18UECC100/200	Basic Electronics	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on characteristics of widely employed electronic devices, their applications and design of simple analog and digital circuits.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Discuss** semiconductor diodes and apply the knowledge to build regulated power supply units.	3	1,2	--
CO-2	**Describe** the operation of BJT and its applications.	--	1	2,3
CO-3	**Explain** the working principle and configuration of operational amplifier and discuss its applications.	--	1,2	3
CO-4	**Apply** the concepts of analog and digital techniques to build simple electronics circuits.	--	2,12	1,3
CO-5	**Explain** various processors and hardware, software units embedded into a system.	--	--	1

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.6	1.75	1.5	--	--	--	--	--	--	--	--	2	--	--

Pre-requisites: Semiconductor theory

Contents:

Unit-I

Semiconductor Diode and Characteristics: P-N junction diode, Diode characteristics, Photo diode, LED and Zener diode.

Applications of Diodes: Rectification-Half wave rectifier, Full wave rectifier, Bridge rectifier, Effect of capacitor filter on rectifiers, Zener diode as a voltage regulator, 78XX fixed IC voltage regulator, Regulated power supply. **07 Hrs**

Unit-II

Bipolar Junction Transistor: Construction and working, CB,CE,CC configurations, Transistor voltage and currents, DC operating point,Selection of operating point, Fixed biasing,Voltage divider biasing.

Applications of BJT: BJT as a switch, BJT as an amplifier, Feedback Amplifiers – Principle, Properties, Advantages of negative feedback, Voltage series feedback, Oscillators – Barkhausen's criteria for oscillation, RC phase shift oscillator, Hartley oscillator. **09 Hrs**

Unit-III

Introduction to Operational Amplifier: Introduction to op-amp, Pin Configuration of 741, Op-amp differential amplifier configurations, Ideal characteristics, CMRR, PSRR, Slew Rate, Input offset voltage, Bias current, Frequency response.

Applications of Operational Amplifiers: Inverting amplifier, Adder, Voltage follower, Integrator, Differentiator, Comparator. **07 Hrs**

Unit-IV

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal gates, Realization of expression using universal gates, Half adder, Full adder.

Basics of Communication Systems: Block diagram of communication system, Modulation and need for modulation, Amplitude modulation, Frequency modulation. **09 Hrs**

Unit-V

Introduction to Embedded Systems: An embedded system, Hardware units, Software embedded into a system, Exemplary embedded systems.

Processors in the System: Introduction, Microprocessor, Microcontroller, Digital signal processor. **07 Hrs**

Reference Books:

1) D.P.Kothari, I.J.Nagarath, “Basic Electronics”, 2/e, Mc Graw Hill, 2018.
2) Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuits”, 10/e, PHI, 2008.
3) Thomas L. Floyd,” Electronic Devices”, 9/e, Pearson Education, 2012.
4) David A. Bell, “Electronic Devices and Circuits”, 5/e, Oxford University Press, 2008.
5) George Kennedy and Bernard Davis, “Electronic Communication Systems”, 5/e, TMH, 2011.
6) Raj Kamal, “Embedded Systems, Architecture, Programming and Design”, 1/e, TMH, 2008.

Academic Program: UG

Academic Year 2021-22

Syllabus

III & IV Semester B.E.

Electronics & Communication Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Ph: 0836-2447465 Fax:0836-2464638 Web: www.sdmcet.ac.in

SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for III & IV semester of UG program in Electronics and Communication Engineering is recommended by Board of Studies of Electronics and Communication Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Chairman BOS & HOD

Principal

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SDM College of Engineering & Technology, Dharwad-02

Department of Electronics & Communication Engineering

College – Vision and Mission

VISION:

To develop competent professionals with human values

MISSION:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

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Department- Vision and Mission

Vision

Fostering excellence in the field of Electronics & Communication Engineering, showcasing innovation, research and performance with continuous Industry – Institute Interaction with the blend of Human values.

Mission

M1: To provide quality education in the domain of Electronics & Communication Engineering through state of the art curriculum, effective teaching learning process and the best of laboratory facilities.

M2: To encourage innovation, research culture and team work among students.

M3: Interact and work closely with industries and research organizations to accomplish knowledge at par.

M4: To train the students for attaining leadership with ethical values in developing and applying technology for the betterment of society and sustaining the global environment.

Program Educational Objectives (PEOs)

The Graduates, after a few years of Graduation will be able to:

I. **Apply** the latest in-depth knowledge in the field of Electronics and Communication Engineering with Mathematical applications to address real life challenges.
II. **Exhibit** the confidence for independent working and / or spirit to work cohesively with group.
III. **Readily** be accepted by the Industry globally.
IV. **Develop** design skills, fault diagnosis skills, communication skills and create research orientation.
V. **Inculcate** professional, social ethics and to possess awareness regarding societal responsibility, moral and safety related issues

Programme Outcomes (POs):

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

13. Design economically and technically sound analog and / or digital systems based on the principles of signal processing, VLSI and communication Engineering (PO-13)

14. Integrate hardware – software, and apply programming practices to realize the solutions in electronics domain. (PO-14)

Scheme and Syllabus

III Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration in Hrs.
18UMAC300	BS	Engg. Mathematics-III	3 - 0 - 0	3	50	100	3	-	-
18UECC300	PC	Electromagnetic Theory	3 - 2 - 0	4	50	100	3	-	-
18UECC301	PC	Digital Circuit Design	3 - 0 - 0	3	50	100	3	-	-
18UECC302	PC	Network Analysis	3 - 2 - 0	4	50	100	3	-	-
18UECC303	PC	Analog Electronic Devices and Circuits	4 - 0 - 0	4	50	100	3	--	--
18UECC304	PC	Signals & Systems	3 - 0 - 0	3	50	100	3	--	--
18UECL305	PC	Analog Electronic Devices and Circuits Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL306	PC	Digital Circuit Design Laboratory	0 - 0 -3	1.5	50	--	--	50	3
	Total		**19 - 4 - 6**	**24**	**400**	**600**		**100**	

BS- Basic Science, PC- Program Core

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

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IV Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max Marks	Duration in Hrs.
18UMAC400	BS	Engg. Mathematics-IV	3 - 0 - 0	3	50	100	3	-	-
18UECC400	PC	Communication Systems - I	4 - 0 - 0	4	50	100	3	-	-
18UECC401	PC	Control Systems	3 - 2 - 0	4	50	100	3	-	-
18UECC402	PC	Microcontroller	3 - 2 - 0	4	50	100	3	-	-
18UECC403	PC	HDL Programming Using Verilog	3 - 0 - 0	3	50	100	3	--	--
18UECC404	PC	Linear ICs and Applications	3 - 0 - 0	3	50	100	3	--	--
18UECL405	PC	HDL Programming Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL406	PC	Linear Integrated Circuits Laboratory	0 - 0- 3	1.5	50	--	--	50	3
18UECL407	PC	Introductory Project	0 - 0- 2	1	50	--	--	--	--
	Total		**19 - 4 - 8**	**25**	**450**	**600**		**100**	

BS- Basic Science, PC- Program Core

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

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18UMAC300	Engineering Mathematics-III	(3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

To have an insight into Laplace transforms, Fourier series, Fourier transforms, Difference equations and Z-transforms. To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Transform the given function using Laplace/Fourier transforms depending on the nature of engineering applications.			1
CO-2	Express periodic function as a Fourier series and obtain the various harmonics of the Fourier series expansion for the given numerical data.			1,2
CO-3	Solve difference equations using Z-transform.			1
CO-4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.		1,2	
CO-5	Determine the externals of functional using calculus of variations and solve problems arising in engineering.			1,2

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.2	1.3	-	-	-	-	-	-		-	-	-

Pre-requisites: A basic course on differentiation and integration of function.

Contents:

Unit-I

Laplace Transforms: Definition and Properties. Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function problems. **Laplace Transforms**: Inverse Laplace transform - problems, Convolution theorem(without proof) to find the inverse Laplace transform and problems, solution of linear differential equations using Laplace transform. **8 Hrs.**

Unit-II

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions of period 2π and arbitrary period. Half- range Fourier series. Practical harmonic analysis, examples from engineering field. **8 Hrs.**

Unit-III

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simpleproblems.

Z-Transforms and Difference Equations: Z-transform- definition, Standard Z-transforms, Damping and shifting rules, Initial value and Final value theorems (without proof) with problems. Inverse Z-transform. Simple problems. Difference equations-basic definition. Application of Z-transform to solve Difference equation. **8 Hrs.**

Unit-IV

Numerical Solutions of Ordinary Differential Equations (ODE's): Numerical solution of ODE's of first order and first degree-Taylor's series method, Modified Euler's method. Runge–Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae).Problems. **7 Hrs.**

Unit-V

Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne's predictor and Corrector method. (No derivations of formulae).

Calculus of Variations: Variation of function and functional, variational problems, Euler's equation (without proof), Geodesics (plane), hanging chain problems.**8 Hrs**

Reference Books:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.

2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th edition(Reprint),2016.
3. Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

18UECC300	Electromagnetic Theory	(3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the theory and applications of electromagnetic fields. The course concentrates on the study, interpretation and applications of Coulomb's Laws, Gauss's Law, Poisson's and Laplace's equations, Maxwell's equations in the study of electromagnetic fields in different media.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Understand** the significance of vectors and solve problems in various co-ordinate systems.	1	-	2,13
CO-2	**Derive** the expression for electric field due to various types of charge distributions using coulomb's Law, gauss's Law and **apply** divergence and curl for studying nature of electric fields.	-	1,2	13
CO-3	**Define** energy and potential and analyze the properties of current flow through conductors and dielectrics using Poisson's and Laplace's equations.	2	1	3,13
CO-4	**Discuss** the concepts and laws governing the steady magnetic fields.	-	1	2,13
CO-5	**Apply** Maxwell's Equations in understanding wave propagation theory	1,2	-	4,13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.4	2.0	1	1	-	-	-	-	-	-	-	-	1	-

Pre-requisites: Basics of Electronics and Electrical Engineering, Integration, Differentiation and Vector algebra.

Contents:

Unit-I

Vector Analysis: Vector Algebra, Rectangular Coordinate system, Vector Field, Dot Product and Cross-Product of vectors, Cylindrical and Spherical coordinate systems.

Coulomb's law and Electric field intensity: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge, line charge and sheet charge distribution. **08L+02T Hrs**

Unit-II

Electric flux density, Gauss' law and Divergence: Electric flux density, Gauss' law, Applications of Gauss' law, Divergence and Divergence theorem.

Energy and potential : Energy expended in moving a point charge in an electric field, Line integral, Definition of potential difference and Potential, Potential field of a point charge and system of charges, conservative property, Potential gradient, Energy density in an electrostatic field. **10L+02T Hrs**

Unit-III

Conductors, Dielectrics and Capacitance: Current and current density, Continuity of current, metallic conductors, Conductor properties and boundary conditions, Boundary conditions for perfect dielectric, capacitance and examples.

Poisson's and Laplace's equations: Derivation of Poisson's and Laplace's equation, Uniqueness theorem, Examples of solutions of Laplace's and Poisson's equations. **08L+02T Hrs**

Unit-IV

The steady magnetic field: Biot-Savart law, Ampere's circuital law, Curl and the Stokes Theorem, magnetic flux and flux density, Scalar and vector magnetic potentials.

Magnetic Forces and Boundary Conditions: Force on a moving charge and differential current element, Force between differential current elements, Magnetic boundary conditions. **08L+02T Hrs**

Unit-V

Time varying fields and Maxwell's equations: Faraday's law, displacement current, Maxwell's equation in point and integral form.
Wave Propagation: Wave Propagation in free space and dielectrics. **08L+02T Hrs**

Reference Books:

1) Hayt & Buck, "Engineering Electromagnetics", Tata McGraw-Hill, 7th edition, 2006.
2) Hayt & Buck, "Engineering Electromagnetics", Tata McGraw-Hill, 8th edition, 2010.
3) Kraus & Fleisch, "Electromagnetics with Applications", McGraw Hill, 5th edition, 1999.
4) Edminister, "Electromagnetics", Schaum Outline Series, McGraw Hill, 2nd edition, 2006.

18UECC301 Digital Circuit Design (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on study of various simplification techniques of Boolean expressions and designing of optimized combinational circuits and sequential circuits. It also focuses on application of Digital circuits.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Apply** various techniques to simplify Boolean expressions.	-	2,3	12
CO-2	**Design** combinational circuits using MSI components.	-	2,3	13
CO-3	**Analyze** and **design** combinational circuits using PLDs.	3	-	12
CO-4	**Realize** flip flops and its applications.	3	13	-
CO-5	**Design** of synchronous sequential networks.	-	13	12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	-	2	2.5	-	-	-	-	-	-	-	-	1	1.67	-

Contents:

Unit-I

Boolean algebra: Canonical forms, prime implicants and irredundant disjunctive expressions prime implicates and irredundant conjunctive expressions. Simplification of Boolean expressions: Karnaugh maps, Quine-McClusky, map entered Karnaugh maps techniques. **08 Hrs**

Unit-II

Logic Design with MSI Components: Binary adders and subtractors, decimal adders, comparators, encoders, decoders, multiplexers and de-multiplexers. Design of combinational circuits using decoders and multiplexers. **08 Hrs**

Unit-III

Programmable logic devices: Introduction, programmable read only memory, programmable logic array, programmable array logic, gate performance considerations, transistor transistor logic, wired logic. **07 Hrs**

Unit-IV

Flip–flops and its applications: Latches, S-R flip flop, J-K flip flop, D and T flip flop, Master-slave flip-flops, edge triggered flip-flops, registers, counters: asynchronous counters, design of synchronous counters: MOD counters, up/down counters, self-correcting counter. **09 Hrs**

Unit-V

Synchronous sequential networks: Structure and operation of clocked synchronous sequential networks, analysis of synchronous sequential networks, serial binary adder as a Mealy/Moore network, sequence recognizer. **07 Hrs**

Reference Books:

1) Donald D Givone, “Digital Principles and Design”, Tata McGraw Hill Edition, 2002.
2) John M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2001.
3) Charles H Roth Jr; “Fundamentals of logic design”, Thomson Learning, 2004.

4) Mono and Kim, “Logic and computer design Fundamentals”, Pearson, 2nd edition 2001.

18UECC302	Network Analysis	(3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on mesh and nodal techniques, network theorems and topology, responses of RLC network, AC networks and two port network parameters.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Determine** currents and voltages using mesh / nodal analysis	-	2	1
CO-2	**Solve** network problems by applying various network theorems to reduce circuit complexities	2	5	1
CO3	**Calculate** current and voltages for the given circuit under transient conditions	2	1	-
CO-4	**Apply** various analysis and simplification techniques for AC networks	2	1	13
CO-5	**Solve** for currents and voltages using the concept of network equilibrium equations and **Determine** the various parameters of two port networks.	2,3	1,13	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.6	2.8	3	-	2	-	-	-	-	-	-	-	1.5	-

Pre-requisites: Engineering Mathematics, Basic Electrical Engineering

Contents:

Unit-I

Basic Nodal and Mesh Analysis: Node analysis, Supernode, Mesh Analysis, Supermesh, Nodal Vs Mesh analysis.

Network Theorems: Linearity, Superposition, Source Transformations, Thevenin and Norton equivalent circuits, Maximum power transfer, Millman's, Reciprocity, Tellegen's, Delta-Wye and Wye-Delta conversions. **10L+02T Hrs**

Unit-II

Basic RL and RC circuits : Source-free RL circuit, Properties of exponential response, Source-free RC circuit, General perspective, Unit-step function, Driven RL circuits, Natural and forced response, Driven RC circuits, Source-free parallel circuits. **08L+02T Hrs**

Unit-III

Basic RLC circuits: Source-free series RLC circuits, complete response of RLC circuit.

Circuit analysis in frequency domain : Sinusoidal response, Passive circuit elements in frequency domain, *Kirchhoff's* laws in frequency domain, Series, Parallel and delta-to-Y simplifications, Source transformations & Thevenin-Norton equivalent circuits, Node-voltage method, Mesh-current method**.** **08L+02T Hrs**

Unit-IV

Laplace transforms: Review of Laplace transforms, Nodal and mesh analysis in s-domain.

Frequency Response: Series resonance: Impedance, Phase angle variations with frequency, Voltage and current variation with frequency, Bandwidth, Selectivity, Parallel resonance: Resonant frequency and admittance variation with frequency, Bandwidth and selectivity. **08L+02T Hrs**

Unit-V

Network Topology: Graph of a network, Concept of tree and co-tree, Incidence matrix, Tie-set and cut-set schedules, Branch voltage and current equations, Examples on network equilibrium equations.

Two-Port Networks: Admittance parameters, Impedance parameters, Hybrid parameters, Transmission parameters**,** Interrelationship between parameters.

08L+02T Hrs

Reference Books:

1) William H Hayt. Jr., Jack E Kemmerly, Steven M Durbin, “Engineering Circuit Analysis”, Sixth Edition, Tata-McGraw Hill, 2006.
2) Roy Choudhury, “Networks and Systems”, Second Edition, New age International Publications, 2010.
3) James W. Nilsson, Susan A. Riedel, “Electric Circuits”, Eighth Edition, Pearson Edu. 2008.
4) John D Ryder, “Networks, Lines and Fields”, Second Edition, Prentice-Hall of India, 2005.

18UECC303 Analog Electronic Devices and Circuits (4- 0- 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the understanding of electrical characteristics, working and applications of analog electronic devices and the design/analysis of various analog electronic circuits.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Design** and **analyze** various wave shaping circuits using Diodes.	1,2	3	-
CO-2	**Discuss** the working, electrical characteristics and biasing techniques for an FET	-	1,2	13
CO-3	**Perform** small signal analysis of FET.	1,2	4	-
CO-4	**Explain** the working of different analog electronic devices and their applications.	-	1,3,4	-
CO-5	**Analyze** the various characteristics of feedback mechanism in amplifiers and oscillators.	1,2,3	-	4,5

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.6	2.8	2.3	1.7	1	-	-	-	-	-	-	-	1	-

Pre-requisites: Basic Semiconductor Physics, Basic Electronics

Contents:

Unit-I

Wave Shaping Circuits using Diodes: Clippers, Clampers.

Field-Effect Transistors: Introduction, construction and working of JFET, transfer characteristics, depletion type MOSFET and enhancement type MOSFET, Introduction to CMOS. **10 Hrs**

Unit-II

FET biasing: Fixed bias, self-bias, voltage divider bias, biasing in Depletion type MOSFETs and Enhancement type MOSFETs.

Small signal analysis of FET: JFET small signal model, small signal analysis of JFET based fixed bias, self-bias, voltage divider bias and source follower configurations, small signal models of depletion type MOSFETs and enhancement type MOSFETs, low frequency response of FET Amplifiers. **12 Hrs**

Unit-III

Feedback amplifiers: Feedback concept, feedback connection types, effect of negative feedback on gain and bandwidth.

Oscillator circuits: Oscillator operation, FET based phase-shift oscillator, Wein Bridge oscillator, Tuned oscillator circuits: FET Colpitts oscillator, FET Hartley oscillator, Crystal oscillator. **10 Hrs**

Unit-IV

Other Two terminal Devices: Light emitting diode (LED), Liquid crystal displays (LCD), Photo conductive cell, Photo diode and Solar cell, Phototransistors, Schottky barrier diodes, Varactor diodes, Power diodes, Tunnel diodes, IR Emitters, Thermistors. **10 Hrs**

Unit-V

Thyristors: Introduction, construction, working and characteristics of SCR, TRIAC, UJT.

Power amplifiers: Introduction, classification of power amplifiers, series fed and transformer coupled Class A, Class B amplifier circuits: Push Pull operation, Class C and Class D amplifier circuits, Amplifier distortion and heat sink. **10 Hrs**

Reference Books:

1) Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 10/e, PHI, 2012.
2) Jacob Millman and Christos C. Halkias, - "Integrated Electronics", 8/e, McGraw Hill, 1999.
3) D. A. Bell, "Electronic Devices & Circuits", 4th Edition, PHI, 2007.
4) M. H. Rashid, "Power Electronics", Pearson Education 3rd Edition, 2009.

18UECC304	**Signals & Systems**	**(3-0-0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on learning mathematical model for a signal, properties of a signals and systems, representation of a signal in different domains. Also, the course emphasizes on relation between Fourier representations, sampling and reconstruction of a signal.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** different types of signals, systems and its properties.	1	2	
CO-2	**Analyze** the time domain signals and **Solve** for the system response.	1,2		13
CO-3	**Analyze** the frequency domain signals	1	2	
CO-4	**Relate** different Fourier representations and **apply** it for various applications**.**	1	2	3, 13

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CO-5	**Apply** the Z- transform to analyze discrete-time signals and systems.	1	2	

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2.2	1	-	-	-	-	-	-	-	-	-	1	-

Pre-requisites: Calculus

Contents:

Unit-I

Introduction: Definitions of signals and systems, Classification of signals, Basic operations on signals, Elementary signals, Properties of systems. **07 Hrs**

Unit-II

Time Domain Representation: Convolution, Interconnection of LTI systems, Relations between LTI system properties and impulse Response, Solving Differential and Difference Equations, Block diagram representation. **08 Hrs**

Unit-III

Frequency domain Representation: Complex Sinusoids and Frequency response of LTI Systems, Fourier Representations for four classes of signals - DTFS, FS, DTFT, FT. **08 Hrs**

Unit-IV

Frequency domain Representation: Properties of Fourier transform, Frequency response of LTI systems.

Applications of Fourier Representations: Relating FT to FS, DTFT to DTFS, FT to DTFT, FT to DTFS, convolution and multiplication with mixtures of periodic and non-periodic signals, sampling and reconstruction of continuous time signals.

08 Hrs

Unit-V

Z–Transforms: Basic concepts, Properties of region of Convergence, Properties of the z-transform, Inversion of z-transform: Partial fraction expansion method and power series method, Unilateral z–transform, Transfer function. **08 Hrs**

Reference Books:

1) Simon Haykin, Barry Van Veen, “Signals and Systems”, 2/e, Wiley Publications, reprint 2009.
2) Alan V Oppenheim, Alan S, Willsky and A Hami Nawab**,** “Signals and Systems”, Pearson Education Asia / PHI, 2/e, 1997. Indian Reprint 2002.
3) H. P Hsu and R. Ranjan, “Signals and Systems”, Schaum’s outlines, TMH, 2006.
4) Luis F. Chaparro, Aydin Akan, "Signals and Systems Using MATLAB", 3/e, Academic Press, 2019.

18UECL305 Analog Electronic Devices and Circuits Laboratory (0-0-3)1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on conducting experiments to determine characteristics, understand the working and applications of analog electronic devices and circuits.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Conduct** experiments to determine characteristics of analog electronic devices such as BJTs and FETs.	1	3	5,13
CO-2	**Design** and **Analyze** the wave shaping circuits using diodes.	1,2	3	13
CO-3	**Design** and **Analyze** RC coupled amplifier.	1,2	3	13
CO-4	**Demonstrate** the working of oscillator circuits.	3	1,2	13
CO-5	**Design** and **Analyze** Power amplifiers.	1,3	5	13

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**

Mapping Level	2.8	2.66	2.4	-	1.33	-	-	-	-	-	-	-	1	-

List of Experiments:

1) Full Wave Rectifier Circuit Operation (with and without filter).
2) Clipping Circuits using Diodes.
3) Clamping Circuits using Diodes.
4) Bipolar Junction Transistor (BJT) Characteristics.
5) Single stage RC Coupled (CE) Amplifier.
6) RC Phase Shift Oscillator using FET.
7) Hartley Oscillator using FET.
8) Colpitts Oscillator using FET.
9) Junction Field Effect Transistor (JFET) Characteristics.
10) Complementary Symmetry class B push-pull power amplifier.
11) Transistor as a switch/ Relay driver

Reference Books:

1) Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 10/e, PHI, 2012.
2) Jacob Millman and Christos C. Halkias, - “Integrated Electronics”, 8/e, McGraw Hill, 1999.
3) D. A. Bell, “Electronic Devices & Circuits”, 4th Edition, PHI, 2007.
4) M. H. Rashid, “Power Electronics”, Pearson Education 3rd Edition, 2009.

18UECL306 Digital Circuit Design Laboratory (0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on design and implementation of optimized combinational and sequential circuits.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to	Mapping to POs(1-12)/ PSOs (13,14)		
	Substantial Level (3)	Moderate Level (2)	Slight Level (1)

CO-1	**Design** and **realize** the digital circuits for given Boolean equations.	2	13	12
CO-2	**Design** and **implement** arithmetic circuits, encoder, decoder ,multiplexer and other combinational circuits.	2,3	13	-
CO-3	**Implementation** of code converters and **realization of** flip flops.	2	3,13	-
CO-4	**Design** and **implement** sequential circuits**.**	2,3	13	-
CO-5	**Realize** shift registers.	2	3	13

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	-	3	2.5	-	-	-	-	-	-	-	-	1	1.8	-

List of Experiments:

1) Realization of adder / subtractor using basic gates and universal gates.
2) i) Code conversion using logic gates.
   ii) Realization of parallel adder and parallel subtractor / BCD to excess-3 converter and vice-versa using IC 7483.
3) i) Design and implementation of comparator using logic gates.
   ii) Implementation of comparator using 7485 IC.
4) i) Realization of MUX using universal gates.
   ii) Realization of DEMUX using universal gates.
5) i) Implementation of the given function using MUX IC 74153.
   ii) Design and implementation of adders and subtractors using decoder IC 74139.
6) i) Verification of priority encoder IC 74148.
   ii) Use of BCD to seven segment decoder IC 7447 to drive the LED display.
7) i) Verification of flip-flops using logic gates and IC's.
   ii) Conversion of flip-flops.
8) Realization using IC 7476
   i) Ring counter
   ii) Johnson Counter
9) Design and implementation of synchronous counters.
10) Design and implementation of asynchronous counters.

