parameter passing to subroutines, hardware and software interrupts and interrupt handling of 8086.

Unit 3 - Interfacing of microprocessors: Interfacing a microprocessor with RAM and ROM chips, address allocation and decoding techniques. Interfacing with LED, LCD, ADC, DAC, toggle switch and keypad. Memory-mapped i/o. Interfacing

with 8255 (architecture, ports, i/o modes and BSR mode) , 8251. Basic architecture and features and interfacing of 8251, 8259 programmable interrupt controller,

Unit 4 - Microcontrollers: 8051 microcontroller: architecture, i/o ports, memory organization, addressing modes, instruction set, simple programs. Introduction to IoT: basic architecture, sensing and actuating, application domains.

Unit 5 - High-end microprocessors and microcontrollers: Important features of 32-bit processors, Introduction to Arduino: basic architecture, hardware and software, simple programs. Cortex -M Architecture

SUGGESTED READINGS

1. D. V. Hall, "Microprocessor and Interfacing Programming & Hardware" TMH – 2nd Edition.
2. S. P. Morse, "8086 Primer: An Introduction to Its Architecture, System Design and Programming" Hayden Book Co.
3. S. Monk, "Programming Arduino: Getting Started with Sketches", 2nd Edition, McGraw-Hill.
4. M.A. Mazidi et. al. "The 8051 Microcontroller and Embedded Systems: Using Assembly and C" Pearson Publishers.
5. Jonathan W. Valvano "Introduction to ARM Cortex M Microcontroller"-5th Edition.

Guidelines for practical work:

1. Write an assembly program to generate the numbers of the Fibonacci series.
2. Write an assembly program to clear all flags without using any data transfer instruction.
3. Write an assembly program to search for a number in a list.
4. Write an assembly program to sort a list.
5. Write an assembly program to copy a list from one part of the memory to another.
6. Write an assembly program to multiply two numbers using successive additions.
7. Write an assembly program to calculate the square root of a number.
8. Write an assembly program to calculate the factorial of a number using recursion.
9. Write a self-replicating assembly program.
10. Interface 8255 with a microprocessor and use all its modes.
11. Interface 8251 with a microprocessor and use it to generate differ types of clock signals.
12. Interface 8259 with a microprocessor and use all its features.
13. Design digital systems with Arduino and simple sensors and actuators.

Note: Course teachers may design 3-4 new experiments/small projects in addition to the above suggested practical exercises.

Course No.	Title of the Course	Course Structure	Pre-Requisite
MAECC08	Microprocessor and Microcontroller	**L-T-P: 3-0-2**	NONE

Course Outcome

After completion of this course, the students are expected to be able to demonstrate the following knowledge, skills and attitudes:

CO1: To understand normally used words in modern computers: bit, word, double word, MIPS, etc.

CO2: To understand arithmetic and logic functions and high level and low-level languages.

CO3: To understand the operation and architecture of a popular 8-bit microprocessor including Instruction Set Architecture, Memory and Port Interfacing, Assembly Language Programming, timing and speed of operation.

CO4: To understand the need for peripheral operations circuits for digital data exchange, timer, serial communication, merits of direct memory access, interrupt controller and other circuits.

CO5: To understand the various mechanisms for analog signal interfacing using ADC and DAC circuits.

CO6: To understand and learn the operation of circuits for user interaction through switches, keyboard and display devices.

CO7: To understand the architecture of microcontroller.

COURSE CONTENT:

UNIT-1Fundamentals of Digital Electronics: Review of Number Systems: Binary, Octal, Hexadecimal, BCD, Conversion to different bases, codes, Sign Magnitude Representation, 1's and 2's Complement Arithmetic. NAND/NOR based realization of logic circuits. Combinational Logic: Parallel adders, Encoders, Decoders, Multiplexers, Comparators, Code converters: BCD to seven segment display.

UNIT-2

Sequential Logic: Latches vs Flip Flops, D, SR, JK, and T flip-flops, Excitation Tables, Synchronous & Asynchronous Counters, Shift Registers, FSM Implementation: Mealy versus Moore

UNIT-3

Introduction to Microprocessor Systems: 8085 Architecture: General Purpose and Special Purpose Registers; Pin Diagram: Serial and Parallel I/O; Flow of Data for Instruction Set, Timing Diagram, Addressing Modes, Interrupts, Assembly Language Programming, Flowcharts, Routines, Subroutines, Sample Programs, Delay Generation. Multibyte Processing; Memory and Organization: Memory Hierarchy, Sequential & Parallel Accessing, RAM, ROM, PROM, EPROM, EEPROM, Cache, Timing Diagram of RAM Chips, Increasing Word and Address Sizes, Address Decoding;

UNIT-4

Interfacings of 8085 with peripheral ICs: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI) 8255, USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor Heater Control etc.

UNIT-5

Overview of Microcontroller 8051: Introduction to 8051 Micro-Controller, Architecture, Memory Organization, Special Function Registers, Port Operation, Memory Interfacing, I/O Interfacing, Interrupts, Programmer's Model of 8051, Operand Types, Operand Addressing, Data Transfer Instructions, Arithmetic Instructions, Logic Instructions, Control Transfer Instructions, Timer & Counter Programming, Interrupt Programming.

SUGGESTED READING

[T1] M.M. Mano, M.D. Cilleti, "Digital design'' Pearson 5th Edition, 2013

[T2] C. Roth, L. Kinney, "Fundamentals of Logic Design ", 7th Edition Cengage Learning, 2014

[T3] Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085" - PHI.

[T4] J. Mazidi, "Microprocessors and Microcontrollers" Pearson, 2013

[T5] M. Mazidi, J. Mazidi and R. McKinlay, "The 8051 Microcontroller and Embedded Systems" Pearson.

[T6] K. Ayala, "The 8086 Microprocessor: Programming & Interfacing" - Delmar Publishers.

[T7] A. Ray and K. Bhurchandi, "Advanced Microprocessors and Peripherals" McGraw Hill.

EXPERIMENTS:

1. Write a Program to add and subtract two 16-bit numbers with/without carry using 8086.
2. Write a Program to multiply two 8-bit numbers by repetitive addition method using 8086.
3. Write a Program to generate Fibonacci series.
4. Write a Program to generate Factorial of a number.
5. Write a Program to read 16-bit Data from a port and display the same in another port.
6. Write a Program to generate a square wave using 8254.
7. Write a Program to generate a square wave of 10 kHz using Timer 1 in mode 1(using 8051).
8. Write a Program to transfer data from external ROM to internal (using 8051).
9. Design a Minor Project using 8086 Microprocessor (Ex: Traffic light controller/Temperature controller, etc.)
10. Design a Minor Project using 8051 Microcontroller

Note: Course teachers may design 3-4 new experiments/small projects in addition to the above suggested practical exercises.