Academic Program: UG

Academic Year 2020-21

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)

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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 2020-21 till further revision.

Chairman BOS & HOD Principal

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

VII Semester

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/ Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration In hours
15UECC700	Real Time Operating Systems	4-0-0	4	50	100	03	-	-
15UECC701	ASIC Design	4-0-0	4	50	100	03	-	-
15UECC702	Antennas & Wave Propagation	4-0-0	4	50	100	03	-	-
15UECC703	Computer Communication Networks	4-0-0	4	50	100	03	-	-
15UECE75X	Elective –V	4-0-0	4	50	100	03	-	-
15UECE76X	Elective –VI	4-0-0	3	50	100	03	-	-
15UECL705	CCN & Embedded System Laboratory	0-0-2	1	50	-	-	50	03
15UECL704	Project Phase - I	0-0-8	4	50	-	-	50	03
		24-0-10	**28**	**400**	**600**		**100**	
Elective –V								
15UECE753	Multimedia Communication	4-0-0	4	50	100	03	-	-
15UECE754	Simulation, Modeling & Analysis	4-0-0	4	50	100	03	-	-
15UECE755	Operation Research	4-0-0	4	50	100	03	-	-
15UECE756	Automotive Electronics	4-0-0	4	50	100	03	-	-
Elective –VI								
15UECE761	Optical Fiber Communication	4-0-0	3	50	100	03	-	-
15UECE763	Adaptive Signal Processing	4-0-0	3	50	100	03	-	-
15UECE764	Design for Testability	4-0-0	3	50	100	03	-	-
15UECE765	Pattern Recognition	4-0-0	3	50	100	03	-	-

VIII Semester

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration In hours
15UECC800	Wireless Communication	4-0-0	4	50	100	03	-	-
15UECE87X	Elective –VII*	4-0-0	4	50	100	03	-	-
15UECE88X	Elective -VIII	4-0-0	3	50	100	03	-	-
15UECL801	Seminar	0-0-2	2	50	--	-	-	-
15UECL802	Project Phase - II	0-0-16	10	50	-	-	50	03
		12-0-18	**23**	**250**	**300**		**50**	
Elective –VII								
15UECE870	Re-configurable Computing	4-0-0	4	50	100	03	50	03
15UECE871	Adhoc Wireless Networks	4-0-0	4	50	100	03	-	-
15UECE872	GPU Computing	4-0-0	4	50	100	03	-	-
15UECE874	Satellite Communication	4-0-0	4	50	100	03	-	-
Elective –VIII								
15UECE880	Low Power VLSI Design	4-0-0	3	50	100	03	-	-
15UECE883	Error Control Coding	4-0-0	3	50	100	03	-	-
15UECE884	High Speed System Design	4-0-0	3	50	100	03	-	-
15UECE885	MEMS	4-0-0	3	50	100	03	-	-

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

L: Lecture **T**: Tutorials **P**: Practical **S**: Self-study

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

*Inter disciplinary elective for E&E, E&C, CSE & ISE Departments.

Total Credits offered for IV Year : 51

Interdisciplinary Elective open for all Engineering Branches :

15UMAE875 Applied Numerical Methods (VIII Sem)

15UPHE876 Nanotechnology (VIII Sem)

15UECC700	Real Time Operating Systems	(4-0-0)4

Contact hours: 52

Course Learning Objectives (CLOs):

The course focuses on real time task scheduling, modifications required in multiprocessor environment, handling of resource sharing and database requirements. Knowledge of Operating System is required as prerequisite.