Reference Books:

1) Donald D Givone, “Digital Principles and Design”, Tata McGraw Hill Edition, 2002.
2) John M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2001.
3) Charles H Roth, Jr; “Fundamentals of logic design”, Thomson Learning, 2004.
4) Mono and Kim, “Logic and computer design Fundamentals”, Pearson, 2nd edition 2001.

IV Semester

18UMAC400 Engineering Mathematics-IV (3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

To provide an insight into applications of conformal mapping, integration of complex functions and application of probability distributions in Engineering.

Course Outcomes (COs):

Description of the Course Outcomes: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Construct and use** the concepts of analytic function to solve the problems arising in Engineering field.			1
CO-2	**Utilize** conformal transformation and complex integral to transform irregular domain onto a relatively simple domain.		1	
CO-3	**Apply** discrete and continuous probability distributions in analyzing the probability models arising in engineering field.		1	
CO-4	**Make** use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.		1,2	
CO-5	**Estimate** the correlation, covariance using joint probability distributions. Also use student's t-distribution, Chi-square distribution as a test of goodness of it.		1,2	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.8	2	-	-	-	-	-	-		-	-	-

Pre-requisites: 1.A basic course on Differentiation and integration of function.
2. A basic course on probability and statistical averages.

Contents:

Unit-I

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms. Construction of analytic functions: Milne-Thomson method-Problems. **7 Hrs.**

Unit-II

Conformal transformations: Introduction. Discussion of transformations $w = e^z; w = z^2, w = z + \frac{1}{z}, z \neq o)$.Bilinear transformations- Problems.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's Integral theorem. **8 Hrs.**

Unit-III

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression–problems.

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form $= ax + b; y = ax^2 + bx + c; y = ax^b$ **.** **8 Hrs.**

Unit-IV

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions-problems (No derivation for mean and standard deviation)-Illustrative examples. **8 Hrs.**

Unit-V

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. **8 Hrs.**

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons 10^{th}edition.(Reprint) 2016.

2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
3. Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

18UECC400	Communication Systems - I	(4-0-0)4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on time and frequency domain description of various analog modulation techniques, their generation and detection with necessary mathematical analysis. Various types of noise and performance of radio receivers in the presence of noise is covered in the course. The course also deals with theoretical bounds on sampling rates, practical aspects of sampling, quantization and various encoding methods.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** various analog modulation techniques in time and frequency domain	1,2		
CO-2	**Describe** the generation and detection of various analog modulation techniques		1,3,13	12
CO-3	**Explain** various types of noise and **evaluate** the performance of the receiver in presence of noise		1,2,3	
CO-4	**Derive** sampling rates to convert signal from analog to digital and practical aspects of sampling	1,2	3	
CO-5	**Describe** types of quantization and various source encoding techniques for data transmission		1,2,3,13	12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.4	2.5	2	-	-	-	-	-	-	-	-	1	2	-

Pre-requisites: Fourier analysis, Analog Electronic Circuits.

Contents:

Unit-I

Amplitude Modulation: Introduction to communication system, Need for modulation, AM, DSBSC, SSB, VSB: time domain description, frequency domain description, modulation index, bandwidth, power relations, modulation by several sine waves, generation, detection, quadrature carrier multiplexing, comparison of various amplitude modulation techniques, frequency translation, frequency division multiplexing, applications: AM radio. **12 Hrs**

Unit-II

Angle Modulation: Frequency modulation, Phase modulation, time domain description, spectrum analysis of FM waves, transmission bandwidth, narrow band FM, wideband FM, generation of FM waves: indirect FM, direct FM, demodulation: balanced frequency discriminator, zero crossing detector, phase locked loop, applications: FM radio, FM stereo multiplexing. **09 Hrs**

Unit-III

Noise in CW Modulation systems: Introduction, various types of noise, narrow band noise, noisy receiver model, noise in DSB-SC receivers, noise in SSB receivers, noise in AM receivers, noise in FM receivers, pre-emphasis and de-emphasis in FM **09 Hrs**

Unit-IV

Sampling Process: Introduction, sampling theorem, signal distortion in sampling, practical aspects of sampling: natural sampling, flat top sampling, sample and hold circuit, time division multiplexing, T1 carrier multiplexing, pulse modulation techniques: PAM, PWM, PPM **12 Hrs**

Unit-V

Waveform Coding Techniques: Quantization, quantization noise, signal to quantization noise ratio, robust quantization, Pulse Code Modulation, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation. **10 Hrs**

Reference Books:

1) Simon Haykin, “An introduction to analog and digital communications”, John Wiley India Pvt. Ltd., 2008.
2) Simon Haykin, “Communication systems”, 5/e, John Wiley India Pvt. Ltd., 2009.
3) Simon Haykin, “Digital Communications”, John Wiley India Pvt. Ltd., 2009.

4) B. P. Lathi, “Modern digital and analog communication systems”, Oxford University Press, 4/e, 2010.

18UECC401	Control Systems	(3-2-0) 4

Contact Hours: 52 Hrs

Course Learning Objectives (CLOs):

The course focuses on mathematical modeling, arriving at system transfer function from block diagram / signal flow graph, finding out time and frequency response of the control systems, various methods of finding out stability of a system, state model representation and its solution for electrical systems. Numerical examples are taken up for discussing these topics.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Classify** different Control Systems with examples and **Analyze** electromechanical systems by mathematical modeling.	1	2	-
CO-2	**Develop** transfer function of a control system using Block diagram reduction technique and signal flow graph method.	1,2	-	-
CO-3	**Determine** Transient and Steady State behavior of systems using standard test signals and it’s time response specifications.	1,2	-	13
CO-4	**Analyze and investigate** the stability of different control systems using graphical and mathematical techniques in time domain and frequency domain.	2	13	3
CO-5	**Realization** of basic Compensators and **Understand** the modeling of linear-time-invariant systems using state-space representation.	-	1,2	13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.7	2.6	1	-	-	-	-	-	-	-	-	-	1.3	-

Pre-requisites:
Laplace Transform, Partial Fractions, Differentiation & Integration

Contents:

Unit-I

Modeling of Systems: The control system, Mathematical models of Physical systems: Differential equations of physical systems - Mechanical systems, Translational systems, Rotational systems, Electrical systems, Analogous systems.
Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs. **10L+02T Hrs**

Unit-II

Time Response of feedback control systems: Standard test signals, Unit step response of First and second order systems, Time response specifications, Steady-State Errors and Error Constants, Types of Control Systems, Dominant Poles of Transfer Functions.
Stability analysis: Concepts of stability, Necessary conditions for Stability, Routh-stability criterion, Relative stability analysis. **08L+02T Hrs**

Unit-III

Root-Locus Techniques: Introduction, the root locus concepts, Construction of root loci, numerical examples.
Stability in the frequency domain: Mathematical preliminaries, Nyquist Stability criterion, Assessment of relative stability using Nyquist criterion, numerical examples. **08L+02T Hrs**

Unit-IV

Frequency response analysis: Introduction, Correlation between time and frequency response, Bode plots, All pass and minimum phase systems, Experimental determination of transfer functions. **08L+02T Hrs**

Unit-V

Compensation: Introduction, Types of compensators, Realization of basic compensators.
Introduction to State variable analysis: Concepts of state, state variable and state models for electrical systems, Solution of state equations, Transfer Function from the State Model. **08L+02T Hrs**

Reference Books:

1) I.J.Nagarath and M.Gopal, "Control Systems Engineering", 5/e, New Age International (P) Limited, Publishers, 2007.
2) A. Anand Kumar, "Control Systems", PHI, 2013.
3) K. Ogata, "Modern Control Engineering", 4/e, Pearson Education Asia/PHI, 2002.
4) B. C. Kuo, "Automatic Control Systems", 7/e, EEE, PHI, 2005.
5) A.K. Jairath, "Solutions and Problems of Control Systems", 2/e, CBS Publishers & Distributors, 1997.

18UECC402	Microcontrollers	(3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on architectural features and instruction set of 8051 microcontroller. It also focuses on programming using assembly language of 8051 and C language, programming the timers in different modes, programming for serial communication, interrupts and interfacing devices.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the architectural features of microcontrollers 8051.	-	14	1
CO-2	**Explain** the operations of data movement, logical and arithmetic instructions.	-	1,14	-
CO-3	**Write** programs on branch instructions in assembly Language.	2,3,4	13,14	-
CO-4	**Program** the timers in different modes using assembly and C programming and for serial communication between 8051 and peripherals.	-	2,3,14	-
CO-5	**Analyze and Implement** a program for 8051 interrupts and other peripherals.	3,4	1,14	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.66	2.5	2.66	3	-	-	-	-	-	-	-	-	2	2

Pre-requisites: Digital Circuits and basic programming skills.

Contents:

Unit-I

Microprocessors and Microcontrollers: Introduction, Overview of 8085 Microprocessor, difference between Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture. The 8051 Architecture-Block diagram, Pin Configuration, 8051 port structure. **8L+2T Hrs**

Unit-II

Addressing Modes and Operations: Introduction, Addressing modes, External data transfer, Code Memory, Read Only Data transfer / Indexed Addressing modes, PUSH and POP opcodes, Data exchanges, Example Programs; Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Example Programs. Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Example-programs. **8L+2T Hrs**

Unit-III

Jump and Call Instructions: The JUMP and CALL Program range, Jumps, calls and Subroutines, Interrupts and Returns, Examples.

8051 programming in C: Data types and time delays in C for 8051, I/O programming, logic operations, data conversion programs. **08 Hrs**

Unit-IV

Timer/Counter Programming in 8051: Programming 8051 Timers, Counter Programming, programming timers 0 and 1 in C and ALP.

8051 Serial Communication: Basics of Serial Communication, 8051 connections to RS-232, 8051 Serial communication Programming, Serial port programming in C and ALP. **10L+2T Hrs**

Unit-V

Interrupts Programming: 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051, interrupt programming in C and ALP

Embedded Sub Systems Using 8051: Interfacing 8051 to LCD, Keyboard, DAC and Stepper Motor. **10L+2T Hrs**

Reference Books:

1) Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", 3rd Edition, Cengage Learning, 2011.
2) Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontroller and Embedded Systems – using assembly and C", 2nd Edition, Pearson, 2008.
3) Predko, "Programming and Customizing the 8051 Microcontroller", TMH, 2005.
4) Dr. Ramani Kalpathi and Ganesh Raja, "Microcontroller and its applications", Sanguine Technical Publishers, 2005.

18UECC403 HDL Programming using Verilog (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on HDL programming concepts, Verilog constructs, and application to the implementation of various digital circuits. Also, course focuses on hardware description of a digital system using Verilog.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Recognize** the need for HDL and **describe** typical design flow and design methodologies of VLSI.	-	3	1
CO-2	**Identify** and **illustrate** various terminologies, data types and system tasks of verilog language.	-	2, 14	-
CO-3	**Apply** the knowledge of various design models and techniques in verilog programming to describe the digital system.	-	1,4,13, 14	2,3
CO-4	**Analyze** the given task and **develop** the program using subroutines.	-	14	2,3,4
CO-5	**Identify** the useful modeling techniques in verilog and **illustrate** the concept of synthesis, mapping and optimization	-	2,14	1,3,4

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**

Mapping Level	1.33	1.5	1.25	1.33	-	-	-	-	-	-	-	-	2	2

Pre-requisites: Digital circuit design, Programming fundamentals

Contents:

Unit-I

Overview of Digital Design with Verilog HDL: Typical VLSI Design Flow, Design Méthodologies, 4 bit Ripple Carry Counter, Modules, Instances, Components of a Simulation, Examples.

Basic Concepts & Modules and Ports: Basic Concepts: Lexical Conventions, Data types, System Tasks and Compiler Directives, Modules, Ports, Examples.

09 Hrs

Unit-II

Gate Level Modeling: Gate types And/ Or gates, Buffer / Not gates, Example, Gate Delays, Rise, Fall and turn –off delays, Minimum / Typical /Maximum values.

Dataflow Modeling: Continuous Assignments, Delays, Expressions, Operations, and Operands, Operator types, Examples. **08 Hrs**

Unit-III

Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, Multi-way Branching, Loops, Traffic light controller, Examples. **08 Hrs**

Unit-IV

Tasks and Functions : Difference between Tasks and Function, Tasks declaration and invocation, Task examples, Function declaration and invocation, Function examples. **07 Hrs**

Unit-V

Useful modeling techniques: Time Scales, Useful System tasks.

Logic Synthesis with Verilog HDL : Logic Synthesis, Synthesis information from module inputs / Outputs, Synthesis Design Flow, RTL Description, translation, Logic Optimization, Technology Mapping and Optimization, examples. **07 Hrs**

Reference Books:

1) Samir Palnitkar, “Verilog HDL”, 2/e, Pearson Education, IEEE 1364-2001 Compliant, 2015.
2) T.R. Padmanabhan, B. Bala Tripura Sundari, “Design Through Verilog HDL”, ISBN: 978-0-471-44148-9, Wiley-IEEE Press, 2004.
3) Nazeih M Botros, “HDL Programming, VHDL and Verilog”, Deamtech Press, 2007.

4) Peter J. Ashenden, “Digital Design: An Embedded Systems Approach Using verilog”, Elsevier, 2010.

18UECC404	Linear ICs and Applications	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on understanding fundamentals of Op-amp ICs, analysis of its performance and responses in various circuit configurations and its various applications. It also focuses on other linear ICs such as 555 Timer, PLL and their various applications.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the fundamentals of op-amp and **derive** the expressions for gain and input resistance for differential amplifier.		1	2
CO-2	**Derive** the expressions for gain, bandwidth and resistances of op-amp with negative feedback and **analyze** frequency response.		1,3	2
CO-3	**Design** various circuits using op-amp for different applications and **analyze** their operational characteristics.		13	1,2,3
CO-4	**Design** and **explain** the filters and oscillators using op-amp.	3	13	1
CO-5	**Design** and **explain** comparator and converter circuits, 555 Timer and PLL.		1,2	

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.6	1.25	2	-	-	-	-	-	-	-	-	-	2	-

Pre-requisites: Transistor biasing and analysis, Network analysis,

Contents:

Unit-I

Differential Amplifiers: Dual input-Balanced output differential amplifier, Dual input-Unbalanced output differential amplifier, Level translator.
Operational amplifier Fundamentals: Block diagram representation of Op-amp, Op-amp parameters such as Input offset voltage, Input offset current, Input bias current, CMRR, SVRR, Output voltage swing, Output short circuit current, Slew rate and Gain-bandwidth product, The ideal Op-amp, Equivalent circuit of an Op-amp, Ideal voltage transfer curve, Open Loop Op-Amp configurations **07 Hrs**

Unit-II

Op-Amp with Negative Feedback: Block diagram representation of feedback configuration, Voltage series feedback amplifier, Voltage shunt feedback amplifier, Differential Amplifier, Input offset voltage compensation. Op-Amps frequency response: High frequency Op-amp equivalent circuit, Open loop voltage gain as a function of frequency, Closed Loop frequency response. **08 Hrs**

Unit-III

OP-Amp Applications: Peaking amplifier, Summing, scaling and averaging amplifiers, Instrumentation amplifier, Voltage to current converter with floating load, Current to voltage converter, Integrator, Differentiator. **07 Hrs**

Unit-IV

Active filters and Oscillators: Active filters, first and second order low pass and high pass Butterworth filter, Phase shift oscillator, Wein-bridge oscillator, Square and triangular wave generators, voltage controlled oscillators. **08 Hrs**

Unit-V

Comparators and Converters: Basic comparator, Zero crossing detector, Schmitt trigger, A/D and D/A converters, peak detectors, sample and hold circuit. Specialized IC applications: 555 timer-Basic timer circuit, 555 timer used as astable and mono-stable multivibrator, PLL-operating principles, Monolithic phase locked loops, PLL applications. **09 Hrs**

Reference Books:

1) Ramakant A. Gayakwad,"Op-Amps and Linear Integrated Circuits", 3/e, PHI.
2) D. Roy Choudhury and Shail B. Jain,"Linear Integrated Circuits", 3/e, New Age International, Reprint 2006.
3) Robert. F. Coughlin & Fred. F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 5/e PHI, 2006.
4) William D. Stanley, "Operational Amplifiers With Linear Integrated Circuits",, 4/e, Pearson

18UECL405	HDL Programming Laboratory	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on experiments based on HDL programming for digital circuit design using Verilog. Also, the course contemplates the interfacing programs to interface different hardware components using Field Programmable Logic Device (FPGA).

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Relate** the need for HDL in Typical design flow of VLSI Technology.	-	14	1
CO-2	**Apply** appropriate techniques, resources, and EDA tools for modeling, simulation and synthesis of various digital systems.	5,14	3,4,13	1,2
CO-3	**Design** combinational and Sequential circuits using various programming techniques.	-	3,4,5,13, 14	1,2
CO-4	**Build** the HDL model to interface FPGA kits with various peripherals	14	5	1,2,3,4
CO-5	**Generate** the test vectors for the HDL model using stimulus block.	-	3,4,5,13, 14	1,2

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POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1	1	1.75	1.75	2.25	-	-	-	-	-	-	-	2	2.4

List of Experiments:

1) Write a Verilog code to implement the following Basic Gates: (Using Dataflow, Behavioral and Structural style of modelling).
2) Write a Verilog code to implement Adders, Subtractors, Encoders and Decoders. (Using Dataflow, Behavioral and Structural style of modelling).
3) Write a Verilog code to implement Multiplexers, De-multiplexers, Code converters, Comparators.
4) (Using Dataflow, Behavioral and Structural style of modelling).
5) Write a Verilog Code to implement 4-bit ALU. Verify the same generating test vectors for the various operations. Write the test bench (stimulus block) and verify that it behaves as ALU.
6) Design a 4-bit ripple carry adder using concept of hierarchical structured modeling by using module instantiation, tasks and functions.
7) Write the verilog code to implement all flip flops.
    a) Write a Verilog code to implement the following:
    b) 4-bit Shift register (Right shift and left shift)
    c) 4-bit Ring counter and Johnson counter
    d) 4-bit up counter and 4-bit down counter
    e) 4-bit updown counter
    f) Any given sequence counter (4-bit)
    g) BCD updown Counter
    h) Mealy and Moore's synchronous circuit design.
8) Write a verilog code to run the stepper motor in clockwise and anti-clockwise direction.
9) Write a verilog code to generate any given waveforms using DAC kit.
10) Write a verilog code to Interface hex keypad and display it on 7-segment LED.

Note: Simulation should be done using Xilinx ISE tool and Implementation on Spartan –6 FPGA Kits.

Reference Books:

1) Samir Palnitkar, "Verilog HDL", 2/e, Pearson Education, IEEE 1364-2001 Compliant, 2015.

2) T.R. Padmanabhan, B. Bala Tripura Sundari, “Design Through Verilog HDL”, ISBN: 978-0-471-44148-9, Wiley-IEEE Press, 2004.
3) Nazeih M Botros, “HDL Programming, VHDL and Verilog”, Deamtech Press, 2007.
4) Peter J. Ashenden, “Digital Design: An Embedded Systems Approach Using verilog”, Elsevier, 2010.

18UECL406 Linear Integrated Circuits Laboratory (0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on experiments highlighting various applications of linear ICs: op-amp and 555 timer.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Demonstrate** Op-amp as DC and AC amplifier in inverting and non-inverting configuration			1
CO-2	**Design** Op-amp based circuits for various arithmetic operations, filters and comparators and DAC.	2	3	1
CO-3	**Design** of 555 timer as multivibrator.	2	4	1
CO-4	**Demonstrate** the use of Op amp as wave-shaping and rectifier circuits.		13	1,2
CO-5	**Design** various waveform generators using Op-amp.	13	1,2	

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.25	2.25	2	2	-	-	-	-	-	-	-	-	2.5	-

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List of Experiments:

1) Operational amplifier as voltage follower, inverting and non-inverting amplifier.
2) Operational amplifier for implementing given arithmetic expressions.
3) Instrumentation amplifier using Op-Amps.
4) Design low-pass and high-pass first and second order Butterworth filters.
5) Design a Schmitt Trigger for a given UTP and LTP.
6) Design R-2R DAC using OP-Amp.
7) Design of multivibrators for given specifications using IC-555.
8) Wave shaping Circuits using Op-Amp.
9) Waveform Generators using Op-Amp.
10) Rectifiers using Op-amp.

Reference Books:

1) Ramakant A. Gayakwad,"Op-Amps and Linear Integrated Circuits", 3/e, PHI.
2) D. Roy Choudhury and Shail B. Jain,"Linear Integrated Circuits", 3/e, New Age International, Reprint 2006.
3) Robert. F. Coughlin & Fred. F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 5/e PHI, 2006.
4) William D. Stanley, "Operational Amplifiers With Linear Integrated Circuits",, 4/e, Pearson

18UECL407	Introductory Project	(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

The course provides an exposure to the students to identify simple societal problems and propose a technical solution. It also helps them to find related material, use appropriate tool to obtain the solution and prepare a report based on the work carried out.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Conduct a **survey** and **identify** the community needs.	-	6, 7	2
CO-2	**Formulate** the problem statement.	-	2	1
CO-3	**Propose** a solution by applying the	-	1,2	3

	fundamental knowledge of basic sciences and basic engineering courses			
CO-4	**Develop** the team spirit, communication and management skills.	-	9,10,12	11
CO-5	**Prepare** a report and present the findings.	-	9,12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.5	1.7	1	-	-	2	2	-	2	2	1	2	-	-

Contents:

Introductory Project is introduced with an objective of understanding and identifying the community expectation in terms of possible engineering solutions by applying the fundamental knowledge of basic sciences and basic engineering courses. The Project shall be engineering oriented in terms of problem definition, related literature survey and existing solutions. Students are supposed to meet the faculty members, discuss the problem definition and formulate the project. Project Team size Minimum of 03 and Maximum of 04 Students. The synopsis format shall be strictly adhered failing which may lead to rejection of the proposal and may cause delay in project. If the Introductory-Project idea is suggested by the faculty member, the synopsis must be duly signed by the respective faculty member. Maximum efforts will be made to allocate the same guide but may not be guaranteed. If the proposed project matches with one or more project titles, they are suggested to modify them in consultation with their respective guides and proceed with the submission.

Academic Program: UG

Academic Year 2021-22

Syllabus

V & VI Semester B.E.

Electronics & Communication Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Ph: **0836-2447465 Fax: 0836-2464638 Web:** www.sdmcet.ac.in

SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for V & VI semester of UG program in Electronics and Communication Engineering is recommended by Board of Studies of Electronics and Communication Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Chairman BOS & HOD Principal

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SDM College of Engineering & Technology, Dharwad-02

Department of Electronics & Communication Engineering

College – Vision and Mission

VISION:

To develop competent professionals with human values

MISSION:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

Department- Vision and Mission

Vision

Fostering excellence in the field of Electronics & Communication Engineering, showcasing innovation, research and performance with continuous Industry – Institute Interaction with the blend of Human values.

Mission

M1: To provide quality education in the domain of Electronics & Communication Engineering through state of the art curriculum, effective teaching learning process and the best of laboratory facilities.

M2: To encourage innovation, research culture and team work among students.

M3: Interact and work closely with industries and research organizations to accomplish knowledge at par.

M4: To train the students for attaining leadership with ethical values in developing and applying technology for the betterment of society and sustaining the global environment.

Program Educational Objectives (PEOs)

The Graduates, after a few years of Graduation will be able to:

I. **Apply** the latest in-depth knowledge in the field of Electronics and Communication Engineering with Mathematical applications to address real life challenges.
II. **Exhibit** the confidence for independent working and / or spirit to work cohesively with group.
III. **Readily** be accepted by the Industry globally.
IV. **Develop** design skills, fault diagnosis skills, communication skills and create research orientation.
V. **Inculcate** professional, social ethics and to possess awareness regarding societal responsibility, moral and safety related issues

Programme Outcomes (POs):

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

13. Design economically and technically sound analog and / or digital systems based on the principles of signal processing, VLSI and communication Engineering (PO-13)

14. Integrate hardware – software, and apply programming practices to realize the solutions in electronics domain. (PO-14)

Scheme and Syllabus

V Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration in Hrs.
18UHUC500	HU	Management, Entrepreneurship and IPR	4 - 0 - 0	4	50	100	3	-	-
18UECC500	PC	CMOS VLSI Design	4 - 0 - 0	4	50	100	3	-	-
18UECC501	PC	Communication Systems -II	4 - 0 - 0	4	50	100	3	-	-
18UECC502	PC	Digital Signal Processing	3 - 0 - 0	3	50	100	3	-	-
18UECC503	PC	Information Theory & Coding	3 - 0 - 0	3	50	100	3	--	--
18UECE5XX	**PE**	**Program Elective-I**	3 - 0 - 0	3	50	100	3	--	--
18UECL504	PC	Communication Systems Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL505	PC	DSP Laboratory	0 – 0 - 3	1.5	50	--	--	50	3
18UECL506	PC	Minor Project-1	0 – 0 - 2	1	50	--	--	--	--
18UHUL507	HU	Soft skills/Aptitude	0 - 0 - 2	1	50	--	--	--	--
Total			**21- 0 -10**	**26**	**500**	**600**		**100**	

Program Elective-I

18UECE510	PE	Object Oriented Programming using C++	3 - 0 - 0	3	50	100	3	--	--
18UECE511	PE	Telecommunication Networks	3 - 0 - 0	3	50	100	3	--	--
18UECE512	PE	Scientific Computing using Python	3 - 0 - 0	3	50	100	3	--	--
18UECE513	PE	Sensors and Transducers	3 - 0 - 0	3	50	100	3	--	--

HU- Humanities, PC- Program Core

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
L: Lecture **T**: Tutorials **P**: Practical
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

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VI Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UECC600	PC	Analog & Mixed Mode VLSI Design	4 - 0 - 0	4	50	100	3	-	-
18UECC601	PC	IOT & Embedded System Design	4 - 0 - 0	4	50	100	3	-	-
18UECE6XX	PE	**Program Elective-II**	3 - 0 - 0	3	50	100	3	-	-
18UECE6XX	PE	**Program Elective-III**	3 - 0 - 0	3	50	100	3	-	-
18UECE6XX	OE	**Open Elective**	3 - 0 - 0	3	50	100	3	-	-
18UECL602	PC	Embedded Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL603	PC	VLSI Laboratory	0 - 0 - 3	1.5	50	--	--	50	3
18UECL604	PC	Minor Project-2	0 - 0 - 4	2	50	--	--	50	3
18UHUL605	HU	Soft skills/Aptitude	0 - 0 - 2	1	50	--	--	--	--
		Total	**17 - 0 -12**	**23**	**450**	**500**		**150**	

Program Elective-II

18UECE610	PE	System Verilog	3 - 0 - 0	3	50	100	3	-	-
18UECE611	PE	Advanced Digital System Design	3 - 0 - 0	3	50	100	3	-	-
18UECE612	PE	Image Processing & Computer Vision	3 - 0 - 0	3	50	100	3	-	-
18UECE613	PE	Operating System	3 - 0 - 0	3	50	100	3	-	-

Program Elective-III

18UECE620	PE	Speech Processing	3 - 0 - 0	3	50	100	3	-	-
18UECE621	PE	Robotics	3 - 0 - 0	3	50	100	3	-	-
18UECE622	PE	Data structure using C++	3 - 0 - 0	3	50	100	3	-	-
18UECE623	PE	Artificial Intelligence	3 - 0 - 0	3	50	100	3	-	-

Open Elective

18UECO630	OE	Cryptography	3 - 0 - 0	3	50	100	3	--	--
18UECO631	OE	Soft Computing	3 - 0 - 0	3	50	100	3	--	--
18UECO632	OE	Automotive Electronics	3 - 0 - 0	3	50	100	3	--	--
18UECO633	OE	Multimedia Communication	3 - 0 - 0	3	50	100	3	--	--
18UMAO675	OE	Applied Mathematics	3 - 0 - 0	3	50	100	3	--	--

PC- Program Core, PE-Program Elective, OE- Open Elective and HU- Humanities

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
L: Lecture **T**: Tutorials **P**: Practical
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

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V Semester

18UHUC500	Management, Entrepreneurship & IPRs	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on concepts of Entrepreneurship, concepts of Management and about the Intellectual Property Rights. Entrepreneurship part discusses about meaning of Entrepreneurship, Business ideas, family business and doing business in India. Management part discusses about Planning, Forecasting, Organizing & Staffing, Motivating and Controlling. Intellectual Property Rights part discusses various legal aspects of Patents, Trademarks and Copyright.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Understand** the concept of Entrepreneurship and Business ideas.	12	6	-
CO-2	**Describe** about family business in India and doing business in India	12	6	-
CO-3	**Discuss** Management principles/process and illustrate Planning and Organizing.	-	11	-
CO-4	**Analyze** aspects of Motivating and Controlling functions of Management.	-	6	-
CO-5	**Discuss** about the legal aspects of Intellectual Property Rights: Patents, Trade Marks and Copyright.	8	12	7

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	-	-	-	-	-	2.0	1.0	3.0	-	-	2.0	2.7	**-**	**-**

Contents:

Unit-I

Entrepreneurship

Understanding Entrepreneurship: Introduction, Definition, Role of an Entrepreneur, Reasons for growth of Entrepreneurship, Age of an Entrepreneurial

firm, Why start a business, Entrepreneurial Characteristics & Skills, Types of Entrepreneurs, Entrepreneurial failure.

Growth of a Business Idea: Introduction, New Business Idea, Pre-selection process, Sources of Business Ideas, Preliminary Research, Business Idea Evaluation, Other analysis.

Family Business: Introduction, Family Business in India, The Founder, The Next Generation, Entry of Family Members, Non-family Managers, Succession, Best Practices. **11 Hrs**

Unit-II

Doing Business in India: Introduction, Major Issues, Types of Organizations, Legal Compliances.

Entrepreneurial Support: Introduction, Policies, Business Incubation, Business Clusters.

Management Planning, Forecasting and Decision Making: Nature of Planning, the foundation of planning, some planning concepts, forecasting, nature of decision making, management science, tools for decision-making. 11 Hrs

Unit-III

Organizing and staffing: nature of organizing, traditional organizational theory, technology and modern organization structures, staffing technical organization, authority and power; delegation, meeting & committees.

Motivating: Motivation, leadership, motivating and leading technical professionals. **10 Hrs**

Unit-IV

Controlling: process of control, financial controls, and non-financial controls.

Intellectual Property Rights

Patents: Introduction, Protectable Subject Matter-Patentable Invention, Procedure for Obtaining Patent, Provisional and Complete Specification, Rights conferred on a Patentee, Transfer of Patent, Revocation and Surrender of Patents, Infringement of Patents. **10 Hrs**

Unit-V

Trade Marks: Introduction, Statutory Authorities, Principles of Registration of Trade Marks, Rights conferred by Registration of Trade Marks, Infringement of Trade Marks and Action against Infringement, Procedure of Registration and Duration.

Copyright: Introduction, Author and Ownership of Copyright, Rights conferred by Copyright, Term of Copyright, Assignment/License of Copyright, Infringement of Copyright, Infringement in Literary, Dramatic and Musical Works. **10 Hrs**

Reference Books:

1) Rajeev Roy, “Entrepreneurship”, 2nd Edition, 2011, Oxford University Press, New Delhi.
2) Daniel L Babcock, Lucy C Morse, "Managing Engineering and Technology" Third Edition, 2005, Prentice Hall of India Pvt. Ltd., New Delhi.

3) Wadehra B. L.,"Law relating to Intellectual Property",4th Edition, 2012, Universal Law Publishing Co. Pvt. Ltd., Delhi.
4) N. K. Acharya, "Text book on Intellectual Property Rights" Asia Law House, Hyderabad, 4th Edition.

18UECC500 CMOS VLSI Design (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the theory, fabrication and design principles of CMOS devices and circuits. The course concentrates on the study and analysis of various combinational and sequential MOS logic circuits for digital VLSI applications.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the theory, construction and the characteristics of MOS structures and logic circuits.	-	-	1,2,13
CO-2	**Elaborate** the steps and processes involved in the VLSI fabrication technology.	-	-	1,2,4
CO-3	**Apply** design rules to design layout of various digital VLSI circuits.	5	1,2	3,9
CO-4	**Estimate** the parasitics for various MOS layouts.	-	1	2
CO-5	Perform a **comparative** study of different MOS circuit technologies.	2	4,13	1,5,9

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.4	1.6	1	1.5	2	-	-	-	1	-	-	-	1.5	-

Pre-requisites: Semiconductor Devices, Analog Electronic circuits, Digital Electronic circuits

Contents:

Unit-I

MOS Transistor: Metal Oxide Semiconductor (MOS) Structure, MOS System under External Bias, Structure and Operation of MOS Transistor, MOSFET

Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects. Introduction to FinFET.

MOS Inverters: Static Characteristics: Introduction, Resistive-Load Inverter, Inverters with n-Type MOSFET Load, CMOS Inverter. **10 Hrs**

Unit-II

Fabrication Technology: Introduction, Czochralski growth process, Fabrication processes: Thermal oxidation, Diffusion, Ion implantation, Photo lithography, Epitaxy, Metallization and interconnections, Ohmic and Schottky contacts, fabrication of resistors and capacitors.

Basic CMOS Technology: Basic CMOS technology: P-Well / N-Well / Twin Well process, MOS mask layer, stick diagrams, Lambda based design rules, Schematic and Layouts **10 Hrs**

Unit-III

Basic Circuit Concepts: Sheet resistance, standard unit capacitance, concepts delay unit time, Inverter delays, driving capacitive loads, Propagation delays, PVT analysis and Process corners, RC delay, Elmore Delay, Logical Effort, Electrical Effort, Parasitic delay, Non-ideal delay, Examples **12 Hrs**

Unit-IV

Combinational MOS Logic Circuits & Sequential MOS Logic Circuits: Introduction, MOS logic circuits with depletion nMOS loads, CMOS logic circuits, complex logic circuits, CMOS Transmission gate, Introduction to sequential MOS logic circuits, Behavior of bi-stable elements, SR latch circuit, clocked latch and flip flop circuits **10 Hrs**

Unit-V

Dynamic Logic Circuits: Introduction, Basic principles of Pass transistor circuits, voltage bootstrapping, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, high performance dynamic CMOS circuits, Semiconductor Memories. **10 Hrs**

Reference Books:

1) Sung Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, 3/e, McGraw-Hill, 2008.
2) Kanaan Kano, “Semiconductor Devices”, 3/e,Pearson education, 2004.
3) Douglas A Pucknell & Kamran Eshragian, “Basic VLSI Design”, 3/e, PHI, 2005.
4) Michael John Sebastian Smith “Application Specific Integrated Circuits”, Pearson Publication, 2013.

18UECC501	Communication Systems - II	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on shaping of baseband signal for data transmission, various digital modulation techniques along with probability of error computation, spread spectrum techniques for secure communication. The microwave sources, devices and propagation of microwaves in waveguides is dealt along with application in RADAR engineering.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** various signaling formats used for baseband signal transmission and **analyze** the effect of channel on transmission	1,2	3	-
CO-2	**Describe** various digital modulation and spread spectrum techniques and **analyze** their performance measures	1,2,3	13	12
CO-3	**Analyze** the modes of wave propagation in a rectangular waveguide and **derive** scattering matrix for various waveguide components	1,2	-	-
CO-4	**Describe** the working principle of various microwave semiconductor devices and microwave tubes, **outline** their properties and applications	-	1,2	-
CO-5	**Understand** Radar concepts, different forms of Radar and their applications	-	1,2,3,13	12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.6	2.6	2.3	-	-	-	-	-	-	-	-	1.0	2.0	-

Pre-requisites: Communication Systems - I

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Contents:

Unit – I

Base-band shaping for data transmission: Discrete PAM signals, power spectra of discrete PAM signals. Inter-symbol Interference, Nyquist criterion for distortionless base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems, adaptive equalization for data transmission. **10 Hrs**

Unit – II

Digital modulation techniques: Gram-Schmidt orthogonalization procedure, geometric interpretation of signals, digital modulation formats, coherent binary modulation techniques, coherent quadrature modulation techniques, non- coherent binary modulation techniques, comparison of binary and quaternary modulation techniques, M-ary modulation techniques, bandwidth efficiency.

Spread Spectrum Modulation: Pseudo noise sequences, a notion of spread spectrum, direct sequence spread coherent binary PSK, signal space dimensionality and processing gain, probability of error, frequency hop spread spectrum, applications**.** **12 Hrs**

Unit – III

Introduction to Microwaves: Microwave frequency bands, applications of microwaves.

Rectangular waveguides: Propagation of waves in a waveguide, modes, TE and TM modes, propagation of TE and TM modes in rectangular waveguides.

Waveguide Components: Waveguide Tees(T-Junctions), directional coupler, circulator and isolator**.** **10 Hrs**

Unit – IV

Transferred electron and avalanche transit time devices: Gunn-effect diode, modes of operation, Read diode, IMPATT Diode, TRAPATT Diode.

Microwave Tubes: Two cavity Klystron amplifier, Reflex Klystron oscillator, applegate diagram, construction and working principle of magnetron and travelling wave tube. **11 Hrs**

Unit – V

Introduction to Radar: Basic Radar, Radar block diagram, Radar range equation, Radar frequencies and applications, MTI and Pulse Doppler Radar, Digital MTI processing. **09 Hrs**

Reference Books:

1) Simon Haykin, “Digital Communications”, John Wiley India Pvt. Ltd., 2009.
2) Samuel Y. Liao, “Microwave Devices and Circuits”, 4th Edition, Pearson, 2008.
3) Merrill I. Skolnik, "Introduction to Radar systems", 3rd Edition, TMH, 2001.

4) B. P. Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems, 4th Edition, Oxford University Press.

18UECC502 Digital Signal Processing (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on Discrete Fourier Transforms, properties and their applications. It also deals with the design of analog and digital filters using various methods and their realization.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Compute** Discrete Fourier Transform (DFT), Inverse DFT (IDFT) and **apply** the properties of DFT to **solve** signal processing problems	1,2	-	13
CO-2	**Optimize** the computation of DFT and **Compare** with direct computations.	2, 3,	13, 12	-
CO-3	**Design** various types of filters using pole-zero techniques, Butterworth and Chebyshev approximations.	2, 3	12	-
CO-4	**Design** digital IIR filters to satisfy the given specifications and their hardware implementation.	2, 3	12	-
CO-5	**Design** digital FIR filters to satisfy the given specifications and their hardware implementation.	2, 3	12	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1	3	3	-	-	-	-	-	-	-	-	2	1.5	-

Pre-requisites: Signals and Systems

Contents:

Unit-I

Discrete Fourier Transform (DFT): Introduction to Digital Signal Processing, frequency domain sampling and reconstruction of discrete time signals, Discrete

Fourier Transform, Properties of DFT, Linear Filtering Methods based on DFT, frequency analysis of signals using DFT. **07 Hrs**

Unit-II

Efficient Computation of the DFT: Radix-2 Fast Fourier Transform (FFT) algorithms for the computation of DFT and IDFT: Decimation-In-Time (DIT) and Decimation-In-Frequency (DIF) algorithms, comparison of direct computation and FFT computation of DFT, applications of FFT algorithms. **08 Hrs**

Unit-III

Pole-Zero Placement Method for Design of Simple Filters: Ideal filter characteristics, Simple IIR & FIR digital filters, Notch filters, Comb filters, All-pass filters, Digital Resonators.

Design of Analog IIR Filters: Introduction to Butterworth and Chebyshev type – I approximations, Design of analog filters. **08 Hrs**

Unit-IV

Design of Digital IIR Filters: IIR filter design by Approximation of Derivatives, Impulse Invariance and Bilinear Transformation, frequency transformations in digital domain (LPF, HPF only), Implementation of Discrete-Time Systems for IIR filters. **08 Hrs**

Unit-V

Design of Digital FIR Filters: Symmetric and Antisymmetric FIR filters, Design of Linear phase FIR filters using windows method and frequency sampling method, Design of FIR Differentiators, Design of Hilbert Transformers, Implementation of Discrete-Time Systems for FIR filters. **08 Hrs**

Reference Books:

1) Proakis & Monalakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4/e, Pearson Education, New Delhi, 2007.
2) Sanjit K. Mitra, “Digital Signal Processing”, 2/e Tata Mc-Graw Hill, 2004.
3) Li Tan, “Digital Signal Processing Fundamentals and Applications”, Elsevier,2003.
4) Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, Pearson Education, 2/e, 1999.
5) Alan V. Oppenheim and A. S. Willsky, “Signals and Systems”, Second Edition, Pearson Education.

18UECC503	Information Theory and Coding	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on the basic concepts of information theory and coding, including information theory, source coding, different communication channel models, channel capacity and channel coding.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** and **evaluate** dependent model and Markoff model of information sources.	-	1,2	3
CO-2	**Construct** the codes using different source coding algorithms.	3	1,2	5
CO-3	**Design** and **evaluate** Communication Channel to improve the efficiency.	-	1,2	3
CO-4	**Design** and **Analyze** linear Block codes and binary cyclic codes for error detection and correction capabilities.	-	3,13	1,2,5
CO-5	**Analyze** the convolution codes using different techniques.	-	1,2	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.8	1.8	1.75	-	1	-	-	-	-	-	-	-	2	-

Pre-requisites: Probability theory, Communication Systems

Contents:

Unit-I

Information Theory : Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Markoff Sources. **08 Hrs**

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Unit-II

Source Coding: Basic definitions, Encoding of the source output, Properties of codes, Prefix codes, Kraft McMillan's Inequality, Code efficiency and redundancy, Shannon's first theorem (Noiseless coding theorem), Shannon-Fano algorithm, Huffman coding. **08 Hrs**

Unit-III

Information Channels: Communication Channels, Discrete Communication channels, Channel Matrix, Joint Probability Matrix, Binary Symmetric Channel, Entropy functions of a channel, Relation between entropies, Mutual information and its properties, Rate of transmission over a discrete channel, Shannon's theorem on channel capacity. **07 Hrs**

Unit-IV

Error Control Coding: Types of errors, types of codes, Linear Block Codes: Matrix description of linear block codes. Error detecting and correcting capabilities of linear block codes, Lookup table decoding using standard array, Single error correcting Hamming codes.

Binary Cyclic Codes: Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation, Error detection and error correction.

09 Hrs

Unit-V

Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, Viterbi Algorithm. **07 Hrs**

Reference Books:

1) K. Sam Shanmugam, "Digital and analog communication systems", John Wiley, 2005**.**
2) P.S. Satyanarayana. "Concepts of Information Theory & coding", Dynaram Publications, 2005.
3) Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill Publication, 2002.
4) Daniel J. Costello and Shu Lin, "Error Control Coding: Fundamentals and Applications", Pearson, Second Edition, 2011.

18UECE510 Object Oriented Programming using C++ (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course is aimed at the basics of object oriented programming. The language selected for illustrating the concepts is C++. The course deals with functions and

discusses the classes and objects. Then inheritance and polymorphism are introduced. This is followed by templates and exception handling. Real life examples help in understanding the significance of the course.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Understand** and **Apply** the concepts of classes and objects to a given real-life problem.	-	1,2,13	3, 5
CO-2	**Implement** the constructor/ destructor functions and use the operator overloading concept to develop object oriented programs.	-	1,2,3	12
CO-3	**Develop** the code using inheritance.	-	1,2,3	12
CO-4	**Write** the object oriented code using virtual functions and illustrate the function overloading basics in developing the templates for different functionalities.	-	1,2,3	12,5
CO-5	**Understand** and **Implement** the operational aspects of error checking through exception handling to develop robust codes.	-	1,2,3	12

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	2	1.8	-	1	-	-	-	-	-	-	1	2	-

Pre-requisites: Basic Programming concepts

Contents:

Unit-I

Functions: Introduction, The main function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, const Arguments, Recursion, Function Overloading, Friend & Virtual Functions.

Classes and Objects : Introduction, Specifying a Class, Defining Member Functions, C++ program with Class, Making an outside Function Inline, Nesting of Member Functions, Private Member Functions, Arrays within a Class, Memory Allocation for Objects, Static Data Members, Static Member Functions, Array of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects, const Member Functions, Pointers to Members, Local Classes. **8 Hrs**

Unit-II

Constructors and Destructors : Introduction, Constructors, Parameterized Constructors, Multiple Constructors in a class, Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Constructor, Dynamic Constructors, const Objects, Destructors.

Operator Overloading and Type Conversions : Introduction, Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Overloading Binary Operators Using Friends, Manipulation of Strings Using Operators, Rules for Overloading Operators, Operator Overloading Examples, Type Conversions. **8 Hrs**

Unit-III

Inheritance: Extending Classes, Introduction, Defining Derived Classes, Single Inheritance, Making a Private Member Inheritable, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Nesting of Classes. **7 Hrs**

Unit-IV

Pointers, Virtual Functions and Polymorphism: Introduction, Pointers, Pointers to Objects, this Pointer, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions, Virtual Constructors and Destructors.

Templates: Introduction, Class Templates, Class Templates with Multiple Parameters, Function Templates, Function Templates with Multiple Parameters, Overloading of Template Functions, Member Function Templates. **9 Hrs**

Unit-V

Exceptions: Introduction, Basic of Exception Handling, Exception Handling Mechanism, Throwing Mechanism, Catching Mechanism, Rethrowing an Exception. **7 Hrs**

Reference Books:

1) Robert Lafore, “Object Oriented Programming using C++”, Galgotia Publications, fourth edition, 2004.

2) Herbert Schildt, “C++: The Complete Reference”, fourth edition, McGraw Hill OSBORNE publications, 2003.
3) K R Venugopal, Rajkumar, T Ravishankar, “Mastering C++”, Second Edition, Tata McGraw Hill Publishing Company Limited, New-Delhi, 2006.
4) S. B. Lippman & J. Lajoie, “C++ Primer”, third edition, Addison Wesley, 2000.

18UECE511	Telecommunication Networks	(3-0-0)	3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on fundamental principles of telecommunication system, various switching techniques used in telecommunication, construction, operation and standards of telephone networks, data networks, Integrated Services Digital Networks and Mobile Networks.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Apply** suitable switching techniques and **select** suitable switches and hardware components for telecommunication applications	1	2	-
CO-2	**Design** a plan for constructing and maintaining various parts of telephone networks	2	13	11
CO-3	**Plan** the construction, operation and maintenance of various parts of data networks	-	1	13
CO-4	**Explain** the principles, construction and operation of various parts of ISDN	-	1	6
CO-5	**Describe** the principles, construction and operation of various parts and techniques of Mobile Networks	-	12	2

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.3	2	-	-	-	1	-	-	-	-	1	2	1.5	-

Pre-requisites: Analog and Digital Signals and Circuits, Fundamentals of Analog and Digital Communication

Contents:

Unit-I

Introduction: Evolution of Telecommunication, Basics of Switching System, Switching System parameters, Components of switching system.

Strowger Switching Systems: Signalling Tones, Strowger switching components, Step by step switching, Control in Strowger switch

Crossbar Switching: Principles of common control, Touchtone dial telephone, Principles of crossbar switching, Crossbar switch configurations **08 Hrs**

Unit-II

Telephone Networks: Subscriber Loop systems, Switching Hierarchy and Routing, Transmission Plan, Transmission systems, Numbering Plan, Charging Plan, Signalling Techniques, In-channel Signalling, Common channel signaling. **08 Hrs**

Unit-III

Data Networks: Data transmission in PSTNs, Switching Techniques for Data Transmission, Data Communication Architecture, Link to Link Layers, End to End Layers, Satellite based Data Networks, Local Area Networks, Metropolitan Area Networks, Fiber optic networks, Data network standards. **08 Hrs**

Unit-IV

Integrated Services Digital Network: Motivation for ISDN, ISDN services, Network and Protocol Architecture, Transmission channels, User Network Interfaces, Signalling, Numbering and addressing, Service characterization, Interworking, ISDN standards, Broadband ISDN, BISDN architecture, Voice data Integration. **08 Hrs**

Unit-V

Mobile Communication: Wireless Channel, Two-ray model, Path loss model, Fading, Multiple Access techniques, Cellular communications, Co-channel reuse ratio and Signal to interface, Trunking and grade of service, Fade margin analysis, Generations of mobile communication, Global System for Mobile (GSM). **07 Hrs**

Reference Books:

1) Thyagarajan Viswanathan, Manav Bhatnagar, “Telecommunication Switching Systems and Networks”, 2/e, PHI, 2015.
2) P. Gnanasivam, “Telecommunication Switching and Networks”, 2/e, New Age International Publisher, 2010.

3) J.E. Flood, “Telecommunication Switching, Traffic and Networks”, 1/e, Pearson Education, 2002.
4) Roger L Freeman, “ Fundamentals of Telecommunication”, 2/e, Wiley, 2005.

18UECE512 Scientific Computing using Python (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on programming concepts in Python. It includes basic numerical algorithms covering interpolation, integration, differentiation, ordinary differential equations (ODE) and partial differential equations (PDE) solvers, and basic linear algebra.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSOs (13, 14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Examine** Python syntax and semantics and use the Python flow control and functions.	-	1,2,13	3
CO-2	**Write** Python scripts for plotting functions and understand the core data structures like Lists, Dictionaries.	-	1,2,3	12,5
CO-3	**Understand and apply** the basic array methods to statistical problems.	-	1,2,3	12
CO-4	**Implement** the codes for manipulating the polynomials, matrices and understand the basics of Matplotlib.	-	1,2,3	12,5
CO-5	**Solve** the Integration and ordinary differential equations, and perform interpolation.	-	1,2,3	12

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	2	1.8	-	1	-	-	-	-	-	-	1	2	-

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Pre-requisites: Programming Fundamentals

Contents:

Unit-I

The core Python language I: Introduction, The Python shell, Numbers, variables, comparisons and logic, Python objects I: strings, Python objects II: lists, tuples and loops, Control flow, File input/output, Functions. **08 Hrs**

Unit-II

Simple plotting with Pylab: Basic plotting, Labels, legends and customization, more advanced plotting.