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	**Identify** the principles and characteristics of real time systems.	14	-	6
CO-2	**Demonstrate** the performances of various task scheduling algorithms in RTOS.	-	3,4	13
CO-3	**Illustrate** features of RTOS and its protocols with an example.	13	3,5	-
CO-4	**Explain** the real time communication concept.		14	1
CO-5	**Design** the scheduling operations of real time tasks in Multiprocessor and **review** the real time data base concepts.	2	14	1,4

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

Pre-requisites: Basics of digital systems, Basics of operating systems

Contents:

Unit-I

Introduction: Definition of Real Time, Applications of Real-Time Systems, Basic Model of Real-Time Systems, Characteristics of Real-Time Systems, Safety and Reliability, Types of Real time Tasks, Timing Constraints, Modeling Timing Constraints.

Real-Time Task Scheduling Some Important Concepts, Types of Real Time Tasks and Their Characteristics. **10 Hrs**

Unit-II

Task Scheduling : Clock-Driven Scheduling, Hybrid Schedulers, Event-Driven Scheduling, Earliest Deadline First (EDF) Scheduling, Rate Monotonic Algorithm, Some Issues associated With Rate Monotonic Algorithm, Issues in using Rate Monotonic Algorithm in Practical Situations, Handling Resource Sharing and Dependencies Among Real-Time Tasks: Resource Sharing Among Real Time Tasks, Priority Inversion, Priority Inheritance Protocol, Highest Locker Protocol, Priority Ceiling Protocol(PCP), Different Types of Priority Inversions Under PCP, Important Features of PCP, Some Issues in using a Resource Sharing Protocol, Handling Task Dependencies. **10 Hrs**

Unit-III

Scheduling Real-Time Tasks In Multiprocessor: Multiprocessor Task Allocation, Dynamic Allocation of Tasks, Fault-Tolerant Scheduling of Tasks, Clocks In Distributed Real-Time Systems, Centralized Clock Synchronization, Distributed Clock Synchronization, Commercial Real-Time Operating Systems: Time Services, Features of Real-Time Operating System, Unix as a Real-Time Operating System, Unix - Based Real-Time Operating Systems, Windows as Real-Time Operating System, POSIX, A Survey of Contemporary Real Time Operating Systems, Benchmarking Real-Time Systems. **12 Hrs**

Unit-IV

Real-Time Communication: Examples of Applications Requiring Real-Time Communication, Basic Concepts, Real-Time Communication In a LAN, Hard Real-Time Communication In LAN, Bounded Access Protocols for LANs, Performance Comparison, Real-Time Communication over Packet Switched Networks, QOs Framework, Routing, Resource Reservation, Tate Control, QOs Models. **10 Hrs**

Unit-V

Real-Time Databases: Example Applications of Real-Time Databases, Review of Basic Database Concepts, Real-Time Databases, Characteristics of Temporal Data, Concurrency Control In Real-Time Databases, Commercial Real-Time Databases. **10 Hrs**

Activity beyond Syllabus:
Case study and Implementation of RTS

Reference Books:

1) Rajib Mall, “Real Time System Theory & Practice”, Pearson Education Asia,2008
2) Jane W.S. Liu “Real time system”, Pearson Education Asia, 2001.
3) R. Bennett, “Real time computer control”, Prentice Hall, 1994.
4) Shem Toy Levi, Ashok K. Agrawala, “Real time system design”, McGraw Hill Publishing Company,1990.
5) C.M. Krishna and Kang Shin, “real time systems”, McGraw Hill Publishing Company inc., 1997.

15UECC701 ASIC Design (4-0-0)4

Contact Hours: 52

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 ASIC design flow and its concepts.	-	1	-
CO-2	**Analyze** the challenges in designing complicated digital circuits.	-	1,2	3
CO-3	**Develop** the methods to overcome the design challenges.	3	4	-
CO-4	**Apply** the tools available to design ASIC circuits	5	-	1,2
CO-5	**Evaluate** the floor-planning, placement and routing tools for ASIC & FPGA design.	13,14	12	-

POs/PSO	**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, Channeled gate array, channel-less gate array, structured gate array, Programmable logic devices (PLD), Field–programmable gate arrays (FPGA), ASIC Design flow, Economics of ASICs, ASIC Cell Libraries. **10 Hrs**