The core Python language II: Errors and exceptions, Python objects III: dictionaries and sets, Pythonic idioms: "syntactic sugar", Modules and packages, An introduction to object-oriented programming. **08 Hrs**

Unit-III

Numpy I: Basic array methods: Creating an array, NumPy's basic data types, universal functions and special values, changing the shape of an array, indexing and slicing an array, sorting an array, structured arrays, arrays as vectors, Reading and writing an array to a file, Statistical methods: ordering statistics, averages, variance and correlations, histograms. **07 Hrs**

Unit-IV

Numpy II: Polynomials: defining and evaluating a polynomial, polynomial algebra, root finding, calculus, fitting polynomials, Linear algebra: basic matrix operations, Eigen values and Eigen vectors, solving equations, Matrices: creating a matrix, matrix operations.

Matplotlib: Matplotlib basics, bar charts and pie charts, multiple subplots. **09 Hrs**

Unit-V

SciPy: Integration: definite integrals of a single variable, integrals of two or more variables, Ordinary differential equations: single 1st order ODE, single 2nd order ODE, Interpolation: univariate and multivariate interpolations. **07 Hrs**

Reference Books:

1) Christian Hill, "Learning Scientific Programming with Python", Cambridge University Press, 2015.
2) Sandeep Nagar, "Introduction to Python for Engineers and Scientists: Open Source Solutions for Numerical Computation", Apress Publication, 2018.

3) T.R. Padmanabhan, “Programming with Python”, Springer, 2016.
4) Allen B. Downey, “Think Python”, Second Edition, O’Reilly Publication, 2015.

18UECE513 Sensors and Transducers (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on fundamentals in sensors & transducers like classification of various transducers, choice of proper transducers to measure various physical parameters like temperature, pressure, force, velocity and acceleration.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the working of different types of sensors, transducers and measurement systems	--	1	2
CO-2	**Describe** various methods of measurement for velocity, speed, vibration and acceleration	--	1	2
CO-3	**Explain** the working principle of various force and torque measurement transducers and their applications	--	1,12	3,13
CO-4	**Describe** construction, working principle of various pressure transducers and their applications	--	1,12	3,13
CO-5	**Discuss** the operation and applications of various temperature sensors/transducers	--	1,12	13

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	1	1	--	--	--	--	--	--	--	--	2	1	--

Pre-requisites: Basic Electronics, Electrical Measurement Systems

Contents:

Unit-I

Introduction: Measurement and measurement system, industrial measuring parameters and their units, definitions of sensors and transducers, classification of transducers, static and dynamic characteristics, selection criteria.

Displacement Measurement: Resistive: Potentiometer, Strain gauges, Inductive: LVDT and Eddy current type, Capacitive: Capacitance pickups, Differential capacitive type, Piezoelectric, Ultrasonic transducers and Hall effect transducers, Optical transducers **09 Hrs**

Unit-II

Velocity, Speed, Vibration and Acceleration measurement: Velocity and Speed: Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, Stroboscopes, Shaft speed measurement. Vibration and acceleration: Eddy current type, Piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type **07 Hrs**

Unit-III

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, piezoelectric force transducers, vibrating wire force transducers, Strain gauge, torque meter, Inductive torque meter, Magnetostrictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement. **07 Hrs**

Unit-IV

Pressure measurement: Definition, pressure scale, standards, working principle, types, materials, design criterion: Manometers, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, force balance type, motion balance, capacitive (delta cell), ring balance, vibrating cylinder type, high-pressure gauges, vacuum gauges, dead weight and vacuum gauge tester **08 Hrs**

Unit-V

Temperature measurement: Temperature Scales, Standards and Units and relations, Classification of temperature sensors Bimetallic Thermometer, Filled system thermometers, SAMA classifications, Resistance Temperature Detectors (RTD), Thermistor, Thermocouples, Study of thermocouple tables (calculation of intermediate temperature and voltage), Lead wire compensation, Cold junction compensation techniques, Protection (Thermo well), Thermopiles, Pyrometers, Temperature IC sensors (AD590 and LM35) **08 Hrs**

Reference Books:

1) B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis”, 3/e, Tata McGraw Hill Education, 2009

2) D. Patranabis, “Principle of Industrial Instrumentation”, 2/e, Tata McGraw Hill, 1994.
3) D.V.S. Murty, “Instrumentation and Measurement Principles”, 2/e, PHI, 2008
4) E.O. Doebelin, “Measurement Systems: application and design”, 5/e, McGraw Hill, 2003

18UECL504	Communication Systems Laboratory	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on experiments highlighting the design and demonstration of filters, tuned amplifier, generation and detection of various analog, pulse and digital modulation techniques. It also includes experiments related to microwave communication.

Course Outcomes (COs):

Description of the Course Outcome: At **the end of the course the student** will be able to:		**Mapping to POs (1-12) / PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Design** and plot the frequency response of active filters and class C tuned amplifier	1,3	2,13	9,12
CO-2	**Generation** and **detection** of various amplitude modulation techniques	1,3	13	9,12
CO-3	**Generation** and **detection** of various pulse modulation techniques	1,3	13	9,12
CO-4	**Generation** and **detection** of various digital modulation techniques	1,3	13	9,12
CO-5	**Demonstrate** the characteristics of microwave sources and devices	-	1,13	9,12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.8	2	3	-	-	-	-	-	1	-	-	1	1	-

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List of Experiments:

1. Design of Band pass filter and Notch filter
2. Design tuned amplifier, find centre frequency, bandwidth and quality factor
3. Amplitude modulation using transistor/FET and detection using envelop detector
4. DSBSC generation using Ring Modulator
5. Verification of sampling theorem using flat top sampling and reconstruction
6. Pulse Amplitude Modulation and demodulation
7. Pulse Width Modulation
8. ASK modulation and demodulation
9. FSK, PSK modulation
10. Measurement of guide wavelength and frequency
11. Repeller mode characteristics of Reflex Klystron
12. Measurement of coupling factor and directivity of directional coupler

Reference Books:

1) Simon Haykin, “An introduction to analog and digital communications”, John Wiley India Pvt. Ltd., 2008.
2) Simon Haykin, “Digital Communications”, John Wiley India Pvt. Ltd., 2009.
3) Samuel Y. Liao, “Microwave Devices and Circuits”, 4th Edition., Pearson, 2008.
4) M. Kulkarni, “Micro Wave and Radar Engineering”, Umesh Publications, 3rd edition, 1998.

18UECL505	Digital Signal Processing Laboratory	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The laboratory course enables students to get practical experience in processing of signals, design of filters and realization of systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Perform** signal manipulations and **Compute** response of LTI systems	-	1,2,5, 12	13,14
CO-2	**Compute** DFT and inverse DFT and **Verify** the properties.	1,2	5,12	13,14
CO-3	**Apply** properties of DFT to **solve** signal processing problems	1,2	5,12	-
CO-4	**Design** analog filters to meet the	2, 3	5,12	-

	given specifications			
CO-5	**Design** digital filters to meet the given specifications	2, 3	5,12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.66	2.8	3	-	2	-	-	-	-	-	-	2	1	1

Contents:

1. Basic signal processing operations.
2. Response of LTI systems.
3. Computation of DFT/IDFT and verification of properties.
4. Frequency analysis of signals using DFT.
5. Linear filtering of long data sequence using DFT.
6. Efficient computation of DFT.
7. Design analog IIR filters for the given specifications and their realization.
8. Design digital IIR filters for the given specifications and their realization.
9. Design digital FIR filters for the given specifications.
10. Applications of signal processing.

Reference Books:

1) Proakis & Monalakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4/e, Pearson Education, New Delhi, 2007.
2) Sanjit K. Mitra, “Digital Signal Processing”, 2/e Tata Mc-Graw Hill, 2004.
3) Li Tan, “Digital Signal Processing Fundamentals and Applications”, Elsevier, 2003.
4) Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, 2/e, Pearson Education, 1999.

18UECL506	Minor Project-1	(0-0-2) 1

Contact Hours: 30

Course Learning Objectives (CLOs):

Minor project –1 is introduced at V semester level to encourage students mainly to solve real time societal problems by integrating the knowledge gained in previous semesters. It may involve the investigation of a problem and the specification and implementation of a solution. Minor project help students to develop problem solving, analysis, synthesis and evaluation skills. It also helps in developing collaborative work culture and team work. In focus with this, students understand the basics of electronics, communication and programming languages in depth and

then work on Planning, analyzing, designing and executing a hardware/software project.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** technical / social problemand **formulate** a problem statement	1,2	6	-
CO-2	**Propose** technical approach towards solution	2	6,7	11
CO-3	**Implement** the solution in hardware and / or software	3,5	13,14	11
CO-4	**Organize** the topics in a systematic manner and **Prepare** the report in a specific format	9,10	12	-
CO-5	**Present** the work in a systematic manner	10	12	-

POs/PSO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	3	3	-	3	2	2	-	3	3	1	2	2	2

Prerequisites:

Basics of Electronics, Communication and Programming languages.

Guidelines for Conduction Spirit of the Course:

To ensure that undergraduates successfully apply the knowledge they have gained in different courses and integrate material learnt at different stages of the curriculum up to the 5th semester so as to complete the project work within the stipulated time duration following guidelines are framed.

1. Project groups are formed with 3-4 students in each team.
2. Project coordinators instruct student project batches to submit synopsis in the prescribed format in the field of their choice.
3. Project coordinators allot guides based on their field of specialization. However students can have further discussions on the project topic and can modify their project title.

4. Students are instructed to report to their respective guides on weekly basis for discussion.
5. Students are instructed to maintain separate project diary/notebook to show the progress work while having discussion with guide and review committee members.
6. Two reviews are fixed in a semester to monitor the progress of the project.

Assessment: CIE- Guides evaluate project for 30 marks and 20 marks are allotted by reviewers by conducting 2 reviews. Total marks for project is 50 (CIE only). **SEE:** There is no semester end exam (SEE) component for minor project-1.

Note:

- Designated committee is constituted with 2-4 committee members to monitor the process of Mini Project-1
- An internal guide is allotted per group who guides and monitors the project
- progress.
- Problem statements can be derived from industry, society, etc., after interacting with them.
- Course outcomes (4 or more) are written and mapped toprogram outcomes and program specific outcomes. In addition to that other POs can also be included if those POs are deemed suitable.
- At the end of the course, students are required to document the project in the form of report.

18UHUL507	Soft skills/Aptitude	(0-0-2)1

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the significance of communication in the profession.	-	10	-
CO-2	**Use** the English language with	-	10	12

	proficiency			
CO-3	**Solve** Aptitude related problems	-	9	12
CO-4	**Demonstrate** the competency in the placement activities.	-	9	-

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	-	-	-	-	-	-	-	-	2.0	2.0	-	1.0	-	-	-

Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

VI Semester

18UECC600	Analog and Mixed Mode VLSI Design	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the basic requirements of circuit design, difficulties in the design phase and various circuit examples. The course considers widely used analog circuits such as OPAMP, ADC, DAC, current source and sinks, mirrors and PLL as examples for the discussion.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the characteristics and short channel effects of MOS devices	-	-	1
CO-2	**Analyze and design** various configurations (CS, CD, CG) of single stage amplifiers.	2,3,13	-	1
CO-3	**Design** the analog circuits such as op-amps, current sources, current sinks and current mirrors.	2,3,13	-	-
CO-4	**Compare** data converter characteristics and **build** data converter architectures.	13,14	4,5	-
CO-5	**Explain** PLL and its applications.	1,13	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.66	3	3	2	2	-	-	-	-	-	-	-	3	3

Pre-requisites: Analog Electronics, Network Analysis, Digital circuits & Basics of CMOS VLSI Design.

Contents:

Unit-I

Introduction to Analog Design: Introduction to MOS, MOS V/I characteristics, second order effects, MOS device models.

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Common source single stage amplifiers: Basic concepts, common source stage with resistive load, diode connected load, current source load, triode load and source degeneration. **12 Hrs**

Unit-II

Other single stage amplifiers: source follower, Common gate stage, Cascode stage.

Current Sinks, Current Sources and Current Mirrors: Current sinks and sources, techniques to improve performance of current sinks and sources, current mirrors, effects to cause current mirror to be different from ideal situation.

10 Hrs

Unit-III

Operational Amplifiers: General considerations, Single stage Op-Amps, two stage Op-Amps, gain boosting, comparison, common mode feedback, slew rate, power supply rejection ratio, Comparator. **10 Hrs**

Unit-IV

Data Converter fundamentals and architectures: Introduction, sample and hold characteristics, digital to analog converter (DAC) specifications, analog to digital converter (ADC) specifications, DAC architectures: Resistor string, R-2R ladder network, Charge scaling DACs, ADC architectures: Pipeline ADC, Successive approximation ADC. **10 Hrs**

Unit-V

Phase Locked Loops: Simple PLL, Basic PLL Topology, Dynamics of Simple PLL, Charge Pump PLLs, Non ideal effects in PLLs, Delay Locked Loops and Applications. **10 Hrs**

Reference Books:

1) Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw-Hill Edition 2008.
2) R. Jacob Baker, Harry W. LI, David E. Boyce, “CMOS Circuit Design, lay out and Synthesis”, IEEE press, 2005.
3) Phillip E. Allen, Douglas R. Holberg, “CMOS Analog Circuit Design”, 2/e, New York Oxford, Oxford University.
4) Adel S. Sedra, Kenneth C. Smith, “Microelectronic Circuits Theory and Applications”, 5th edition Oxford University Press, 2013.

18UECC601 IOT and Embedded Systems Design (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on architectural features and instructions of -ARM Cortex M3, Develop Programs using the various instructions of ARM Cortex M3 and C language for different applications. Develop the prototype using hardware software co-design approach.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Describe** the architectural features and instructions of ARM Cortex M3.	-	2	1
CO-2	**Program** ARM Cortex M3 for different applications	-	1,2	-
CO-3	**Develop** an embedded system application using component engineering.	3	2,12	-
CO-4	**Develop** the hardware software co-design and firmware design approaches.	5	3,13	1,2
CO-5	**Demonstrate** the need of real time operating system and IoT.	5	2,12	14

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.33	1.8	2.5	-	3	-	-	-	-	-	-	2	2	1

Pre-requisites: Microcontrollers and Operating systems.

Contents:

Unit-I

ARM Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence **10 Hrs**

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Unit-II

ARM Cortex M3 Instruction Sets and Programming: Assembly basics, Instruction list and description, Thumb and ARM instructions, Special instructions, Useful instructions, CMSIS, Assembly and C Language Programming **10 Hrs**

Unit-III

Embedded System Components: Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of embedded systems. Elements of an Embedded System, Differences between RISC and CISC, Harvard and Princeton architectures, Big and Little Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Opt-coupler, Communication Interfaces.

10Hrs

Unit-IV

Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling, Embedded firmware design and development **10 Hrs**

Unit-V

Real Time Operating Systems: RTOS basics, Types of operating systems, Task, process and threads, Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores, How to choose an RTOS.

Introduction to IoT and applications: Introduction to IoT, Illustrating the Device-to-Device/ Machine-to-Machine Integration Concept, Explaining the Aspect of Device-to-Cloud (D2C) Integration, The Emergence of the IoT Platform as a Service (PaaS),Digging into the Cloud-to-Cloud (C2C) Integration Paradigm, Describing the Sensor-to-Cloud Integration Concept, Azure IoT Hub Device Management, The Prominent IoT Realization Technologies, Architecture for IoT Using Mobile Devices, Mobile Technologies for Supporting IoT Ecosystem, Layered Architecture for IoT, Protocol Architecture of IoT

12 Hrs

Reference Books:

1) Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes, (Elsevier), 2010.
2) Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd edition.

3) Pethuru Raj and Anupama C. Raman “The Internet of Things Enabling Technologies, Platforms and Use Cases” CRC press 2017, Taylor & Francis Group.
4) James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008, ISBN: 978-0-471-72180-2.
5) Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language andC”, 2nd E -Man Press LLC ©2015
6) Embedded real time systems by K.V. K. K Prasad, Dreamtech publications, 2003.

18UECE610	System Verilog	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on coding guidelines for system Verilog, data types, data structures supported, subroutines, methods of testing the program. Automation with respect to input vector generation, output vector collection, assertions and coverage and overall knowledge of environment is addressed.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Establish** the relevance of System Verilog as a (Hardware Description and Verification Language) HDVL.	1	-	-
CO-2	**Identify** the Language constructs and their usage.	1	-	4
CO-3	**Emphasize** on the importance of utilization of Data structures (array, structure and unions).	1	2,3	4
CO-4	**Demonstrating** the coding skills for synthesis.	13,14	3,4,5	-
CO-5	**Demonstrate** the importance of Verification and its guidelines and **design** proper verification bed using Language strength **utilizing** different verification strategies applying assumptions, assertions and coverage.	1,3,13,14	4,5	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3.0	2	2.3	1.5	1	-	-	-	-	-	-	-	3	3

Pre-requisites: Verilog, Programming using C++ and Digital System Design.

Course Contents:

Unit-I

Introduction to System Verilog: System Verilog origins ,Generations of the System Verilog standard, Donations to System Verilog , Key System Verilog enhancements for hardware ,design, System Verilog Declaration Spaces , Packages ,Package definitions , Referencing package contents, Synthesis guidelines , $unit compilation-unit declarations, Coding guidelines, System Verilog identifier search rules ,Source code order, Coding guidelines for importing packages into $unit , Synthesis guidelines , Declarations in unnamed statement blocks , Local variables in unnamed blocks, Simulation time units and precision ,Verilog's timescale directive, Time values with time units , Scope-level time unit and precision , Compilation-unit time units and precision. **10 Hrs**

Unit-II

System Verilog Literal Values and Built-in Data Types: Enhanced literal value assignments 'define enhancements, System Verilog variables, Using 2-state types in RTL models ,2-state type characteristics , Relaxation of type rules, Signed and unsigned modifiers, Static and automatic variables, Deterministic variable initialization, Type casting, Constants System Verilog User-Defined and Enumerated Types, User-defined types, Enumerated types. **07 Hrs**

Unit-III

System Verilog Arrays, Structures and Unions: Structures. Unions , Arrays , The foreach array looping construct X, Array querying system functions, The $bits "sizeof" system function ,Dynamic arrays, associative arrays, sparse arrays and strings. **System Verilog Procedural Blocks, Tasks and Functions:** Verilog general purpose always procedural block, System Verilog specialized procedural blocks, Enhancements to tasks and functions **08 Hrs**

Unit-IV

Verification Guidelines: The Verification Process, The Verification Methodology Manual , Basic Test bench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus , What Should You Randomize?, Functional

Coverage , Test bench Components, Layered Test bench , Building a Layered Test bench ,.12 Simulation Environment Phases, Maximum Code Reuse, Test bench Performance. **07 Hrs**

Unit-V

Connecting the Test bench and Design: Separating the Test bench and Design, The Interface Construct, Stimulus Timing, Interface Driving and Sampling, Program Block Considerations, Connecting It All Together, Top-Level Scope, Program–Module Interactions, System Verilog Assertions, The Four-Port ATM Router, The Ref Port Direction. **07 Hrs**

Reference Books:

1) Stuart Sutherland, Simon Davidmann, PeterFlake, Foreword by Phil Moorby "System Verilog For Design A Guide to Using System Verilog for Hardware Design and Modeling", Second Edition, Springer Publications,2006
2) Chris Spear and Greg Tumbush "System Verilog for Verification A Guide to Learning the Testbench Language Features", Third edition, Springer Publications,2012
3) Mark Zwolinski "Digital System Design with System Verilog", Pearson Education, 2009
4) Mike Mintz, Robert Ekendahl, "Hardware Verification with System Verilog: An Object-Oriented Framework", Springer Publications, 2007.

18UECE611	**Advanced Digital System Design**	**(3-0-0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses mainly on design of advanced digital systems using finite state machines (FSM) charts. It also discusses the implementation of advanced digital circuits on programmable devices of varied complexity.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Elaborate** the various concepts of digital circuit design.	1	2,14	-
CO-2	**Develop** various models for arithmetic operations and sequential digital system designs.	-	1, 2, 3, 14	13

CO-3	**Design** the digital systems using SM Charts and Microprogramming techniques.	-	3, 5,13, 14	1,4
CO-4	**Realize** digital system design using Field Programmable Gate Arrays.	-	2,3,13	1
CO-5	**Design** and **Model** various sequential circuits and memories	-	4, 5, 14	1,12

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.6	2	2	1.5	2	-	-	-	-	-	-	1	1.6	2

Pre-requisites: Digital Circuit Design, HDL Programming using verilog

Contents:

Unit-I

Review of Logic Design Fundamentals: Combinational and Sequential Circuits, Boolean Algebra and Algebraic Simplification, Karnaugh Maps, Universal Gates, Hazards in Combinational Circuits, Flip-Flops and Latches, Fundamentals of Moore and Mealy Sequential Networks, Timings, Set-up and Hold Times, Synchronous Designs, Tristate Logic and Busses, Examples. **07 Hrs**

Unit-II

Design Examples: BCD to 7-Segment Display Decoder, A BCD Adder, 32-Bit Adders, Traffic Light Controller, State Graphs for Control Circuits, Scoreboard and Controller, Synchronization and Debouncing, A Shift-and-Add Multiplier, Array Multiplier, A Signed Integer/Fraction Multiplier, Keypad Scanner, Binary Dividers, Problems **09 Hrs**

Unit-III

SM Charts and Microprogramming: State Machine Charts, Derivation of SM Charts, Realization of SM Charts, Implementation of the Dice Game, Microprogramming, Linked State Machines, Problems **07 Hrs**

Unit-IV

Designing with Field Programmable Gate Arrays: Implementing Functions in FPGAs, Implementing Functions Using Shannon's Decomposition, Carry Chains in FPGAs, Cascade Chains in FPGAs, Examples of Logic Blocks in Commercial FPGAs, Dedicated Memory in FPGAs, Dedicated Multipliers in FPGAs, Cost of Programmability, FPGAs and One-Hot State Assignment, FPGA Capacity: Maximum Gates versus Usable Gates, Design Translation (Synthesis), Mapping, Placement, and Routing. **08 Hrs**

Unit-V

Sequential Basics: Storage Elements, Shift Registers, Latches, Sequential Datapaths and Control, Finite-State Machines.
Memories: General Concepts, Memory Types, Asynchronous Static RAM, Synchronous Static RAM, Multiport Memories, Dynamic RAM, Read-Only Memories, Error Detection and Correction. **08 Hrs**

Reference Books:

1) Charles H. Roth, Jr., Lizy Kurian John, Byeong Kil Lee, "Digital Systems Design Using Verilog", First Edition, Cengage Learning, 2014.
2) Peter J. Ashenden. "Digital Design: An Embedded Systems Approach Using Verilog, Elsevier, 2010.
3) Samir Palnitkar, "Verilog HDL", 2/e, Pearson Education, IEEE 1364-2001 Compliant, 2015.
4) Nazeih M Botros, "HDL Programming, VHDL and Verilog", Deamtech Press, 2007.

18UECE612 Image Processing & Computer Vision (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course introduces to the concepts of image processing and computer vision. Topics covered include radiometry, colors, various image enhancement techniques, detection of discontinuities, edge linking and boundary detection.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSO (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Describe** the basic radiometric properties and develop models of source geometry	--	1,2	12
CO-2	**Describe** image acquisition system, its representation and human color perception	--	1	12
CO-3	**Apply** suitable image enhancement techniques in spatial and frequency domain	2	1, 3	12
CO-4	**Compare** various restoration techniques	2	1, 13	--
CO-5	**Compare** various image segmentation techniques	--	1,13	--

PO's/PSO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.0	2.66	2	--	--	--	--	--	--	--	--	1	2	--

Pre-requisites: Digital signal processing, Mathematics

Contents:

Unit-I

Radiometry — Measuring light: Light in space, Light at surfaces, Important special cases: Radiosity, Hemisperic reflectance, Lambertian and specular surfaces and models

Sources Shadows and Shading: Radiometric properties of light, Qualitative radiometry, Local shading models, Photometric stereo. **08 Hrs**

Unit-II

Colors: The physics of color, Human color perception, Representing color, Surface color from image color.

Digital Image Fundamentals: Image sensing and acquisition, Image sampling and quantization, Basic relationship between pixels, Linear and non-linear operations. **08 Hrs**

Unit-III

Intensity Transformation: Basic intensity transformation functions, Image negatives, Contrast stretching, Histogram processing, Histogram equalization, Enhancement using arithmetic and Logic operations.

Spatial and Frequency Filtering: Spatial Filter Masks, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods, Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering. **08 Hrs**

Unit-IV

Fundamentals of Image Restoration: Introduction, noise models, Restoration in the presence of noise, Linear position invariant degradation, Degradation function.

Image Restoration Filters: Spatial filtering, Periodic noise reduction by frequency domain filtering, Inverse filtering, Minimum mean square error filtering,

Constrained least squares filtering, Geometric mean filter, Geometric transformations. **08 Hrs**

Unit-V

Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding.

Advanced Topics in Segmentation: Region-based segmentation, Segmentation using morphological watersheds, Use of motion in segmentation. **07 Hrs**

Reference Books:

1) C Gonzalez and Richard E Woods, Rafael, "Digital Image Processing", 3/e, Pearson Education, 2005.
2) K.P.Soman, "Digital Signal & Image Processing", 1/e edition, Elsevier India, 2012
3) David Forsyth and Jean Ponce, "Computer Vision, A modern Approach ", 2/e, Pearson Education, 2012.
4) Richard Szeliski, "Computer Vision: algorithms and applications ", 1/e, Springer-Verlag London Limited 2010

18UECE613 Operating System (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on basic components of a computer operating system, and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the services, system calls, process, inter process communication and should be able to **solve** process scheduling problems.	3	1, 2	-
CO-2	**Understand** the process synchronization, critical section, deadlock and **solve** related problems.	-	1, 2,3	14

CO-3	**Illustrate** various ways of main memory organization, techniques of Memory allocation and Paging.	-	3,12	-
CO-4	**Elaborate** the demand paging, File accessing methods, directory structure and solve page replacement problems.	-	3,14	-
CO-5	**Summarize** the disk allocation, scheduling and space management.	-	2,	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	2	2.25	-	-	-	-	-	-	-	-	2	-	1.5

Pre-requisites: Computer organization, Programming fundamentals.

Contents:

Unit-I

Process Scheduling: Introduction to Operating System (OS), OS Services, System calls, Process concept, Process scheduling, Operation on processes, cooperating processes, Inter process communication. CPU scheduling- Basic concepts, scheduling criteria, Scheduling algorithms. **08 Hrs**

Unit-II

Process issues: The Critical section problem, Synchronization hardware, Semaphores, problems of synchronization, Critical regions. Deadlock - System model, Deadlock characterization, Methods for handling deadlocks - Deadlock prevention, deadlock avoidance, Deadlock detection and solution for deadlock. **09 Hrs**

Unit-III

Main Memory Management: Overview, Main memory management- Background, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging. **07 Hrs**

Unit-IV

Virtual memory: Background, Demand paging, Process creation, Page replacement algorithms, Allocation of frames, thrashing. File System interface - File concept, Access methods, Directory structure, File system mounting, File system implementation. **08 Hrs**

Unit-V

Secondary Memory Management: Directory implementation, Allocation methods and free space management. Mass storage structures – Disk structure, Disk scheduling methods, Disk management, Swap space management**.** **07 Hrs**

Reference Books:

1) Abraham Silberschatz, Peter Baer Galvin, Greg Gagne – "Operating System Concepts", 6thedition, John Wiley & Sons.
2) Milan Milankovic, "Operating system concepts and design", 2ndEdition, McGraw-Hill.
3) Harvey M. Deital , "Operating systems", Addison Wesley Publications.
4) D.MDhamdhere, "Operating systems - A concept based Approach", Tata McGraw-Hill the Operating systems.

18UECE620	Speech Processing	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on speech production, perception mechanism, their mathematical modeling and study of acoustic phonetics. It deals with various speech processing techniques in time and frequency domains. Concept of Homomorphic and Linear Predictive Coding analysis is also covered in the course.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Understand** acoustic phonetics, speech production and perception mechanism and **develop** mathematical models	1	2,3	5,12
CO-2	**Describe** various parameters of speech signal in time domain	-	1	5,12
CO-3	**Analyze** speech signal in Frequency domain	1,2	-	5,12
CO-4	**Apply** Homomorphic transformation to measure speech signal parameters	-	1,2,3	5,12
CO-5	**Analyze** speech signal using linear predictive coding	-	1,2,3	5,12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Mapping Level	2.4	2.2	2	-	1	-	-	-	-	-	-	1.0	--	-

Pre-requisites: Digital Signal Processing

Contents:

Unit-I

Production, perception and classification of speech sounds: Introduction, mechanism of speech production, mechanism of hearing, acoustic phonetics, digital models for speech production - vocal tract, radiation, excitation, the complete model. **07 Hrs**

Unit-II

Time-domain methods for speech processing: Time dependent processing of speech, short-time energy and average magnitude, short-time average zero crossing rate, speech vs. silence detection, pitch period estimation using parallel processing approach, short-time autocorrelation function, short time average magnitude difference function, pitch period estimation using autocorrelation. **09 Hrs**

Unit-III

Short time Fourier analysis: Introduction, spectrographic displays, analysis by synthesis, pitch synchronous spectrum estimation, pole zero analysis, analysis synthesis systems - phase vocoder and channel vocoder. **07 Hrs**

Unit-IV

Homomorphic speech processing: Introduction, homomorphic systems for convolution, the complex cepstrum of speech, pitch detection, formant estimation, homomorphic vocoder. **08 Hrs**

Unit-V

Linear predictive coding of speech: Basic principles of linear predictive analysis, solution of LPC equations, frequency domain interpretation of linear predictive analysis, relationship between various speech parameters. **08 Hrs**

Reference Books:

1) L. R. Rabiner and R. W. Schafer, “Digital Processing of Speech Signals", Pearson Education, 2004.
2) Lawrence Rabinar and B. Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
3) D. O’Shaughnessy, “Speech Communications: Human and Machine,” Universities Press, 2001.

4) B. Gold and N. Morgan, “Speech and Audio Signal Processing: processing and perception of speech and music”, Pearson Education 2003.

18UECE621	Robotics	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on the theory and design principles of Robotics. The course deals with utilization of Sensors, Actuators, Kinematics, Motion and Trajectory planning used in Robotics.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** the different parameters of Robot and **Classify** the Robots on the considerations.	2	4	-
CO-2	**Develop** an understanding of specifications of robot and **choose** appropriate sensors, actuators and Processing platform.	2,3	4	12
CO-3	**Rephrase** the Kinematics of the robot, **understand** and **analyze** the kinematics using suitable model	4	2	5
CO-4	**Understand analyze and build** differential motion-oriented robots.	1,2,3,4,13, 14	-	5,7,10,1 1,12
CO-5	Perform **analysis** of dynamic forces motions, trajectory and achieve required goals by suitable **design**.	13,14	-	5,7,10,1 1,12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2.75	3	2.5	1	-	1	-	-	1	1	1	3	3

Pre-requisites: Microprocessors / Controllers, Embedded System Design

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Contents:

Unit-I

Introduction: Brief History of Robotics, Working Definition of Robot, Growth of the Industry

Types of Robots: Classification by Degrees of Freedom, Classification by Robot Motion, Classification by Platform, Classification by Power Source, Classification by Intelligence, Classification by Application Area **08 Hrs**

Unit-II

Introduction to Robot Mechanics: Robot Arm Kinematics, End-Effectors, Dynamic Considerations, Obstacle Avoidance, Robot Electronic Subsystems, Robot External Sensing Systems, Motor System Design, Servo System Design, Hall-Effect Technology, Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Actuators, Pneumatic Devices, Electric Motors , Microprocessor Control of Electric Motors, Magnetostrictive Actuators, Shape-Memory Type Metals, Electroactive Polymer Actuators **08 Hrs**

Unit-III

Kinematics of Robots:, Position Analysis Robots as Mechanisms ,Conventions, Matrix Representation, Homogeneous Transformation, Matrices, Representation of Transformations, Inverse of Transformation Matrices, Forward and Inverse Kinematics of Robots Forward and Inverse Kinematic Equations: Position, Forward and Inverse Kinematic Equations: Orientation, Forward and Inverse Kinematic, Equations: Position and Orientation, Denavit-Hartenberg Representation of Forward Kinematic Equations of Robots, The Inverse Kinematic Solution of Robots, Inverse Kinematic Programming of Robots, Degeneracy and Dexterity, The Fundamental Problem with the Denavit-Hartenberg Representation Design Projects **08 Hrs**

Unit-IV

Differential Motions and Velocities, Differential Relationships, Jacobian, Differential versus Large-Scale Motions, Differential Motions of a Frame versus a Robot, Differential Motions of a Frame, Differential Translations, Differential Rotations about the Reference Axes ,Interpretation of the Differential, Change, Differential Changes between Frames, Differential Motions of a Robot and its Hand Frame, Calculation of the Jacobian, How to Relate the Jacobian and the Differential Operator, Inverse Jacobian, Design Projects **07 Hrs**

Unit-V

Dynamic Analysis and Forces Introduction , Lagrangian Mechanics: A Short Overview , Effective Moments of Inertia , Dynamic Equations for Multiple-DOF Robots , Kinetic Energy , Potential Energy , The Lagrangian , Robot's Equations of Motion , Static Force Analysis of Robots ,Transformation of Forces and Moments between CoordinateFrames , Design Project Trajectory Planning Introduction, Path versus Trajectory ,Joint-Space versus Cartesian-Space, Descriptions , Basics of Trajectory Planning , Joint-Space Trajectory Planning , Cartesian-Space Trajectories , Continuous Trajectory Recording Design Project **08 Hrs**

Reference Books:

1) Harry H. Poole, "Fundamentals of Robotics Engineering", Springer Publication,1989.
2) Saeed Benjamin Niku, "Introduction to Robotics Analysis, Control, Applications", Second Edition, Wiley Publication, 2011
3) Ashitawa Goshal, "Robotics Fundamental Concepts and Analysis", Ninth Impression, Oxford University Press,2013.
4) Robert J. Schilling, "Fundamentals of Robotics Analysis and Control", Prentice Hall of India, 2003

18UECE622 Data Structures using C++ (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course deals with the basics of data structures. Linked lists, stack, queues and trees etc. are included. An introductory chapter on pointers helps in the knowledge of data structures. Real life examples enhance the effectiveness of the course.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Apply** various concepts of C++ such as Arrays, Strings, Structures, Unions, Files, Pointers and Functions in solving problems.	-	1,2,13	3
CO-2	**Understand and Implement** the operational aspects of linked lists (using pointers) such as creation,	-	1,2,3	5,12

	insertion, deletion and searching in problem solving.			
CO-3	**Realize and Implement** the operational aspects of stack in problem solving using Arrays and Pointers.	-	1,2,3	12
CO-4	**Implement** the operational aspects of queue in problem solving using Arrays and Pointers**.**	-	1,2,3	5,12
CO-5	**Implement** the operational aspects of trees using Arrays and Pointers, and Hash concept in problem solving.	-	1,2,3	5,12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	1.8	-	1	-	-	-	-	-	-	1	2	-

Pre-requisites: Object Oriented Programming using C++

Contents:

Unit-I

Structure, unions and Pointer Revisit: Motivation for using structures. Pointer, access data from memory through pointer, pointer to structures. Motivation for dynamic memory requirement. Realizing arrays using pointer and dynamic memory allocation. Importance of memory management during allocation and de-allocation of memory. **07 Hrs**

Unit-II

Lists: Constructing dynamic data structures using self-referential structure (using the same realized linked Lists), operations on lists. Doubly Linked list. Application of Lists in sorting. **08 Hrs**

Unit-III

Stack: Realization of stack and its operations using static and dynamic structures. Application of stack in converting an expression from infix to postfix and evaluating a postfix expression, Heterogeneous stack using Unions. **08 Hrs**

Unit-IV

Queues: Realization of queues (FIFO, Double-ended queue, Priority queue) and its operations using static and dynamic data structures. **07 Hrs**

Unit-V

Trees: Types of trees and their properties, Realization of trees using static and dynamic data structures. Operations on Binary trees and their application in searching (BST and AVL Tree), Binary heap as priority.

Hash Table: Realizing effective hash table with proper data structure and hash function, its application. **09 Hrs**

Reference Books:

1) Aaron M. Tenenbaum, Yedidyah Langsam and Moche J. Augenstein, "Data Structures using C & C ++" , Pearson Education / PHI, 2006
2) E. Balagurusamy, "Programming in ANSI C", 4th edition, Tata McGraw Hill, 2008.
3) Behrouz A. Foruzan and Richard F. Gilberg, "Computer Science: A Structured Programming Approach Using C", 2nd edition, Thomson, 2003.
4) Robert Kruse and Bruce Leung, "Data structures and Program Design in C", Pearson Education, 2007.

18UECE623 Artificial Intelligence (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focusses on overview of the main concepts in Artificial Intelligence (AI), algorithms applied in construction of intelligent systems, agents, problem solving, search, representation, reasoning, planning, communication, perception, robotics and neural networks.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Discuss** the basic concepts and characteristics of AI with illustrations of current state of the art research, solving real world problems with searching approaches.	14	2,3,4	1
CO-2	**Explain** the strengths and limitations of various state-space search algorithms along with knowledge representation, planning and	11	1,2,3,4	13

	constraint management.			
CO-3	**Identify** the type of an AI problem with search inference, decision making under uncertainty, game theory, etc.	-	2,5	13
CO-4	**Apply** basic principles of AI in solutions that require different forms of learning and decision trees.	-	6,12,14	-
CO-5	**Demonstrate** different language models, steps in Natural language Processing (NLP) and expert systems.	-	14	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.5	2	3	4	2	2					3	2	1	2

Pre-requisites: Discrete Mathematics, basic probability theory and Statistics Knowledge of any programming language and data structures.

Contents:

Unit-I

Introduction: Introduction and Intelligent systems, What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications of A.I. Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, How the components of agent programs work.

Solving Problems by Searching: Study and analysis of various searching algorithms. Implementation of Depth-first search Problem Solving Agents, Searching for Solutions, Uninformed and informed Search Strategies. **09 Hrs**

Unit-II

Local Search Algorithms and Optimization Problems: Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Introduction to adversarial Search and constraint satisfaction problems with examples.

Logical Agents: Knowledge agents, first-Order Logic, Inference to First-Order Logic, Classical planning, Planning and acting in the real world, knowledge representation. **08 Hrs**

Unit-III

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees. **07 Hrs**

Unit-IV

Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, inducing decision trees from examples. **08 Hrs**

Unit-V

Natural Language Processing: Language Models, Steps in NLP, Syntactic Analysis (Parsing), Semantic interpretation, Discourse and pragmatic Processing, Text Classification. Discourse and pragmatic 24 Processing, Implementation aspects of Syntactic Analysis (Parsing)

Expert Systems: What is Expert system, Components of Expert System, Case studies on Expert System. **07 Hrs**

Reference Books:

1) Stuart Russell, Peter Norvig**,** "Artificial Intelligence: A Modern Approach" by Pearson 3rd Edition, 2015.
2) Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", Tata McGraw-Hill Education Pvt. Ltd, 3rd Edition, 2017.
3) Saroj Kausik, "Artificial Intelligence", Cengage Learning, 1st edition, 2011.
4) N P Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2005.

18UECO630	Cryptography	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on study of encryption/ decryption algorithms of different symmetric and asymmetric cryptographic techniques, Hash functions, Message authentication codes & Digital signature algorithms. To understand the various key distribution and management schemes.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** security services, security threats and mechanisms to counter them and **Analyze** different classical encryption and decryption techniques.	2	1,4	-
CO-2	**Analyze** different symmetric cryptographic standards and modular arithmetic concept.	2	1	4
CO-3	**Evaluate** advanced encryption standard (AES).	2	-	4
CO-4	**Apply** the concepts of private and public key encryption techniques and Key Management.	-	4,14	2
CO-5	**Demonstrate** different authentication and digital signature algorithms and **Illustrate** Elliptic curve arithmetic.	1	4,14	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.3	2.5	-	1.6	-	-	-	-	-	-	-	-	-	2

Pre-requisites: Communication networks and finite fields.

Contents:

Unit-I

Introduction and Classical Encryption Techniques: ISO-OSI Model, Services, Mechanisms and attacks, OSI security architecture, Model for network security, Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machines, Steganography. **07 Hrs**

Unit-II

Block Cipher and Encryption Standards: Simplified DES, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher modes of operation, Finite fields of the form GF(2^n). **08 Hrs**

Unit-III

Advanced Encryption Standard: Evaluation criteria for AES, The AES Key expansion, transformation functions. **07 Hrs**

Unit-IV

Public Key Cryptography and Key Management: Principles of public key cryptosystems, RSA algorithm, Key management, Diffie-Hellman key exchange. **08 Hrs**

Unit-V

Elliptic Curve Arithmetic and Message Authentication: Elliptic curve arithmetic, Elliptic curve cryptography, Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MAC's, Digital signature, Digital signature standard. **09 Hrs**

Reference Books:

1) William Stallings, "Cryptography and Network Security," 4/e, Pearson Education (Asia) Pte. Ltd. / Prentice Hall of India, 2011.
2) Behrouz A. Forouzan, "Cryptography and Network Security", TMH, 3rd Edition, 2015.
3) AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
4) Bernard Menezes, "Network Security and Cryptography", Cengage Learning, Cengage Learning India Pvt. Ltd, Second Impression 2011.

18UECO631	Soft Computing	(3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on various aspects of soft computing paradigm like the neural networks, fuzzy logic and genetic algorithms. Each aspect will be explained with the help of suitable applications. Real life examples enhance the effectiveness of the course.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1,12) / PSOs (13, 14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Design and analyze** neural network system for different applications.	-	1,2,13	3
CO-2	**Understand and Implement** the	-	1,2,3	12,5

	operational aspects of unsupervised learning networks.			
CO-3	**Understand** the basics of fuzzy logic.	-	1,2,3	12
CO-4	**Classify** the given data set, and identify using the fuzzy algorithms.	-	1,2,3	12,5
CO-5	**Solve** the optimization problems using genetic algorithms.	-	1,2,3	12,5

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	1.8	-	1	-	-	-	-	-	-	1	2	-

Pre-requisites: Basics of Set theory

Contents:

Unit-I

Introduction: Neural networks, application scope of neural networks, fuzzy logic, genetic algorithm, hybrid systems, soft computing, Fundamental concepts and evolution of neural networks, basic models, important terminologies of ANNs, McCulloch-Pitts neuron, linear separability, Hebb network. Supervised learning networks: Introduction, perceptron networks, adaptive linear neuron (Adaline), multiple adaptive linear neuron, back-propagation network. **09 Hrs**

Unit-II

Unsupervised Learning Networks: Introduction, fixed weight competitive nets, Kohonen self-organizing feature maps, learning vector quantization, counter propagation networks, adaptive resonance theory network. **09 Hrs**

Unit-III

Introduction to Fuzzy Logic: Fuzzy logic, classical sets (Crisp Sets), fuzzy sets. Classical relations and fuzzy Relations: Introduction, Cartesian product of relation, classical relation, fuzzy relation, tolerance and equivalence relations, Membership Functions: Introduction, features, fuzzification, methods of membership value assignments. De-fuzzification: Introduction, lambda-cuts for fuzzy sets (Alpha-Cuts), lambda-cuts for fuzzy relations, defuzzification methods.

06 Hrs

Unit-IV

Fuzzy Classification: Classification by equivalence relations, cluster analysis and validity, hard c-Means clustering (HCM), fuzzy c-Means clustering (CM), classification metric, hardening the fuzzy c-partition.

Fuzzy Pattern Recognition: Feature Analysis, partitions of the feature space, single-sample identification **06 Hrs**

Unit-V

Genetic Algorithm: Introduction, biological background, traditional optimization and search techniques, genetic algorithms and search space, genetic algorithm vs. traditional algorithms, basic technologies in genetic algorithm, simple GA, general genetic algorithm, operators in genetic algorithm, stopping condition for genetic algorithm flow, constraints in genetic algorithm, problem solving using genetic algorithm, the schema theorem, classification of genetic algorithm. **09 Hrs**

Reference Books:

1) S. N. Sivanandam, S. N. Deepa, "Principles of Soft Computing", Wiley Publications, Second Edition-2011.
2) Laurene Fausette, "Fundamentals of Neural Networks", Pearson Education, New Delhi, 2007.
3) Rajasekaran S. And VijayalakshmiPai G A, "Neural Networks, Fuzzy logic and Genetic Algorithms: Synthesis and Applications", PHI Learning, New Delhi, 2006.
4) Eiji Mizutani, Chuen Tsai Sun, JyhShing Roger Jang, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", Pearson Education, New Delhi, 2008.

18UECO632 Automotive Electronics (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on Electronic Engine control system, construction and operation of sensors and actuators, role of electronics in vehicle motion control, instrumentation and advanced features for safety and comfort in vehicles.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** various parts and operation of automobile system, electronic control system and microcomputer system.	-	1	-
CO-2	**Explain** and **apply** control system approach to Engine control and **define** various performance parameters.	3	7	2

CO-3	**Describe** the construction and operation of various sensors and actuators used in automotive control applications.	-	5	13
CO-4	**Analyze** and **Explain** vehicle motion control system and automotive instrumentation systems.	-	2	14
CO-5	**Describe** various advanced electronic features, communication protocols and diagnostics	6	4	12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.0	1.5	3.0	2.0	2.0	3.0	2.0	-	-	-	-	1.0	1.0	1.0

Pre-requisites: Basics of Automobiles and Engines, Analog and Digital Electronic Circuits, Control systems and microcontrollers.

Contents:

Unit-I

Automotive Fundamentals: Evolution of Automotive Electronics, Automobile Physical configuration, The SI Engine and its operation, Engine control, Ignition system, Diesel Engine, Hybrid vehicle configuration, Drive Train, Brakes, Suspension, Steering System

Control System Approach: Open loop and closed loop control systems, Proportional Controller, Proportional-Integral controller, Closed Loop Limit Cycle control**.**

Microcomputer Systems: Microcontroller applications in automotive systems, Instrumentation applications of microcomputers, Microcomputers in control systems. **08 Hrs**

Unit-II

Basics of Electronic Engine Control: Motivation for electronic engine control, Government Test procedures, Concept of an electronic engine control system, Definition of General Terms and Engine performance terms, Engine Mapping, Control Strategy, Electronic fuel control system, Analysis of intake manifold pressure, Idle speed control, Electronic Ignition. **08 Hrs**

Unit-III

Sensors and Actuators: Control system applications of sensors and actuators, Airflow rate sensors, Engine Crankshaft angular position sensors, Throttle angle sensor, Temperature Sensors, Sensors for feedback control, Knock sensors, Engine control actuators, variable valve Timing. **08 Hrs**

Unit-IV

Vehicle Motion Control: Typical Cruise control system, Cruise control electronics, Antilock braking System, Electronic Suspension system, Electronic steering control.

Automotive Instrumentation: Modern Automotive Instrumentation, Input and Output Signal Conversion, Sampling, Fuel Quantity measurement, Coolant Temperature measurement, Oil Pressure measurement, Vehicle Speed measurement. **08 Hrs**

Unit-V

Advanced Automotive Electronic Systems: Occupant Protection Systems, Collision avoidance RADAR warning system, Low Tyre-pressure warning system, Sensor and Control Signal Multiplexing, Navigation.

Communication Protocols: CAN protocol, LIN protocol. **07 Hrs**

Reference Books:

1) William B. Ribbens, “Understanding Automotive Electronics”, 6/e, Newnes,2003
2) A. K. Babu, “ Automotive Electrical and Electronics”, 2/e, Khanna publishing,2016
3) Tom Denton, “Automobile Electrical and Electronic Systems”, 5/e, Institute off Motor Industry, 2017
4) Najamuz Zaman, “Automotive Electronics Design Fundamental’’ first edition, Springer 2015.

18UECO633	Multimedia Communication	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on multimedia signals and their representation, signal compression, standards and protocols followed in representing and transmitting these signals.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Understand and Examine** representation of different media and their formats along with their authoring, versioning and management	2,4	-	-
CO-2	**Justify** the need for compression and **Select** the appropriate compression standard depending upon requirement **analysis**.	1,2,4	3-	12
CO-3	**Understand and deploy** Compression standards with respect to Image, Graphics, Video and Audio	2,4	13,14	12
CO-4	**Explain** various networks and techniques used for multimedia communication	-	3,4,13	14
CO-5	**Identify** and **explain** multimedia communication applied in various entertainment networks	-	3,4,13	6,14

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	2	2	-	1	-	-	-	-	-	1	2	1

Pre-requisites: Digital Signal Processing, Information Theory and Coding

Contents:

Unit-I

Media Representation and Media Formats : Digital Images, Digital Video, Digital Audio ,Graphics, Color Theory The Color Problem , Trichromacity Theory , Color Calibration , Color Spaces , Gamma Correction and Monitor Calibration, Requirements for Multimedia Authoring Tools , Intramedia Processing , Intermedia Processing , Multimedia Authoring Paradigms and User Interfaces , Role of User Interfaces , Device-Independent Content Authoring , Distributed Authoring and Versioning , Multimedia Services and Content Management , Asset Management **08 Hrs**

Unit-II

Overview of Compression : The Need for Compression , Basics of Information Theory , A Taxonomy of Compression , Lossless Compression , Lossy Compression , Practical Issues Related to Compression Systems.

Media Compression: Images, Redundancy and Relevancy of Image Data, Classes of Image Compression Techniques, Lossless Image Coding, Transform Image Coding , Wavelet Based Coding (JPEG 2000) , Fractal Image Coding , Transmission Issues in Compressed Images , The Discrete Cosine Transform **08 Hrs**

Unit-III

General Theory of Video Compression: Types of Predictions, Complexity of Motion Compensation , Video-Coding Standards , VBR Encoding, CBR Encoding, and Rate Control , A Commercial Encoder, The Need for Audio Compression , Audio-Compression Theory , Audio as a Waveform , Audio Compression Using Psychoacoustics , Model-Based Audio Compression , Audio Compression Using Event Lists , Audio Coding Standards **08 Hrs**

Unit-IV

Graphics Compression :The Need for Graphics Compression , 2D Graphics Objects, 3D Graphics Objects, Graphics Compression in Relation to Other Media Compression, Mesh Compression Using Connectivity Encoding, Mesh Compression Using Polyhedral Simplification, Multiresolution Techniques—Wavelet-Based Encoding, Progressive Encoding and Level of Detail ,3D Graphics Compression Standards **07 Hrs**

Unit-V

The OSI Architecture: Local and Wide Area Networks, Modes of Communication, Routing , Multimedia Traffic Control , Multimedia Networking Performance and Quality of Service

Multimedia Communication Standards and Protocols: Wireless Versus Wired Technology, History of Wireless Development , Basics of Wireless Communications , Wireless Generations and Standards , Wireless Application Protocol (WAP) ,Problems with Wireless Communication , Quality of Service (QoS) over Wireless Networks , 2G, 3G, and Beyond 3G **08 Hrs**

Reference Books:

1) Parag Havaldar, Gerard Medioni, “Multimedia Syatems Algorithms Standards and Industry Practices”, Cengage Publication, 2010.
2) Ralf Steinmetz, KlaraNarstedt, “Multimedia Fundamentals - Media Coding and Content Processing”, vol.1, Pearson Education, 2004.