Unit-II

Logic Design: ASIC Library Design, Data-path elements, Adders, A simple example, Multipliers Other Arithmetic and other data-path operators. Logical Effort: Predicting delays, logical areas and logical efficiency, logical paths, Multi stage cells, Optimum delay, Optimum number of stages, Library cell and architecture design. RTL design, Concept of RTL Linting, Clock domain Crossing. **10 Hrs**

Unit-III

Simulation: Concepts of logic verification, Writing Test benches, Types of simulators, the comparator/MUX example with Test bench and Test cases, Logic systems, How logic simulation works, Cell models, Delay models. Finite-state machine synthesis in Verilog. Static timing analysis, Formal verification, Design Constraints, Physical Design and Verification. **10 Hrs**

Unit-IV

Floor-planning, placement and routing: Floor-planning goals and objectives, floor planning tools, I/O and power planning, clock system routing; Placement: placement goals and objectives, placement algorithms, iterative placement improvement; Routing: Global routing, detailed routing, Special routing. **10 Hrs**

Unit-V

FPGA Design Flow: Example Actel Devices. ACT1 logic module, Shannon's expansion theorem, Multiplexer logic as function generators, ACT2 and ACT 3 logic modules. DC output, AC output, DC and AC input, Clock input, power input, boundary scan, other I/O cells. **10 Hrs**

Activity beyond Syllabus:

Case study of FPGA architectures.

Reference Books:

1) M.J.S. Smith, “Application Specific Integrated Circuits”, Pearson Education,1/e 2002.
2) Jose E. France, Yannis Tsividis, “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) Mohammed Ismail, Terri Fiez, “Analog VLSI Signal and Information Processing”, McGraw Hill, 1994.
5) Nazeih M Botros, “HDL Programming-VHDL and Verilog”, Deamtech Publications, 2006.

15UECC702 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	**Understand** 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	2.2	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. **12 Hrs**

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.

11 Hrs

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. **11 Hrs**

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
   a. India Pvt. Ltd., 2008.,John Wiley, 2003.
4) G. S. N. Raju, "Antennas and Wave Propagation", Pearson Education, 2005
   K. D. Prasad "Antenna & Wave Propagation", Satya Prakashana, New Delhi, 1999.
5) D. Kumaraswamy, M. S. Srinivas, K. Giridhar, "Antennas & Propagation", Pooja Publications, Bangalore, 2009-10.

15UECC703 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	**Understand** layere 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	-	1, 3	2

	networking.			
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 information in transport layer.	-	2,3	4

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

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 **10 Hrs**

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). **11 Hrs**

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.

15UECE753 Multimedia Communication (4-0-0) 4

Contact Hours: 52

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	**Represent** various multimedia signals such as text, audio, image and video in different formats.	-	1	-
CO-2	**Explain** various networks and techniques used for multimedia communication.	1	2	6

CO-3	**Explain** various media compression techniques and **apply** the same to compress the multimedia data.	1,2	-	13
CO-4	**Identify** various communication standards for multimedia and **apply** the same for designing the multimedia protocols.	-	3	6,13,14
CO-5	**Identify** and **explain** multimedia communication applied in various entertainment networks.	-	1,6	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.5	2.5	2	-	-	1.3	-	-	-	-	-	-	1	1

Contents:

Unit-I

Multimedia InformationRepresentation: Introduction,Text, Images, Audio, Video. **12 Hrs**

Unit-II

Multimedia Communications: Introduction, Multimedia Information Representation, Multimedia Networks, Multimedia Applications, Media Types, Communication Modes, Network Types, Multipoint Conferencing, Video Conferencing, Network QoS, Application QoS **10 Hrs**

Unit-III

Text and Image Compression: Introduction,Compression Principles, Text Compression, Image **10 Hrs**