3) Nalin K. Sharda, "Multimedia Information Networking", PHI, 2003.
4) Fred Halsall, " Multimedia Communications-Applications, Networks, Protocols and Standards", Pearson Education, Asia, Second Indian reprint, 2002.

18UMAO675 Applied Mathematics (3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about mathematical modelling, use of numerical techniques to deal with engineering systems. Further, they need to learn LPP and statistical tools for interpretation. They are also expected to carry out sampling distribution analysis and use of graph theory for engineering problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	ObtainMathematical model of Engineering Systems using different domains.		1,2	
CO-2	FormulateLPP and obtain optimal solutions using different tools.		1,2	
CO-3	Applystatistical tools to Interpret the data using different tools.		1,2	
CO-4	DetermineType errors and test for goodness of fit usingdifferent methods.		1,2	
CO-5	Usegraph theory to obtain solution for engineering problems.		1,2	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	2	2	-	-	-	-	-	-		-	-	-

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Pre-requisites:
A basic course on the concepts of algebra, geometry, calculus, trigonometry and laws of physics, Statistical averages and probability theory.

Contents:

Unit-I

Introduction to Mathematical Modelling and Numerical Techniques: Introduction, Modelling technique, classification and characteristics. Mathematical modelling through algebra, geometry, calculus, trigonometry. Mathematical model of engineering system. 8 Hrs.

Unit-II

Linear and Non-Linear programming :
Introduction, Mathematical formulation of a L.P.P, basic solution. Geometric (or graphical) method, Simplex method.Assignment problem. Non Linear Programming – Constrained extremal problems-Lagrange's multiplier method-Kuhn- Tucker conditions and solutions. 8 Hrs.

Unit-III

Statistical Techniques : Co-efficient of Variation, Skewness, Karl Pearson's co-efficient of Skewness, Moments, Pearson's Beta and Gamma co-efficient, Kurtosis. Time series and Forecasting. 7 Hrs.

Unit-IV

Sampling distribution: Introduction, population and samples. Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square Distribution as a test of goodness of fit. 8 Hrs.

Unit-V

Graph Theory: Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, basic properties of trees, Binary trees, Preorder and post order traversals, Spanning and Minimal spanning trees, Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs, Matrix representation of graphs, adjacency and incidence matrix Graph theoretical algorithms: Dijkstra, Prims and Kruskal. 8 Hrs**.**

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th edition,2017.
2. E. Kreyszig Advanced Engineering Mathematics John Wiley & Sons,10 edition, 2016.
3. Srimanta Pal et al, Engineering Mathematics, Oxford University Press, 3rd edition, 2016.
4. Dougas B. West, Introduction to Graph theory, second edition, PHLearnig Private Limited, 2009.

18UECL602	Embedded Systems Laboratory	(0-0-3)1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on embedded systems design and development. Hardware-software co design process is explored in real-time system design.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Realize** embedded system design using Integrated Development Environment (IDE).	-	1,5	3,7
CO-2	**Develop** simple embedded C applications using RTOS-APIs.	2,5	3	7,12
CO-3	**Construct** embedded systems using sensors and actuators.	2,13,14	4,5	7,9, 12
CO-4	**Execute** basic IoT applications on embedded platform.	1,2,14	4,5,13	9,6
CO-5	**Realize** communication protocols used in embedded systems.	5	13,14	4

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.5	3	1.5	1.6	2.4	1	1	-	1	-	-	1	2.3	2.6

List of Experiments:

1. Sample Embedded C-programs.
2. Develop Embedded C-Program for the following interfacing examples
   a. ADC and DAC.
   b. LED and PWM.
   c. Real time clock and serial port.
   d. Keyboard and LCD.
   e. EPROM and interrupt.
3. Demonstrate Inter-Process Communication using Mailbox.
4. Interrupt performance characteristics of ARM Controllers.
5. Write a C program to blink LEDs on ARM Controller board.
6. Develop a system to rotate a stepper motor by 180^0 when temperature is above set threshold.

7. Develop a system to rotate a DC motor with different rpm depending upon temperature.
8. Implement Communication protocol on ARM Controllers.
9. Local processing on the sensor nodes
10. Develop a sample IoT application by connecting devices to the cloud and vice Versa

Reference Books:

1) Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes, (Elsevier), 2010.
2) Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd edition.
3) Andrew N. Sloss “Arm System Developer’s Guide” Elsevier Inc. 2004 edition, Morgan Kaufmann Publishers.
4) James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008, ISBN: 978-0-471-72180-2.
5) Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language andC”, 2nd E -Man Press LLC ©2015
6) Embedded real time systems by K.V. K. K Prasad, Dreamtech publications, 2003.

18UECL603	VLSI Laboratory	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on exploring the theoretical concepts studied as part of subjects, CMOS VLSI Design and Analog and Mixed Mode VLSI Design in practical with the help of Cadence tool framework. The lab introduces the complete custom IC design flow and Analog and Mixed Signal (AMS) flow for Analog circuits, Digital circuits and Analog and mixed signal circuits design respectively.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Demonstrate** the working of digital and analog circuits and **apply** the design steps of VLSI flow to build the schematic and layouts of VLSI circuits.	1, 2	5	13

CO-2	**Design** and **perform** the DC and transient analysis on combinational & sequential VLSI circuits.	2	1,5	-
CO-3	**Design** and **Perform** the DRC, LVS and RC extraction of layout designs of combinational & sequential VLSI circuits.	2	1,5	-
CO-4	**Design** analog and mixed signal circuits **and Evaluate their** performance**.**	3,5	13	-
CO-5	**Compare and evaluate** the performance of VLSI circuits.	2	10,13	1,4,14

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.5	3	3	1	2.25	-	-	-	-	2	-	-	1.6	1

List of Experiments:

Draw the Schematic and Layout for the following digital and analog circuits mentioned below with the help of Cadence tool frame work and verify the following.

a. Schematic: i) DC Analysis ii) Transient Analysis iii) Parametric analysis

b. Layout: i) DRC ii) LVS iii) RCX

1. Design CMOS Inverter with given specifications.
2. Design CMOS two input NAND and NOR gates.
3. Design Transmission gate & Multiplexer using transmission gates.
4. Design XOR, AND & OR gates using transmission gates.
5. Design D F/F, SR F/F sequential circuits.
6. Design 2-bit up-down counter using D F/Fs.
7. Design a Common Source Amplifier with resistive load for given specifications.
8. Design a source follower circuit.
9. Design single stage Differential Amplifier with given specifications.
10. Design single stage OPAMP using common source amplifier with resistive load.
11. Design 4 bit R-2R DAC using Op-amp with given specifications.

Reference Books:

1) Sung Mo Kang & Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", 3/e, McGraw-Hill, 2008.
2) Douglas A Pucknell& Kamran Eshragian, "Basic VLSI Design", 3/e, PHI, 2005.
3) Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw-Hill Edition 2008.
4) R. Jacob Baker, Harry W. LI, David E. Boyce, "CMOS Circuit Design, lay out and Synthesis", IEEE press, 2005.

18UECL604	Minor Project-2	(0-0-4) 2

Contact Hours: 30

Course Learning Objectives (CLOs):

Minor project-2 focuses on an exposure to the project work in the domain of their interest by selecting a problem definition from an emerging area. The problem could be defined to develop prototypes for industrial needs.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** and **justify** the technical aspects of the chosen project with a comprehensive and systematic approach.	1	2,4	6,7
CO-2	**Reproduce** and **refine** technical aspects for engineering projects.	2	13	-
CO-3	**Work** as an individual or in a team in development of projects	9	8	-
CO-4	**Implement** the solution in hardware and / or software	3,5	13,14	11
CO-5	**Present** the work in a systematic manner	10	12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2.5	3	2	3	1	1	2	3	3	1	2	2	2

Prerequisites: Knowledge of VLSI, Signal Processing, Analog& Digital Communication and Any Programming Language

Guidelines for Conduction Spirit of the Course:

To ensure that undergraduates successfully apply the knowledge they have gained in different courses and integrate material learnt at different stages of the curriculum up to the 4th semester so as to complete the project work within the stipulated time duration following guidelines are framed.

1. Project groups are formed with 3-4 students in each team.
2. Project coordinators instruct student project batches to submit synopsis in the prescribed format in the field of their choice. In genuine case students can continue their minor project-I for this semester.
3. Project coordinators allot guides based on their field of specialization. However students can have further discussions on the project topic and can modify their project title.
4. Students are instructed to report to their respective guides on weekly basis for discussion.
5. Students are instructed to maintain separate project diary/notebook to show the progress work while having discussion with guide and review committee members.
6. Two reviews are fixed in a semester to monitor the progress of the project.

Assessment: CIE: Project guides evaluate for 30 marks and 20 marks are allotted by reviewers conducting two reviews. 50 marks allotment under CIE. **SEE:** Minor project-2has SEE component and marks allotted for SEE is 50, where students need to demonstrate the project and present it in the presence of examiners.

Note:

- Designated committee is constituted with 2-4 committee members to monitor the process of Mini Project-1
- An internal guide is allotted per group who guides and monitors the project progress.
- Problem statements can be derived from industry, society, etc., after interacting with them.
- Course outcomes (4 or more) are written and mapped to program outcomes and program specific outcomes. In addition to that other POs can also be included if those POs are deemed suitable.
- At the end of the course, students are required to document the project in the form of report.

18UHUL605	Soft skills/Aptitude	(0-0-2) 1

Contact Hours: 24

Course Learning Objectives (CLOs):

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the significance of communication in the profession.	-	10	-
CO-2	**Use** the English language with proficiency	-	10	12
CO-3	**Solve** Aptitude related problems	-	9	12
CO-4	**Demonstrate** the competency in the placement activities.	-	9	-

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	-	-	-	-	-	-	-	-	2.0	2.0	-	1.0	-	-

Contents:

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

Evaluation:

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

Academic Program: UG

Academic Year 2021-22

Syllabus

VII & VIII Semester B.E.

Electronics & Communication Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF

ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Ph: **0836-2447465** **Fax:** **0836-2464638** **Web:** www.sdmcet.ac.in

SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for VII & VIII semester of UG program in Electronics and Communication Engineering is recommended by Board of Studies of Electronics and Communication Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Chairman BOS & HOD Principal

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SDM College of Engineering & Technology, Dharwad-02

Department of Electronics & Communication Engineering

College – Vision and Mission

VISION:

To develop competent professionals with human values

MISSION:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

Department- Vision and Mission

Vision

Fostering excellence in the field of Electronics & Communication Engineering, showcasing innovation, research and performance with continuous Industry – Institute Interaction with the blend of Human values.

Mission

M1: To provide quality education in the domain of Electronics & Communication Engineering through state of the art curriculum, effective teaching learning process and the best of laboratory facilities.

M2: To encourage innovation, research culture and team work among students.

M3: Interact and work closely with industries and research organizations to accomplish knowledge at par.

M4: To train the students for attaining leadership with ethical values in developing and applying technology for the betterment of society and sustaining the global environment.

Program Educational Objectives (PEOs)

The Graduates, after a few years of Graduation will be able to:

I. **Apply** the latest in-depth knowledge in the field of Electronics and Communication Engineering with Mathematical applications to address real life challenges.
II. **Exhibit** the confidence for independent working and / or spirit to work cohesively with group.
III. **Readily** be accepted by the Industry globally.
IV. **Develop** design skills, fault diagnosis skills, communication skills and create research orientation.
V. **Inculcate** professional, social ethics and to possess awareness regarding societal responsibility, moral and safety related issues

Programme Outcomes (POs):

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

13. Design economically and technically sound analog and / or digital systems based on the principles of signal processing, VLSI and communication Engineering (PO-13)

14. Integrate hardware – software, and apply programming practices to realize the solutions in electronics domain. (PO-14)

VII Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UECC700	PC	Antenna & Wave Propagation	4 - 0 - 0	4	50	100	3	-	-
18UECC701	PC	Computer Communication Networks	4 - 0 - 0	4	50	100	3	-	-
18UECE7XX	PE	**Program Elective-IV**	3 - 0 - 0	3	50	100	3	-	-
18UECO7XX	OE	**Open Elective**	3 - 0 - 0	3	50	100	3	-	-
18UECL702	PC	CCN Laboratory	0 - 0 - 2	1	50	--	--	50	3
18UECL703	PC	Major Project Phase-1	0- 0 -4	2	50	--	--	50	3
18UECL704	PC	Internship	4 w e e k s	2	50	--	--	50	3
	Total		**14 - 0 -6**	**19**	**350**	**400**		**150**	

18UECE7XX	PE	**Program Elective-IV**
18UECE710		MEMS
18UECE711		ASIC Design
18UECE712		VLSI DSP Systems
18UECE713		Optical Fiber Communication
18UECO7XX	OE	**Open Elective**
18UECO720		Machine Learning
18UECO721		Pattern Recognition
18UECO722		Multi Core Programming
18UECO723		Mobile Computing

PC- Program Core, PE-Program Elective, OE- Open Elective

VIII Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UECC800	PC	Wireless Communication	4 - 0 - 0	4	50	100	3	-	-
18UECE8XX	PE	**Program Elective-V**	3 - 0 - 0	3	50	100	3	-	-
18UECO8XX	OE	**Open Elective**	3 - 0 - 0	3	50	100	3	--	--
18UECL801	PC	Technical Seminar	0 - 0 - 2	1	50	--	--	--	--
18UECL802	PC	Major Project Phase-2	0-0 -12	7	50	--	--	50	3
	Total		**10- 0 - 14**	**18**	**250**	**300**	**--**	**50**	**--**

18UECE8XX	PE	**Program Elective-V**
18UECE810		Adhoc Wireless Networks
18UECE811		Re-configurable Design
18UECE812		Low Power VLSI Design
18UECE813		Digital Signal Compression
18UECO8XX	OE	**Open Elective**
18UECO820		DSP Architecture
18UECO821		CAD for VLSI
18UECO822		Operation Research
18UECO823		Advanced Computer Architecture

PC- Program Core, PE-Program Elective and OE- Open Elective

VII Semester

18UECC700	Antennas & Wave Propagation	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): The course focuses on the theory and applications of various types of Antennas. Various methods of analysis of antennas are discussed. The properties and characteristics of various types of Antennas are discussed. The course ends with a discussion of various aspects of Radio Wave Propagation.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Discuss** the basics of Antennas.	-	12	1
CO-2	**Analyze** point sources, arrays of point sources and their characteristics.	-	2	-
CO-3	**Derive** field equations for short dipole, small loop and other types of antennas.	4	1,2	-
CO-4	**Discuss** the structures, properties and characteristics of various types of antennas.	1	4	13,5
CO-5	**Discuss** various modes of radio wave propagation.	1	12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.25	2.0	-	3.0	1.0	-	-	-	-	-	-	2.0	2.0	-

Pre-requisites: Electromagnetic Theory

Contents:

Unit-I

Antenna Basics: Introduction, Basic Antenna parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Directivity & Resolution, Antenna apertures, Effective height, Radio Communication link, Fields from oscillating dipole, Antenna Field Zones, Linear, Elliptical & Circular polarization.

09 Hrs

Unit-II

Point Sources And Their Arrays: Introduction, Point Source defined, Power patterns, Power theorem, Radiation intensity, Examples of Power patterns, Field patterns, Phase patterns, Arrays of two Isotropic Point sources, Non-Isotropic but similar Point Sources and Principle of pattern multiplication, Non-isotropic and Dissimilar Point sources, Linear Arrays of n Isotropic Point sources of equal amplitude and spacing. **09 Hrs**

Unit-III

Electric Dipoles And Thin Linear Antennas: Introduction, Short electric dipole, Fields of a short dipole, Radiation resistance of short dipole, Radiation resistance of lambda/2 antenna, Thin linear antenna, Micro strip arrays, Low side lobe arrays, Long wire antenna, Folded dipole antennas.

Loop, Slot, Patch And Horn Antenna: Introduction, Small loop, Comparison of far fields of small loop and short dipole, Loop antenna general case, Far field patterns of Circular Loop, Radiation resistance of loops, Directivity, Slot antennas, Babinet's Principle and Complementary antennas, Impedance of Complementary and Slot antennas, Patch antennas, Horn antennas, Rectangular horn antennas. **12Hrs**

Unit-IV

Antenna Types: Helical antenna, Yagi-Uda array, Corner reflectors, Parabolic reflectors, Log Periodic antenna, Lens antenna, Antennas for special applications – Sleeve antenna, Turnstile antenna, Omni directional antennas, Antennas for ground penetrating radars, embedded antennas, ultra wide band antennas, plasma antenna. **11Hrs**

Unit-V

Radio Wave Propagation: Introduction, Ground wave propagation, Free Space propagation, Ground reflection, Surface wave, Diffraction. Tropospheric propagation: Tropospheric scatter, Ionospheric propagation, Structure of the Ionosphere, Electrical properties of the Ionosphere, Effects of earth's magnetic field, Propagation characteristics of Radio waves for different frequencies, Simple definitions. **11Hrs**

Reference Books:

1. John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan "Antennas for all Applications", 4/e, McGraw-Hill edition, 2010.

2. Harish and Sachidananda, “Antennas and Wave Propagation”, Oxford Press, 2007.
3. C. A.Balanis, “Antenna Theory Analysis and Design”, 3/e,John Wiley India Pvt. Ltd., 2008.,John Wiley, 2003.
4. G. S. N. Raju, “Antennas and Wave Propagation”, Pearson Education, 2005
5. K. D. Prasad “Antenna & Wave Propagation”, Satya Prakashana, New Delhi, 1999.
6. D. Kumaraswamy, M. S. Srinivas, K. Giridhar, “Antennas & Propagation”, Pooja Publications, Bangalore, 2009-10.

18UECC701 Computer Communication Networks (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the process of data communication in computer network through the layered architecture. It also deals with the IEEE standards and various protocols at different layers.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Exploring** layered architecture in OSI and TCP/IP network models and **Explain** the functionalities of layers.	-	1	-
CO-2	**Analyze** and **compare** various protocols for framing, error and flow control and medium access.	1,2	3,14	-
CO-3	**Identify** the IEEE standards for wired and wireless networking and **discuss** the significance of connecting devices in networking.	-	1,3	2
CO-4	**Understand** IPv4 and IPv6 addressing in internetworking and **identify** the need for transition from IPv4 to IPv6	2,3	1	-
CO-5	**Analyze and compare** different routing protocols in network layer and protocols for process to process delivery of	-	2,3	4

	information in transport layer.			

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.25	2.25	2.25	1.0		-	-	-	-	-	-	-	-	2

Pre-requisites: Basics of communication.

Contents:

Unit-I

Introduction to computer networks: Data Communication, Networks, The Internet, Protocols and Standards.

Network Models: Layered tasks, OSI Model, Layers in OSI model, TCP/IP Protocol Suite, Addressing levels

Using Telephone and cable networks for data transmission: Telephone networks, Dial up modem, DSL, Cable TV for data transmission.

10Hrs

Unit-II

Data Link Control: Framing, Flow and error control, Noiseless channels and noisy channels, Protocols Piggybacking

Multiple Access protocol: Random access, Controlled access, Channelization.

11 Hrs

Unit-III

Wired LANs - Ethernet: IEEE standards, Standard Ethernet, Changes in the Standards.

Wireless LANs: IEEE 802.11, Bluetooth.

Connecting LANs, Backbone Networks and Virtual LANs: Connecting devices, Back bone Networks, Virtual LANs **10 Hrs**

Unit-IV

Network Layer: Logical addressing Ipv4 addresses, classful and classless addressing, network address translations (NAT),Ipv6 addresses, Internetworking, Ipv4, Ipv6, Transition from Ipv4 to Ipv6. **10 Hrs**

Unit-V

Network Layer - Delivery, Forwarding and Routing: Delivery, Forwarding techniques, Unicast Routing Protocols, distance vector routing, link state routing.

Transport layer-Process to process Delivery, User Datagram Protocol (UDP), Transmission Control Protocol (TCP). **11Hrs**

Reference Books:

1) B. Forouzan, **"Data Communication and Networking"**, 4th Edition, TMH, 2006.
2) James F. Kurose, Keith W. Ross "**Computer Networks"**, Pearson Education, 2nd Edition, 2003.
3) Wayne Tomasi, **"Introduction to Data communication and Networking"**, Pearson Education, 2007.
4) Andrew S. Tanenbaum, "**Computer Networks**", 4th Edition, Pearson Education, 2009.

18UECE710	MEMS	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on the study of various micro-electromechanical systems. The course discusses different fabrication techniques, modeling aspects and transduction principles of various electromechanical sensors, actuators at micro and nanoscale.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Appreciate** the significance of MEMS, as an emerging area in the field of electronics.	1	-	2
CO-2	**Identify** various micro sensors and actuators used for electromechanical applications.	2	-	4

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CO-3	**Discuss** the processes involved in the fabrication of different micro sensors and micro actuators.	-	2	5
CO-4	**Design** simple micro sensors and actuators using CAD Tools and **perform** simulation.	5	2,3	13
CO-5	**Classify** various micro system packaging technologies related to MEMS.	2	3	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2	2	1	2	-	-	-	-	-	-	-	1	-

Pre-requisites: Physics, Electronics, Material Science, Basic Mechanical principles

Contents:

Unit-I

Overview of MEMS & Microsystems: MEMS & Microsystems, typical MEMS and micro system products — features of MEMS, multidisciplinary nature of microsystems design and manufacture, applications of microsystems.

Scaling Laws in Miniaturization: Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling in electrostatic forces, electromagnetic forces, electricity, scaling in fluid mechanics & heat transfer. **8 Hrs**

Unit-II

Transduction Principles in MEMS & Microsystems: Introduction, micro sensors, electromechanical transducers, micro actuation principles, MEMS with micro actuators, Micro accelerometers, MEMS switches, micro relays, MEMS inductors and capacitors. **8 Hrs**

Unit-III

Microsystems Fabrication Process: Introduction, photolithography, ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, MEMS fabrication processes: Surface micro-machining, Bulk micromachining, LIGA process. **8 Hrs**

Unit-IV

Micro System Design and Modeling: Introduction, Design considerations: Process design, Mechanical design, Modeling using CAD tools: Multiphysics/ Intellisuite/MEMS CAD, Features and Design considerations of RF MEMS, Design considerations of Optical MEMS, Design and Modeling: Case studies- i) Cantilever beam ii) Micro switches **8 Hrs**

Unit-V

Micro system packaging: Over view of mechanical packaging of micro electronics micro system packaging, interfaces in micro system packaging, packaging technologies in MEMS. **7 Hrs**

Reference Books:

1) K. Tai Ran Hsu, "MEMS and Micro Systems: Design and Manufacture", Tata McGraw Hill, 2002.
2) Boca Raton, "MEMS and NEMS: Systems, Devices and Structures", CRC Press, 2002.
3) J. W. Gardner and V. K. Varadan, "Micro Sensors MEMS and SMART Devices", John Wiley, 2002 N. Maluf, "Introduction to Micro Mechanical Systems Engineering, Artech House", Norwood, MA, 2000.
4) V.K.Varadan, K.J.Vinoy and K.A.Jose, "RF MEMS and their Applications", Wiley India Pvt Ltd, Reprint 2011.

18UECE711	ASIC Design	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on ASIC design flow, challenges in the design, verification phase, and various circuit examples and widely used ASIC tools.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Interpret** the types of ASIC design flow and its concepts.	-	1	-
CO-2	**Analyze** the challenges in designing complicated digital circuits and its	-	1,2	3

	CMOS Implementations.			
CO-3	**Apply** the Partitioning & Floor-planning Techniques	3	4	-
CO-4	**Evaluate** placement and routing techniques for ASIC.	5	-	1,2
CO-5	**Design** of SOC based Architectures and its applications.	13,14	12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.66	1.5	2	2	3	-	-	-	-	-	-	2	3	3

Pre-requisites: FPGA and microcontroller architecture.

Contents:

Unit-I

Introduction To ASICs: Types of ASICs, Full-Custom ASICs, Standard cell based ASICs, Gate array based ASICs, Channelled gate array, channel-less gate array, structured gate array, Programmable logic devices (PLD), Field–programmable gate arrays (FPGA),ASIC Design flow, Economics of ASICs with Example. **6 Hrs**

Unit-II

Logic Design: CMOS Implementations, Transistor Sizing, Logical Effort: Predicting delays, logical areas and logical efficiency, logical paths, Multi stage cells, Optimum delay, Optimum number of stages, RTL design, Concept of RTL Linting, Clock domain Crossing. **8 Hrs**

Unit-III

Partitioning & Floor-planning: Partitioning Methods, Measuring Connectivity, Constructive and Iterative Partitioning, The Kernighan–Lin Algorithm, The Ratio-Cut Algorithm**.** Floor-planning goals and objectives, floor planning tools, I/O and powerplanning, clock system planning. **8Hrs**

Unit-IV

Placement & Routing: placement goals and objectives, placement algorithms, iterative placement, Time Driven Placement Algorithm, Global routing and types, Detailed routing: Left edge Algorithm, Special routing**.** **8 Hrs**

Unit- V

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, On-Chip Communication Architecture Standards, Low-Power SoC Design**.** **9 Hrs**

Activity beyond Syllabus: Seminar on Fabrication Techniques

Reference Books:

1) M.J.S. Smith, "Application Specific Integrated Circuits", Pearson Education,1/e 2002.
2) Jose E. France, YannisTsividis, "Design of Analog–Digital VLSI Circuits for Telecommunication and Signal Processing, Prentice Hall, 2/e 1993.
3) Malcolm R Haskard, Lan C, May, "Analog VLSI Design – NMOS and CMOS", Prentice Hall, 1998.
4) Hoi-Jun Yoo, KangminLeeand JunKyong Kim, "Low-Power NoC for High-Performance SoC Design", CRC Press, 2008

18UECE712	VLSI DSP Systems	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

VLSI DSP Systems focuses on various concepts and architectural requirements of a digital signal processing system, with a view point of its implementation in VLSI.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Describe** various parallel processing architectures	-	1, 2	-
CO-2	**Analyze and describe** various techniques of representations of DSP	-	3,5	-

	circuits and retiming.			
CO-3	**Explain and apply** arithmetic strength reduction techniques.	-	3	12
CO-4	**Describe and apply** Pipelined and Parallel Recursive filters implementation.	-	3, 12, 13	-
CO-5	**Explain** Redundant Arithmetic and **apply** numerical strength reduction techniques.	-	3, 13	12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	2	-	2	-	-	-	-	-	-	1.3	2	-

Prerequisites: Digital Signal Processing

Contents:

Unit-I

Introduction to Parallel Processing: Parallelism in uniprocessor systems, Parallel Computer structures, architectural classification schemes, Parallel Processing Applications. Principles of Pipelining and Array Processors, an overlapped parallelism, instruction and arithmetic pipelines, data buffering and busing structures, SIMD array processors, parallel algorithm for array Processors. **08Hrs**

Unit-II

Iteration Bound, Pipelining, Parallel Processing, Retiming: Introduction, Data-Flow graph representations, Loop Bound and Iteration Bound, Algorithms for computing iteration bound, Pipelining of FIR Digital Filters, Parallel Processing, Pipelining and Parallel Processing for low power, Retiming Definitions and properties, solving systems of inequalities, Retiming Techniques. **08Hrs**

Unit-III

Algorithmic Strength Reduction in filters and Transforms: Introduction, Parallel FIR filters, Discrete Cosine Transform and Inverse Discrete Cosine Transform, parallel architectures for Rank-Order filters. **07Hrs**

Unit-IV

Pipelined and Parallel Recursive filters: Introduction, pipeline interleaving in digital filters, pipelining in 1storder IIR digital filters, parallel processing for IIR filters,

combined pipelining and parallel processing for IIR filters, low-power IIR Filter Design using pipelining and parallel processing. **08Hrs**

Unit-V

Redundant Arithmetic and Numerical Strength Reduction: Introduction, Redundant number representations, carry-free radix-2 addition and subtraction, hybrid radix-4 addition, radix-2 hybrid redundant multiplication architectures, data format conversion, sub expression elimination, multiple constant multiplication, sub expression sharing in digital filters, additive and multiplicative number splitting.

08 Hrs

Reference Books:

1) Computer Architecture and Parallel Processing by Kai Hwang & Faye A. Briggs, McGraw-Hill Series, 1984.
2) Parhi, K.K., "VLSI Digital Signal Processing Systems: Design and Implementation", John Wiley,2007.
3) Wanhammar, L., DSP Integrated Circuits, Academic Press, 1999.
4) Magdy A. Bayoumi, VLSI Design Methodologies for Architectures, Kluwer Academic Publishers, 1994.

18UECE713	**Optical Fiber Communication**	**(3-0-0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on principles of Optical Fiber Communication, devices involved in communication system and challenges in Optical Fiber Communication networks.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Classify** the structures of Optical fiber and types and **Calculate** their different parameters in single mode and Multimode operation.	13	-	1
CO-2	**Illustrate** the optical fiber channel impairments and **analyze** various types of optical fiber coupling losses.	4,13	1,2	-

CO-3	**Discuss** different Optical sources and detector swith their principles and **analyze** link power and rise time budget schemes for optical fiber links.	4,13	2,3	1
CO-4	**Describe** the working principles of WDM with different active and passive devices of optical fiber link.	3,13	1,2	-
CO-5	**Explain** concepts, working principles of different types of optical networks andtheirstructures.	-	3,13	1,2,12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.5	1.75	2.33	1.5								1	2.8	

Pre-requisites: Optical physics, Analog Communication, Digital Communication

Contents:

Unit-I

Optical fiber Communications: Historical development, The general system, Advantages of optical fiber communication, Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity, And Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic cystalfibers (PCF)

09 Hrs

Unit-II

Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber. Optical Fiber Connectors: Fiber alignment and joint loss, Fiber splices, Fiber connectors, Fiber couplers. **09 Hrs**

Unit-III

Optical sources: Energy Bands, Direct and Indirect Band gaps, Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant frequencies, Laser Diode structures and their principles.

Photo detectors: Physical principles of Photodiodes, Photo detector noise, Detector responsetime. **07 Hrs**

Unit-IV

Optical Receiver: Optical Receiver Operation: Error sources, Receiver sensitivity, Quantum Limit, Introduction, point–to–point links, System considerations, link power budget, rise-time budget calculations. Short wavelength band and transmission distance for single mode fibers, Power penalties, nodal noise and chirping.

Analog Links: Analog links — Introduction, overview of analog links, CNR, multichannel transmission techniques, key link parameters, Radio over fiber links, microwave photonics. **07 Hrs**

Unit-V

WDM Concepts and Components : Overview of WDM, Operational Principles of WDM, WDM standards, Multiplexers, Isolators and Circulators, Fiber grating filters,Dielectric Thin-Film Filters, Diffraction Gratings, Active Optical Components, Tunable light sources.

Optical Networks: Optical Networks concepts, Network Topologies, Introduction to SONET/SDH networks, Optical Add/Drop Multiplexing, Wavelength Division Multiplexing (WDM) Concepts. Revolution of optical networks in India. **07 Hrs**

Reference Books:

1) Gerd Keiser, “Optical Fiber Communication”,5th Edition,McGraw Hill Education (India) Private Limited,2015.
2) John M Senior, “Optical Fiber Communications, Principles and Practice”,3rd Edition, Pearson Education, 2010.
3) Rama Swamy & Sivarajan, ”Optical Networks”,2nd edition,Elsevier publishers, 2010.
4) Govind P .Agarwal,”Fiber Optic Communication Systems”,3rd edition,John Wiley India.2001.

18UECO720	Machine Learning	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on introduction to the fundamental concepts in machine learning. Topics covered are linear models, generative models, classification, clustering with popular machine learning algorithms. The course also delves into selected topics of deep learning.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Recognize** the need and role of machine learning in engineering and artificial intelligence.	-	2,4	1
CO2	**Design** and implement machine learning solutions to classification and regression problems; and be able to evaluate and interpret the results of the algorithms.	-	2,3	1
CO-3	**Apply** the machine learning algorithms to the identified real-world problem, optimize the models learnt and evaluate models based on the expected accuracy.	12	2,4	1,5
CO-4	**Calculate** weight gradients in a feed forward neural network using back propagation algorithm.	-	2	1
CO-5	**Identify** the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.	12	5	13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1	2	2	2	1.5	-	-	-	-	-	-	3	1	-

Pre-requisites: Digital signal processing, Digital image processing, Stochastic and random process.

Contents:

Unit-I

Introduction: Basic definitions, Machine learning: what and why? Supervised learning, Unsupervised learning. Probability- A brief review of probability theory.

08Hrs

Unit-II

Linear Models for Regression: Linear Basis Function Models, Bayesian Linear Regression, The Evidence Approximation.

Linear Models for Classification: Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, Bayesian Logistic Regression.

08Hrs

Unit-III

Generative models for discrete data: Introduction, Bayesian concept learning, The beta-binomial model, The Dirichlet-multinomial model, Naive Bayes classifiers.

08Hrs

Unit-IV

Neural Networks: Feed-forward Network Functions, Network Training, Error Backpropagation, The Hessian Matrix, Regularization in Neural Networks, Bayesian Neural Networks.

Kernel Methods: Dual Representations, Constructing Kernels, Gaussian Processes.

Sparse Kernel Machines: Maximum Margin Classifiers, Relevance Vector Machines. **07Hrs**

Unit-V

Deep learning: Introduction, Deep generative models, Deep neural networks, Applications of deep networks.

Convolutional Networks: The Convolution Operation, Motivation, Pooling, Variants of the Basic Convolution Function, Data, Efficient Convolution Algorithms.

08Hrs

Reference Books:

1) Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006

2) Kevin Murphy, “Machine Learning - a Probabilistic Perspective”, MIT Press, 2012.

3)Joachims, “Learning to Classify Text using Support Vector Machines”,Kluwer, 2002.

4) Ian Goodfellow and YoshuaBengio and Aaron Courville, “Deep Learning”, An MIT Press book.

18UECO721	Pattern Recognition	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on various pattern recognition techniques such as statistical and parametric decision making. Students will also be introduced to the concepts of artificial neural network.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Demonstrate** the principle of various pattern recognition techniques.			1
CO-2	**Distinguish** various pattern recognition techniques.		12	1
CO-3	**Apply** a pattern recognition technique to a given data.	2,3	13	5
CO-4	**Choose** between pattern recognition techniques to satisfy given requirement		2,3	12
CO-5	**Calculate** weight gradients in a feed forward neural network using back propagation algorithm.		2	1

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1	2.33	3	-	1	-	-	-	-	-	-	1.5	2	-

Pre-requisites: Digital signal processing, Digital image processing, Stochastic and random process.

Contents:

Unit-I

Introduction: Applications of pattern recognition, statistical decision theory, image processing and analysis, probability of events, random variables, Joint distributions and densities, moments of random variables, estimation of parameters from samples, minimum risk estimators. **08 Hrs**

Unit-II

Statistical Decision Making: Introduction, Baye's Theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving-one-out technique. Characteristic curves, estimating the composition of populations. **08Hrs**

Unit-III

Nonparametric Decision Making: Introduction, histograms, Kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminate Functions, minimum squared error discriminate functions, choosing a decision making technique. **08Hrs**

Unit-IV

Clustering: Introduction, hierarchical clustering, partitioned clustering. **07 Hrs**

Unit-V

Artificial Neural Networks: Introduction, nets without hidden layers, Nets with hidden layers, the back propagation algorithms, Hopfield nets an application.**08 Hrs**

Reference Books:

1) Earl Gose, Richard Johnsonburg and Steve Joust, "Pattern Recognition and Image Analysis", PHI, 2003
2) Robert J Schalkoff, "Pattern recognition: Statistical, Structural and neural approaches", 1/e, John Wiley.
3) Christopher Bishop, "Pattern Recognition and Machine Learning", Springer,2006.
4) Richard O. Duda, Peter E. Hart, David G. Stork, " Pattern Recognition", 2/e, Wiley, 2000.

18UECO722	Multicore Programming	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focuses on basic concepts of Multi Core programming and various practical models of Multi Core programming. Aims to provide basic insight into multicore architecture along with Parallel Programming concepts. It also exposes OpenMP and MPI constructs, threading APIs and multicore software development and debugging techniques

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Identify** different parallel computing architectures and their applicability.	1,2		4,10
CO-2	**Develop** an insight into multicore hardware architecture and threading and synchronization and **utilize** it to build applications.	1, 2,14	3	4
CO-3	**Illustrate** programming using OpenMP and MPI.	2,3,4,5	13,14	
CO-4	Examine the threading APIs.	1,3,5		14
CO-5	Distinguish multiprocessor software development products and debugging techniques.	5,12	4	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	2.7	1.8	3	-	-	-	-	-	-	3	2	2

Pre-requisites: Probability theory, Communication Systems

Contents:

UNIT-I

INTRODUCTION TO MULTI-CORE ARCHITECTURE: Motivation for Concurrency in Software, Parallel Computing Platforms (SIMD & MIMD systems, an overview of Single-Core, Multi-Processor, Multi-Core Architectures), Parallel Computing in Microprocessors, Differentiating Multi-Core Architectures from Hyper-Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms, Understanding Performance, Amdahl's Law, Gustafson's Law **08 Hrs.**

Unit-II

MULTI-CORE PROCESSORS: An Overview of Software Threading Defining Threads, System View of Threads: Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, Application Programming Models and Threading, Virtual Environment: Virtual Machines and Platforms Runtime Virtualization, System Virtualization**.**

PARALLEL PROGRAMMING FUNDAMENTAL CONCEPTS: Designing for threads, parallel programming patterns, Threading and parallel programming constructs: Synchronization, Critical sections, Deadlock, Synchronization Primitives, and Messages **08 Hrs.**

Unit-III

OPENMP PROGRAMMING: OpenMP Challenges in Threading a loop, Minimizing Threading overhead, Performance oriented Programming, Library Functions. Solutions to parallel programming problems: Data races, deadlocks and Livelocks Non-blocking algorithms, Memory and cache related issues.

MPI PROGRAMMING: Message-Passing Model, Message-Passing Interface, MPI functions, Compiling and running MPI Programs, collective communication, data decomposition, Point-to-point communication – MPI Library. **08 Hrs.**

Unit-IV

THREADING API'S: Threading APIs for Microsoft Windows, Threading APIs for Microsoft .NET Framework: Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads: Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking **07 Hrs.**

Unit-V

MULTI-THREADED DEBUGGING TECHNIQUES: General Debug Techniques, Debugging Multi-threaded Applications in Windows: Threads Window, Trace points, Breakpoint Filters, Naming Threads, Multi-threaded Debugging Using GDB.

MULTI-CORE PROCESSORS SOFTWARE DEVELOPMENT PRODUCTS: An Overview of Software tools on Multi-Core Processors, Intel Software Development Products: overview, Thread Checker, Compilers: OpenMP, Software-based Speculative Pre computation, Compiler Optimization and Cache Optimization, Debugger , Intel Libraries, Intel Threading Building Blocks , VTune Performance Analyzer , Thread Profiler , MPI Programming :Intel Support for MPI **08 Hrs.**

Reference Books:

1) ShameemAkhter and Jason Roberts, "Multi-core Programming- Increasing Performance through Software Multi-Threading", 1st Edition, Intel Press, 2006.
2) Michael J Quinn, "Parallel programming in C with MPI and OpenMP", 2nd Edition, Tata McGraw Hill, 2007.
3) Peter S. Pacheco, "An Introduction to Parallel Programming",Morgan Kaufmann Publishers is an imprint of Elsevier,2011

18UECO723	Mobile Computing	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on basics of mobile communications, mobile computing, GSM systems, networking, transport and application layer protocols, different mobile platforms and application development and security issues.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the basics of mobile telecommunication systems	-	-	1,4,6,7
CO-2	Illustrate the generations of telecommunication systems in wireless networks	-	1,2,4,5	12,13,14
CO-3	Determine the functionality of MAC, network layer and Identify a routing protocol for a given Adhoc network	-	2,4	12,13,14
CO-4	Explain the functionality of Transport and Application layers	-	1,2,4,10	-
CO-5	Develop a mobile application using android/blackberry/ios/Windows SDK	1,2,3,4,5,13, 14	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.0	2.25	3.0	2.0	2.5	1.0	1.0	-	-	2.0	-	1.0	1.33	1.33

Pre-requisites: Wireless communication, Digital communication Computer Communication Networks;

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Contents:

Unit-I

Introduction: Mobile Communications, Mobile Computing– Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Hand held Devices, Limitations of Mobile and Handheld Devices.

GSM–Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS,CSHSD, DECT. **08 Hrs**

Unit-II

(Wireless) Medium Access Control (MAC): Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Wireless LAN / (IEEE802.11)

Mobile Network Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, DHCP. **08 Hrs**

Unit-III

Mobile Transport Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks.

Database Issues: Data base Hoarding & Caching Techniques, Client-Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process & QoS Issues. **07 Hrs**

Unit-IV

Data Dissemination and Synchronization: Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods ,Data Synchronization– Introduction, Software, and Protocols. **09 Hrs**

Unit-V

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone–M Commerce–Structure–Pros & Cons– Mobile Payment System–Security Issues.

Protocols and Platforms for Mobile Computing: WAP,Bluetooth,XML,J2ME, Java Card, Palm OS, Windows CE, Symbian OS, Linux for Mobile Devices, Android. **07 Hrs**

Reference Books:

1) Jochen Schiller, “Mobile Communications” ,PHI,SecondEdition,2003.
2) RajKamal, “Mobile Computing”,OxfordUniversityPress,2007,
3) Prasant Kumar Pattnaik ,Rajib Mall,”Fundamentals of Mobile Computing”, PHI ,2012

18UECL702	CCN Laboratory	(0-0-2) 1

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on the process of data communication in computer network through the layered architecture. It also deals with the IEEE standards and various protocols at different layers.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Illustrate** the importance of High-Level Data Link Control.	-	1	4
CO-2	**Demonstrate** various functionalities Of Network Layer and usage of algorithms for routing strategies, packet management.	1,4	-	-
CO-3	**Demonstrate** the performance of various protocols and algorithms for Framing, Flow control, Error control and media access control	1,2	3,14	11
CO-4	**Illustrate** the various functionalities of RTOs.	-	3,14	1,2
CO-5	**Demonstrate** the usage and importance of Inter Process Communication(IPC)	2,3	14	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.25	2.23	2.23	2.0		-	-	-	-	-	1	-	-	2

Pre-requisites: Fundamentals of Computer Communication Networks Operating Systems, Knowledge of Embedded Systems.

CCN Experiments:

- Write a C program to simulate bit stuffing and de stuffing in data frames.
- Write a C program to simulate shortest path algorithm.

- Write a C program to implement Sliding Window protocol.
- Write a C program to implement Pipelining protocol which allows multiple outstanding frames.
- Write a C program to compute the polynomial cyclic redundancy check code (CRC Code checksum) for CRC-CCITT.
- Write a C program to simulate a positive acknowledgement with retransmission protocol.
- Write a C program for congestion control using leaky bucket algorithm.
- Write a C program for hamming code (error detection and error correction).

Embedded Experiments:

Note: Implement using RTOS Kernel either RTX, uCOS-II or Free RTOS on LPC2148 ARM-7 kit.

- OS concepts such as task management, IPC, Semaphore, Scheduling can also be demonstrated on Linux platform using gcc.
- Write a C program to create two tasks one to blink all LEDs with fixed delay, other to blink half of the LEDS (use task create, prioritize tasks, task delay and finally kill one of the task after certain delay).
- Demonstrate Producer and Consumer problem using semaphores.
- Demonstrate IPC using pipes and mailboxes.
- Create multiple tasks and demonstrate different scheduling algorithms (round robin, FIFO ,Preemptive).

Reference Books:

1) B. Forouzan, “Data Communication and Networking”,4th Edition, TMH, 2006.

2)James F .Kurose, KeithW. Ross, “Computer Networks”, Pearson education,2ndEdition, 2003.

3) Wayne Tomasi, “Introduction to Data communication and Networking”, Pearson Education,2007.

4) James K. Peckol, “Embedded Systems–A contemporary Design Tool”, John Weily, 2008.

18UECL703	Major Project Phase - I	(0-0-4) 2

Contact Hours: 52

Course Learning Objectives (CLOs):

The objectives of final year project during phase-I are to:

- Allow the students to demonstrate the skills learnt during their course of study by asking them to deliver a product that has passed through design, analysis, testing and evaluation stages.
- Encourage multidisciplinary research through the integration of material learnt in number of courses.
- Allow students to develop problem solving, analysis, synthesis and evaluation skills.
- Encourage teamwork and improve students' communication skills through project reports and presentations of their work.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** societal problems and analyze from engineering view point.	1,2	-	6,7
CO-2	**Perform** extensive literature survey on the identified problem and **explore** possible technical solutions.	1,2,3,4	5	13,14
CO-3	**Implement** and provide feasible solution for the identified problem.	1,2,3,4	5	13
CO-4	**Develop** presentation skills of summarizing technical contents and **organize** the study material in the form of a report.	10	11	-
CO-5	**Inculcate** professional ethics, moral responsibilities and develop the spirit of team work.	8,9	12	-

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POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	3	3	2	1	1	3	3	3	2	2	1	1

Major Project phase-I is a substantial piece of work that requires creative activity and original thinking. The project phase-I has to start with the problem formulation that will lead to feasible solutions. The material collection, survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The project shall consist of a team of students not more than 4. Each batch shall be assigned with a guide. The guide will continuously monitor and evaluate the student project. Further, a review team will also evaluate the project progress.

18UECL704	Internship	4 Weeks

Course Learning Objectives (CLOs):

The students are to undergo internship in Private industries/R&D organizations/Centres of Excellence/Laboratories of Reputed Institutions/Govt. & Semi Govt. organizations, PSUs, construction companies, entrepreneurial organizations, inter departments within the college etc. to get en exposure to the external world for a period of 4 weeks in the summer vacation after VI sem and before start of VII semester. The students are to prepare a report on the internship work carried out. The internal faculty shall monitor the student and award CIE marks. There is a SEE in which the student shall present his work before a panel of examiners consisting of HoD, Guide and one faculty member during VII semester. The performance shall be communicated to the CoE office and the same shall reflect in the VII semester grade card.

Course Outcomes(COs):

Description of the Course Outcome: At the end of the course the student will be able to		**Mapping to POs (1-6)**		
		Level 3 Substantial	**Level 2 Moderate**	**Level 1 Slight**
CO-1	**Acquire** practical experience in an organizational setting	1,2	-	-

CO-2	**Apply** the knowledge and skill set in engineering design processes appropriate to the internship program.	1,2,3,4	5	-
CO-3	**Apply** modern tools and processes to solve the live problems.	5	3,4	-
CO-4	**Get** an opportunity to learn new skills	10	11	-
CO-5	**Learn** strategies like time management, multi-tasking, communication and team work skills in an industrial setup.	8,9	12	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	**3**	**3**	**2.5**	**2.5**	**2.5**	**-**	**-**	**3**	**3**	**3**	**2**	**2**	**-**	**-**

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VIII Semester

18UECC800	Wireless Communication	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on evolution of wired Telecommunication, comparison of wireless1G, 2G, 3G, LTE,4G and 5G Networks, its advantages/ applications. It covers cellular structure, capacity expansion methods, modulation techniques with mathematical description for their parameters and its Hardware and IEEE standards with respect to 4G technology.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Discuss** the evolution and history of wireless technology and **compare** different mobile Networks along with their common System components.	-	3,4,5,13	1,2,10,12
CO-2	**Apply** the cellular concepts such as frequency reuse, handoff to **evaluate** the signal reception and Performance of cellular systems.	13	4,5,14	1,2,3,10, 12
CO-3	**Explain** the GSM techniques and its architecture with time slot structures and **study** different traffic case operations and protocol stack in GSM.	-	4,5	1,2,3,10, 12
CO-4	**Analyze** CDMA techniques with their channel structures and **scrutinize** future mobile communication networks.	-	5,6,7	1,2,3,4,10, 12
CO-5	**Describe** modulation techniques in wireless networks and **Explain** IEEE standards and protocols of Wireless networks	-	5,6,7	1,2,3,4,10, 12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1	1	1.2	1.6	2	2	2	-	-	1	-	1	2.5	2

Pre-requisites: Analog Communication, Digital Communication
Contents:

Unit-I

Introduction to Wireless Communication: Introduction to wireless communication systems and networks, history and evolution, different generations of wireless cellular networks, 1G, 2G, 3G and 4G networks.
Cellular System: Common cellular system components, common cellular network components, hardware and software, views of cellular networks, 3G cellular systems components, and cellular component identification call establishment.
12 Hrs

Unit-II

Cellular structure and fundamentals: Wireless network architecture and operation, cellular concept, cell fundamentals, capacity expansion techniques, mobility management, radio sources and power management, wireless network security, SS7. **09 Hrs**

Unit-III

Second Generation mobile system: GSM and TDMA techniques, GSM system, overview, GSM network and system architecture, GSM channel classifications & concepts, GSM identifiers.
GSM system operation: System Operation traffic cases, call handoff, roaming, GSM protocol architecture, TDMA systems. **12 Hrs**

Unit-IV

Third, Fourth and Fifth Generation mobile system: CDMA technology CDMA overview, CDMA channel concept, CDMA operations. LTE and 4G architectures and their comparisons, Introduction to 5G and its features. **9 Hrs**

Unit-V

Modulation Techniques: Wireless modulation techniques and hardware, characteristics of air interface, path loss models, wireless coding techniques, digital modulation techniques, OFDM, UWB radio techniques, diversity techniques, demonstration of typical GSM, CDMA hardware.
IEEE standards: Introduction to wireless LAN, 802.11X technologies, introduction to 802.15X, technologies in PAN applications, Introduction to Bluetooth model, introduction to broadband wireless MAN, 802.16X technologies, Black Berry Handsets. **10 Hrs**

Activity beyond Syllabus:
BSNL exchange visit

Reference Books:

1) Mullet,"Wireless Telecommunication Systems and networks", Thomson Learning 2006.
2) Lee W.C.Y," Mobile Cellular Telecommunication",MGH,2002.
3) D.P. Agrawal," Wireless communication",2/e, Thomson Learning,2007.
4) T.S. Rappaport," Wireless Communications", principles &practice, 3/e, Pearson Education,2008.