Unit-IV

Audio and Video Compression: Introduction, Audio Compression, DPCM, ADPCM, APC, LPC, Video Compression, Video Compression Principles, H.26x Standard, MPEG, MPEG-1, MPEG-2, and MPEG-4. **08 Hrs**

Unit-V

Standards for Multimedia Communications: Introduction, Reference Models, Standards relating to Interpersonal Communications, Interactive Applications over Internet and Entertainment Applications. **Entertainment Networks:** Cable TV Networks, Satellite TV Networks, Terrestrial TV **12 Hrs**

Reference Books:

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

3) Ralf Steinmetz, KlaraNarstedt, “Multimedia Fundamentals - Media Coding and Content Processing”, vol.1, Pearson Education, 2004.
4) Prabhat K. Andleigh, KiranThakrar, “Multimedia Systems Design”, PHI, 2004.

15UECE754	Simulation Modeling and Analysis	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on simulation modeling and analysis and on the methodology needed for successful simulation. Course deals with working of simulation, modelling a system using simulation, evaluating the output of simulation and optimizing system performance.

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 **identify** different simulation models and their applicability.	1,2,9	-	7,11
CO-2	**Build** valid and credible simulation models.	1, 2,6,13	3	4
CO-3	**Assess and build** a model for input generation maintaining sample independence and arrival process.	2,3,4	5,13,14	-
CO-4	**Understand** and **utilize** randomization process while building simulation model	1,3,5,11,13	-	-
CO-5	**Interpret** the data using statistical methods.	2,11	4,6	9

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

Contents:

UNIT-I

Basic simulation modeling: Nature of simulation, System models, discrete event simulation, Steps in sound simulation, modeling complex system, List Processing in

simulation, Simple simulation language: simlib. **Building valid, credible and detailed simulation models**: Introduction and definitions, Guidelines for determining the level of model detail, Verification of simulation computer programs, Techniques for increasing model validity and credibility **10 Hrs**

UNIT-II

Selecting input probability distributions: Useful probability distributions, Assessing sample independence, Activity-I, II and III, Selecting the distribution in the absence of data, Assessing the homogeneity of difference data sets ;**Random number generators:** Linear congruential, Other kinds, Testing number generators, Random variate generation: Approaches, Continuous random variates, Discrete random variates, Correlated random variates **12 Hrs**

UNIT-III

Output data analysis: Transient and steady state behavior of stochastic Process, Types of simulations with regard to output analysis, Statistical Analysis of terminating simulations, statistical analysis of for steady state parameters, Statistical analysis for steady state cycle parameters, Multiple measures of Performance. **10 Hrs**

UNIT-IV

Comparing and Optimizing Systems: Comparing alternative system configurations, Confidence Intervals for the difference between the expected response of two systems, Confidence intervals for comparing more than two systems, Ranking and selection, Experimental Design and Optimisation,2^k factorial designs,2^{k-p} Fractional Factorial Designs, Response surfaces and meta models, Simulation based Optimization **12 Hrs**

UNIT-V

Variance-reduction Techniques: Common random numbers, Antithetic Variates, Control Variates, Indirect estimation, Conditioning **08 Hrs**

Reference Books:

1) Averill Law, "Simulation modeling and analysis", McGraw Hill 4th edition, 2007.
2) Jerry Banks, "Discrete event system Simulation", Pearson, 2009
3) Seila Ceric and Tadikamalla, "Applied simulation modeling", Cengage, 2009.
4) George. S. Fishman, "Discrete event simulation", Springer, 2001
5) Frank L. Severance, "System modeling and simulation", Wiley, 2009.

15UECE755 Operations Research (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course aims to introduce students to use quantitive 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.	1,13	2,3	4
CO-3	**Sequence** various operations in an establishment.	2	-	-
CO-4	**To understand** the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type..	2,5	7,9,10	-
CO-5	**Evaluate** various inventory control techniques and device the CPM and PERT methods for project management.	11	5	13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	1.5	1.5	2	-	2	-	-	2.5	3	-	1.75	2

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, two-phase method, degeneracy and unbound solutions. **12 Hrs**

Unit-II

Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.