18UECE810 Adhoc Wireless networks (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on functions and protocols of Adhoc Wireless Networks.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Describe** typical issues in ad-hoc/sensor networks and **Analyze** the challenges in designing MAC protocols	-	13	1,2
CO-2	**Classify** MAC protocols and **investigate** the challenges in designing routing protocols and classify them for ad-hoc wireless networks.	1,2,13	3	4
CO-3	**Discuss** the challenges in designing transport layer protocols for wireless ad-hoc/sensor networks.	1,2,13	3	
CO-4	**Describe** security issues for wireless ad-hoc networks.		1,2,3,13	
CO-5	**Analyze and compare** different routing protocols in network layer and protocols for process to process delivery of information in transport layer.	-	3,13	1,2,5,12

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	2	1	1	-	-	-	-	-	-	1	2.4	

Prerequisites:

Computer Communication Networks, Basic Wireless Communication Concepts.

Contents:

Unit-I

Adhoc Networks: Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet.

MAC Protocols For Ad Hoc Wireless Networks: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks. 0**8Hrs**

Unit-II

Classification of MAC protocols: Contention - based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols.

Routing Protocols for Ad Hoc Wireless Networks: Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols,Table driven routing protocol, On-demand routing protocol, Hybrid routing protocol, Routing protocols with effective flooding mechanisms, Hierarchical routing protocols, Power aware routing protocols.

08 Hrs

Unit-III

Transport Layer Protocols For Ad Hoc Wireless Networks: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks. **08 Hrs**

Unit-IV

Security: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning. **08 Hrs**

Unit-V

Quality Of Service In Ad Hoc Wireless Networks: Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoSsolutions 0**7 Hrs**

Reference Books:

1) C. Siva Ram Murthy & B. S. Manoj, Adhoc wireless Networks, Pearson Education, 2nd Edition, reprint 2005.

2) Ozan K. Tonguz and Gianguigi Ferrari, Adhoc wireless Networks, Wiley Publications, 2009.

3) Cheng, Xiao Hung, Ding- Zhu Du, Kluwer, Adhoc wireless Networking, Xiuzhen Academic publishers, 2013.

4) B. S. Manoj and C. Siva Ram Murthy, Ad Hoc Wireless Networks: Architectures and Protocols, 6th Edition, Pearson Education, 2008.

18UECE811	Reconfigurable Design	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on key criteria: area, speed, optimization techniques employed, various system architectures considered in the FPGA method of Design.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Demonstrate** the basics of FPGA Architecture and its Function mapping.	-	1,2	13,14
CO-2	**Modeling** the languages and its synthesis.	-	1,2	-
CO-3	**Understand** AdvancedFPGA design principles w.r.t speed and area.	1,2	-	-
CO-4	**Design** strategies for DSP and Image Processing applications.	3	13,14	5
CO-5	**Analyze** and **explore** the architectural design of FPGA for Deep Learning Applications.	3	13,14	5

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.33	2.33	3	-	1	-	-	-	-	-	-	-	1.66	1.66

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Pre-requisites: Knowledge of FPGA and microcontroller architecture

Contents:

Unit-I

FPGA Design Flow: Reconfigurable Logic Devices, Field-Programmable Gate Arrays, Basic Architecture, Example Actel Devices: ACT1 logic module, Shannon's expansion theorem, Routing, Programmable I/O Architectures**,** Specialized Function Blocks: Embedded Microprocessors. Coarse-Grained Reconfigurable Arrays: Raw &PipeRench Architectures. **6 Hrs**

Unit-II

Languages and Compilation, Design Cycle, Languages, Algorithmic RC Languages, Hardware Description Languages (HDL): Modelling of Abstraction Level, High Level Compilation, Compiler Phases. Analysis and Optimizations, Scheduling, Low Level Design Flow, Logic Synthesis Technology Mapping, Logic Placement, Signal Routing Configuration Bit streams **8Hrs**

Unit-III

Architecting Speed & Area Speed: High Throughput, Low Latency, Timing, Add Register Layers, Parallel Structures, Flatten Logic Structures, Register Balancing, Reorder Paths.**Area:**Rolling Up the Pipeline, Control-Based Logic Reuse, Resource Sharing, Impact of Reset on Area, Resources Without Reset, Resources Without Set, Resources Without Asynchronous Reset, Resetting RAM, Utilizing Set/Reset FF Pins. **8 Hrs**

Unit-IV

FPGA Applications: Signal processing applications: Filtering, DSP application building blocks: Efficient Airthmetic, CORDIC, Transforms, Examples: Beam forming, Software Defined Radio. **Image and video processing**: Local Neighbourhood functions, Convolution, Morphological Operations, Feature Extraction & matching. **8 Hrs**

Unit-V

Accelerating the CNN Inference on FPGAs : Introduction, Background on CNNs and Their Computational Workload, General Overview, Inference versus Training, Inference, Layers, and CNN Models, FPGA-Based Deep Learning Computational Transforms: Winograd Transform and Fast Fourier Transform, Loop Unrolling. Loop Tiling. **Approximate Computing of CNN Models**: Approximate Arithmetic for CNNs, Fixed-Point Arithmetic, Dynamic Fixed Point for CNNs, FPGA

Implementations, Extreme Quantization and Binary Networks, Reduced Computations, Weight Pruning, Low Rank Approximation. **9 Hrs**

Activity Beyond Syllabus: Seminar on Reconfigurable Computing.

Reference Books:

1) M. Gokhale and P. Graham, "Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays", Springer, 2005.
2) Steve Kilts," Advanced FPGA Design Architecture, Implementation, and Optimization", WILEY INTERSCIENCE, 2007.
3) Mahmoud Hassaballah and Ali Ismail Awad, "Deep Learning inComputer Vision", CRC Press,Taylor& Francis Group, 2020.
4) Deep Learning by Ian Goodfellow and YoshuaBengio and Aaron Courville, MIT Press.https://www.deeplearningbook.org/

18UECE812 Low Power VLSI Design (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focuses on factors which may lead to the techniques of power saving in design of VLSI circuits. Knowledge of CMOS digital circuits and analog Mixed Mode VLSI Design are required as prerequisites.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**List** the factors effecting the power requirement in design of VLSI circuits.	-	-	2,3,13
CO-2	**Explain** various methods of achieving the power minimization	2,13	-	-
CO-3	**Compare** various methods of achieving the power minimization	1,2,12	-	-
CO-4	**Estimate** the features of synthesis tools for Low Power VLSI Design	-	5	-
CO-5	**Analyze**and **investigate** switched capacitance, leakage power minimization techniques	1,2	4	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2.5	1	2	2	-	-	-	-	-	-	3	2	-

Prerequisites: Basics of CMOS digital circuits and Analog Mixed Mode Design.

Contents:

Unit-I

MOS Transistor structure and device modeling, MOS Inverters, MOS Combinational Circuits - Different Logic Families. **08 Hrs**

Unit-II

Sources of Power dissipation: Dynamic Power Dissipation, Short Circuit Power, Switching Power, Glitching Power, Static Power Dissipation, Degrees of Freedom

Supply Voltage Scaling Approaches: Device feature size scaling, Multi-Vdd Circuits, Architectural level approaches: Parallelism, Pipelining, Voltage scaling using high-level transformations, Dynamic voltage scaling, Power Management. **08 Hrs**

Unit-III

Switched Capacitance Minimization Approaches: Hardware Software Tradeoff, Bus Encoding, Two's complement Vs Sign Magnitude, Architectural optimization, Clock Gating, Logic styles. **08 Hrs**

Unit-IV

Leakage Power minimization Approaches: Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach, Power gating, Transistor stacking, Dual-Vt assignment approach (DTCMOS). **08 Hrs**

Unit-V

Special Topics: Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, CAD tools for low power synthesis. **07 Hrs**

Reference Books:

1) Gary K Yeap, "Practical low power digital VLSI Design" ,Kluwer Academic, 1998.
2) Jan M. Rabaey, MassoudPedram, " Low power design methodologies", Kluwer

Academic, 2010.
3)Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, Wiley 2000.
4) A.P. Chandrasekaran and R. W. Broadersen, “Low power digital CMOS design”, Kluwer Academic, 1995.

18UECE813 Digital Signal Compression (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on the need of compression, various lossless and lossy compression techniques and their performance measures.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Understand** the need, types and the mathematical preliminaries required for compression	-	1	-
CO-2	**Analyze** different lossless coding techniques for uncorrelated sources	-	2,3	4,5
CO-3	**Analyze** different lossless coding techniques for correlated sources	-	2,3	4,5
CO-4	**Understand** and **Analyze** various scalar quantization techniques for lossy compression	-	2,3	4,5
CO-5	**Understand** and **Analyze various** vector quantization techniques for lossy compression	-	2,3	4,5

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	2	1	1	-	-	-	-	-	-	-	-	-

Pre-requisites: Digital Signal Processing, Digital Communication, Information Theory and Coding.

Contents:

Unit-I

Introduction: Compression techniques: Lossless Compression, Lossy Compression, Measure of performance, Modeling & coding.

Mathematical Preliminaries for Lossless Compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes.

Mathematical Preliminaries for Lossy Compression: Introduction, Distortion Criteria, Models: Probability models, Linear System Models, Physical models.

08 Hrs

Unit-II

Huffman coding: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding: Lossless image compression, Text compression, Audio Compression. **08 Hrs**

Unit-III

Arithmetic Coding: Coding a sequence, Generating a Tag, Deciphering the Tag, Generating a binary code: Uniqueness and Efficiency of the Arithmetic Code, Algorithm Implementation, Integer Implementation, Comparison of Binary and Huffman coding, Applications.

Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary: The LZ77 Approach, The LZ78 Approach, Applications. **08 Hrs**

Unit-IV

Scalar Quantization: Quantization problem, Uniform Quantizer, Adaptive Quantization: Forward Adaptive Quantization, Backward Adaptive Quantization, Non-uniform Quantization: pdf optimized Quantization, Compaded Quantization.

08 Hrs

Unit-V

Vector Quantization: LBG algorithm, Tree structured VQ, Structured VQ, Trellis coded quantization. **07 Hrs**

Reference Books:

1) K. Sayood, “Introduction to Data Compression," Harcourt India Pvt. Ltd. & Morgan Kaufmann Publishers, 1996.

2) N. Jayant and P. Noll, “Digital Coding of Waveforms: Principles and Applications to Speech and Video,” Prentice Hall, USA, 1984.
3) D. Salomon, “Data Compression: The Complete Reference”, Springer, 2000.
4) Z. Li and M.S. Drew**,** “Fundamentals of Multimedia,” Pearson Education (Asia) Pvt. Ltd., 2004.

18UECO820	**DSP Architecture**	**(3-0-0)3**

Contact Hours: 39

Course Learning Objectives (CLOs):

Digital Signal Processor Architecture focuses on various architectural requirements and concepts of a digital signal processor, programming aspects and interfacing the processor to memory and I/O devices considering as exampleTMS320C54xx.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Describe** basics of DSP, Computational Accuracyin a digital signal processor.	-	1	-
CO-2	**Describe** architectural featuresof a digital signal processor.	-	3,5	-
CO-3	**Describe** Instructions and Programming aspects of a digital signal processor.	-	3,5	12
CO-4	**Implement** DSP Algorithms and **develop** programmingskills for signal processing.	-	3, 12	-
CO-5	**Interface** Memory And Parallel I/O Peripherals digital signal processor.	-	13	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	-	2	-	2	-	-	-	-	-	-	1.5	2	-

Prerequisites: Digital Signal Processing

Contents:

Unit-I

Introduction To Digital Signal Processing: Introduction, A digital signal processing system, the sampling process, discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), LTI systems, Digital filters.

Computational Accuracy in DSP Implementation: Introduction, Number formats for signals and coefficients in DSP systems, Dynamic range and precision, Sources of error in DSP implementations, A/D conversion error, DSP computational error and D/A Conversion error. **08Hrs**

Unit-II

Digital Signal Processing Devices: Introduction, Basic architectural features, DSP computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation unit, Programmability and Program execution, Speed issues.

Programmable Digital Signal Processors: Introduction, Architecture of TMS320C54xx digital signal processors: Bus structure, Central processing unit, internal memory and memory mapped registers, Data addressing modes of TMS320C54xx processors, Memory space of TMS320C54xx processors. **08Hrs**

Unit-III

TMS320C54xx Instructions and Programming, On-chip peripherals, Interrupts of TMS320C54xx processors, Pipeline operation of TMS320C54xx processors. **07Hrs**

Unit-IV

Implementation Of Basic DSP Algorithms: Introduction, The Q-notation, Linear Convolution, Circular Convolution, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, butterfly computation and FFT implementation on the TMS320C54xx. **08Hrs**

Unit-V

Interfacing Memory And Parallel I/O Peripherals To Programmable DSP Devices: Introduction, Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access(DMA). Interfacing Serial Converters to a Programmable DSP device: Introduction, Synchronous Serial Interface (SSI), A multi channels buffered serial port (McBSP). **08 Hrs**

Reference Books:

1) Avtar Singh and S. Srinivasan, "Digital Signal Processing", Thomson Publications, 2004.
2) Lapsley et al. DSP Processor Fundamentals, Architectures & Features"S. Chand & Co, 2000.
3) B.VenkataRamani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", TMH, 2004.

18UECO821	CAD for VLSI	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on key criteria in VLSI CAD such as basic data structures and algorithms, partitioning, floor planning, placement and routing. Various algorithms that are used for constructing the CAD tools are discussed.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Comprehend** the basic algorithms required for VLSI CAD.	-	2,4	1
CO-2	**Recognize** the basic data structures and graph algorithms for physical design issues.	-	2,3	4
CO-3	**Sequence** various operations in partitioning and floor planning.	-	2	-
CO-4	**Recognize** the various challenges in pin assignment and placement phases.	-	-	5
CO-5	**Evaluate** the global and detailed routing methods.	12	5	13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1	2	2	1.5	1.5	-	-	-	-	-	-	3	1	-

Pre-requisites: VLSI Basics

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Contents:

Unit-I

Basic Algorithms: Basic terminology, Complexity issues and NP-Hardness. Examples - Exponential, heuristic, approximation and special cases. Basic Algorithms. Graph Algorithms for Search, spanning tree, shortest path, min-cut and max-cut, Steiner tree. Computational Geometry Algorithms: Line sweep and extended line sweep methods. **08Hrs**

Unit-II

Basic Data Structures: Atomic operations for layout editors, linked list of blocks, Bin-based method, Neighbor pointers, corner-stitching, multi-layer operations, Limitations of existing data structures. Layout specification languages.

Graph algorithms for physical design: Classes of graphs in physical design, Relationship between graph classes, Graph problems in physical design, Algorithms for Interval graphs, permutation graphs and circle graphs. **08Hrs**

Unit-III

Partitioning: Problem formulation, Design style specific partitioning problems, Classification of Partitioning Algorithms. Group migration algorithms: Kernighan-Lin algorithm, Fiduccia-Mattheyses Algorithm, Simulated Annealing, Simulated Evolution.

Floor Planning: Problem formulation, Constraint based floor planning, Rectangular dualization, Simulated evolution algorithms. **08Hrs**

Unit-IV

Pin Assignment: Problem formulation. Classification of pin assignment problems, General pin assignment problem.

Placement: Problem formulation, Classification of placement algorithms. Simulation based placement: Simulated annealing, simulated evolution, force directed placement. Partitioning based algorithms: Breur‘s Algorithm, Terminal propagation algorithm, Other algorithms for placement. **08 Hrs**

Unit-V

Global Routing: Problem formulation, Classification of Global routing algorithms, Maze routing algorithms: Lee‘s algorithm, Soukup‘s algorithm and Hadlock‘s Algorithm, Line probe algorithms.

Detailed Routing: Problem formulation, Routing considerations, models, channel routing and switch box routing problems. General river routing problem, Single row routing problem. Two-layer channel routing algorithms: Basic Left Edge Algorithm, Dogleg router, Symbolic router-YACR2. **07Hrs**

Reference Books:

1) Naveed Sherwani, "Algorithms for VLSI Physical Design Automation", 3rd Ed, 1999 Kluwer Academic Publishers, Reprint 2013 Springer (India) Private Ltd. ISBN 978-1475771947.
2) Rolf Drechsler, "Evolutionary Algorithms for VLSI CAD", Springer reprint, 2010, ISBN-13 : 978-1441950406.
3) Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu, "VLSI Physical Design: From Graph Partitioning to Timing Closure", Springer, 2011, ISBN-13 : 978-9048195909.
4) Niranjan N. Chiplunkar, Kotari Manjunath, "VLSI CAD", PHI Publication, 2011.

18UECO822 Operations Research (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course aims to introduce students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Recognize** the need for operation research.	-	2,4	1
CO-2	**Design** the alternative solutions for transportation problem.	-	2,3	4
CO-3	**Sequence** various operations in an establishment.	-	2	-
CO-4	**To comprehend** the characteristics of different types of decision-making environments and the appropriate	-	-	5

	decision making approaches and tools to be used in each type.			
CO-5	**Evaluate** various inventory control techniques and device the CPM and PERT methods for project management.	12	5	13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1	2	2	1.5	1.5	-	-	-	-	-	-	3	1	-

Pre-requisites: Management & Entrepreneurship, Basics of Statistics

Contents:

Unit-I

Introduction to OR: Basics definition, scope, objectives, phases, models and limitations of Operations Research.

Linear Programming Problem: Formulation of LPP, Graphical solution of LPP, Simplex Method, Artificial variables, big-M method. **08Hrs**

Unit-II

Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method.

Assignment Model: Formulation, Hungarian method for optimal solution Solving unbalanced problem, Traveling salesman problem and assignment problem.**08Hrs**

Unit-III

Sequencing models Solution of Sequencing Problem – Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

Decision theory Decision under uncertainty, Decision under certainty, Decision under risk, Decision trees, Game Theory, Two-person zero sum game, Competitive games. **08Hrs**

Unit-IV

Game Theory Two-person zero sum game, Competitive games, rectangular game, saddle point, mini-max (maximin) method of optimal strategies, value of the game.

Replacement Models Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly: individual replacement policy, group replacement policy. **08 Hrs**

Unit-V

Inventory Models Inventory costs, Models with deterministic demand – model (a) demand rate uniform and production rate infinite, model (b) demand rate non-uniform and production rate infinite, model (c) demand rate uniform and production rate finite.

Project Management Phases of project management, guide lines for network construction, CPM and PERT, Resource analysis in network scheduling, updating a project. **07Hrs**

Reference Books:

1) A M Natarajan, P. Balasubramani,"Operation Research", 2nd Edition, Pearson Publications, 2014.
2) J.K. Sharma, "Operation Research : Theory and applications", 5th Edition, Macin Publishers, 2012.
3) Wayne L Winston,"Operations Research : Applications and Algorithms", Duxbuty Press, 2003.
4) Hamdy H Taha, "Operations Research : An Introduction", 9th Edition, Pearson Education, 2010.

18UECO823 Advanced Computer Architecture (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course deals with the understanding quantitative principles guiding the computer system design. It focuses on enhancing the performance by addressing parallelism at different levels such as Instruction, thread, task, job. Evaluates memory hierarchy, speculations, ISA, ALU architectures, choice of I/O is major motivation.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** the performance, Quantitative Principles of computer design and Choose/utilize Computer Arithmetic units.	1,2	3,4	-

CO-2	**Identify and address** concepts and challenges of ILP	1, 2	3	4
CO-3	**Investigate** Hardware and Software for VLIW and EPIC	-	1,2,3	5
CO-4	**Design** and **evaluating** an I/O system	1,3	-	5
CO-5	**Comprehend** Critical Performance Issue and **deduce** Characteristics of Scientific Applications	2	4,6	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.75	2.75	2.25	1.67	1	2	-	-	-	-	-	-	-	-

Pre-requisites:

Knowledge of Processor/Controllers, Languages-Compilers is appreciated.

Contents:

Unit-I

Introduction and Review of Fundamentals of Computer Design: Introduction; Classes computers; Defining computer architecture; Trends in Technology; Trends in power in Integrated Circuits; Trends in cost; Dependability, Measuring, reporting and summarizing Performance; Quantitative Principles of computer design

Some topics in Pipelining: Instruction –Level Parallelism, Its Exploitation and Limits on ILP: Introduction to pipelining, ILP; Crosscutting issues, fallacies, and pitfalls. **7 Hrs**

Unit-II

Introduction to limits in ILP: Performance and efficiency in advanced multiple-issue processors.

Memory Hierarchy Design, Storage Systems: Review of basic concepts; Crosscutting issues in the design of memory hierarchies; Case study of AMD Opteron memory hierarchy. Fallacies and pitfalls in the design of memory hierarchies. **8 Hrs**

Unit-III

I/O performance: reliability measures, and benchmarks; Queuing theory; Crosscutting issues; Designing and evaluating an I/O system –The Internet archive cluster

Hardware and Software for VLIW: Exploiting Instruction-Level Parallelism Statically, Detecting and Enhancing Loop- Level Parallelism, Scheduling and Structuring Code for Parallelism. **8 Hrs**

Unit-IV

EPIC Introduction and Large-Scale Multiprocessors : Hardware Support for Exposing Parallelism: Predicated Instructions, Hardware Support for Compiler Speculation, The Intel IA-64 Architecture and Itanium Processor, Concluding Remarks.Introduction, Inter-processor Communication: The Critical Performance Issue. **8 Hrs**

Unit-V

Scientific Applications and Computer Arithmetic: Characteristics of Scientific Applications, Synchronization: Scaling Up, Performance of Scientific Applications on Shared-Memory Multiprocessors, Performance Measurement of Parallel Processors with Scientific Applications, Implementing Cache Coherence, The Custom Cluster Approach: Blue Gene/L, Concluding Remarks, Introduction, Basic Techniques of Integer Arithmetic, Floating Point, Floating-Point Multiplication, Floating-Point Addition. **8 Hrs**

Reference Books:

1) Kai Hwang, “Advanced Computer Architecture - Parallelism, Scalability, Programmability”, 2nd Edition.
2) Computer architecture, Pipelined and parallel Processor Design’, M.J.Flynn, Narosa Publishing,2002.
3) Hennessey and Patterson, “Computer Architecture A Quantitative Approach”, 4th Edition, Elsevier, 2007.
4) ‘An introduction to parallel computing : Design and Analysis of Algorithms’, Ananth Grama,Pearson,2nd Edition,2004.

18UECL801	**Technical Seminar**	**(3-0-0) 3**

Contact Hours: 26

Course Learning Objectives (CLOs):

The objective of seminar is to prepare the students for independent study of the state of the art topics in the broad areas of interest. The students are exposed to various aspects of seminar such as literature survey, organization of the material, technical writing and presentation skills.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Read and Understand** technical topics from technical journals/ magazines.	-	1,2	6,7,12

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CO-2	**Analyze** technical content and extract necessary information.	1,2	-	-
CO-3	**Organize** the topic in a systematic manner and **prepare** the report in a specific format	-	5	-
CO-4	**Present** the topic in a convincing manner	9,10	-	13
CO-5	**Inculcate** professional ethics and moral responsibilities	8	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.5	2.5	-	-	-	1	1	3	3	3	-	1	1	-

Technical Seminar: The students are expected to learn how to carry out literature survey to locate the state of the art technology in engineering domain of their interest. They are required to carry out selection of an emerging topic beyond the syllabus relevant to the branch of study, understand the concept, analyze and present effectively for 15-20 minutes followed by 5 minutes of questions and answers before their classmates and faculty. They can also present the technical innovative/novel work carried out in the laboratory. Students are also required to learn the effective communication and modalities of technical interactions. Further, they have to submit the seminar material in the form of a paper in IEEE format. All the students are required to attend all the sessions throughout the semester.

18UECL802 Project Phase – II (0-0-12) 7

Contact Hours: 100

Course Learning Objectives (CLOs):

The objectives of final year project are to:

- Allow students to demonstrate wide range of skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation stages.
- Encourage multidisciplinary research through the integration of material learned in a number of courses.
- Allow students to develop problem solving, analysis, synthesis and evaluation skills.
- Encourage teamwork.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Arrive** at an optimal solution towards the problem identified	1,2,3,9	4	5,12
CO-2	**Implement** proposed solution in the form of development of software and/ or hardware prototype.	3,4,9,13, 14	5,6,7	12
CO-3	**Organize** the topics in a systematic manner and **prepare** report in a specific format	9,10,11	-	12
CO-4	**Present** the work in a systematic way	-	1,6,10	-
CO-5	**Adopt** professional ethics and responsibilities	8	11,12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	3	2.5	1	2	2	3	3	2.5	2.5	1.3	3	3

Major Project phase-II is the continuation from phase – I in which the students are expected to go for material collection, survey, visits, data collection, optimized design, analysis, model development, code writing, field work etc. The same project team formed for phase –I will continue the work under the guidance of the same faculty member. For all the projects, problems may be domain specific or interdisciplinary in nature. The guide will continuously monitor and evaluate the student project. Further, a review team will rigorously evaluate the project progress and completion.

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