Assignment Model: Formulation, Hungarian method for optimal solution Solving unbalanced problem, Traveling salesman problem and assignment problem **12 Hrs**

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, rectangular game, saddle point, mini-max (max-min) method of optimal strategies, value of the game. **12 Hrs**

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. **08 Hrs**

Beyond the Syllabus Coverage (Suggestive): Seminar on Professional Ethics

Reference Books:

1) A M Natarajan, P. Balasubramani - Operation Research
2) J.K. Sharma - Operation Research – theory and applications
3) Wayne L Winston - Operations Research- Applications and Algorithms
4) Hamdy H Taha - Operations Research- An Introduction, 7e Pearson Education/PHI -2012.

15UECE756	Automotive Electronics	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on fundamental principles of 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 of automobile system and **apply** control system approach to Engine control and **analyze** various performance parameters.	1	7	2
CO-2	**Describe** the construction and operation of various sensors and actuators used in automotive control applications.	14	3	2
CO-3	**Explain** and **apply** the concept of microcontroller and communication protocols to the design of automotive control systems and infotainment systems.	1	5	13
CO-4	**Explain** the tools used in the design of automotive systems and **Simulate** the models using MATLAB and Simulink	5	2	14
CO-5	**Analyze** and **explain** vehicle motion control system, automotive instrumentation systems and **describe** various advanced electronic features, communication protocols and diagnostics.	6	4	-

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

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

Contents:

Unit-I

Automotive Systems, Design cycle and Automotive industry overview. Overview of automotive industry, leading players, automotive supply chain, global challenges, Introduction to modern automotive systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles, Spark and compression ignition engines: Ignition systems, Fuel delivery systems. Automotive transmissions: Transmission fundamentals, types MT, AT, CVT and DCT. Vehicle braking fundamentals: Vehicle dynamics during braking, hydraulic brake system components, Introduction to antilock braking systems. Steering control: Steering system basics, Fundamentals of electronically controlled power steering: type, electronically controlled hydraulic systems and tire pressure monitoring system. EMS**:** Engine control functions, Fuel control, Electronic to generate maps, Fuel maps/tables, Ignition maps/table. Overview of hybrid vehicles.V-Model development cycle. **12 Hrs**

Unit-II

Automotive Sensors and Actuators: Systems approach to control and instrumentation: Concept of a system, Analog and digital systems, Basic measurements systems, Analog and digital signal processing, Sensors, Sensor characteristics, Sensor response, Sensor error, Examples of sensors : accelerometers, wheel speed sensors, brake pressure sensors, engine speed, steering wheel angle, vehicle speed sensor, throttle position sensor, temperature sensor, mass air flow (MAF) rate sensor, exhaust gas oxygen concentration sensor, throttle plate angular position sensor, crankshaft angular position/RPM sensor, manifold absolute pressure (MAP) sensor, differential exhaust gas pressure sensor, sensors in airbag system, Actuators used : solenoids, various types of electric motors, and piezoelectric force generators, Examples for actuators: relays, solenoids and motors. **10 Hrs**

Unit-III

Microcontrollers/Microprocessors in Automotive domain: Critical review of microprocessor and microcontroller (Overview of development within the automotive context (Architecture of 8/16 bit microcontrollers with emphasis on Ports, Timer/Counters, Interrupts. Watchdog timers, PWM), Criteria to choose the right microcontroller/processor for various automotive applications. Understanding various architectural attributes relevant to automotive applications, Automotive grade processors ex: Renesas, Quorivva, Infineon. **Communication protocols:** Overview

of Automotive communication protocols: CAN, LIN, Flex Ray, MOST, Ethernet, Wireless LANs standards such as Bluetooth, IEE802.11x communication protocols for automotive applications. **Infotainment Systems**: Application of telematics in automotive domain, Global positioning systems (GPS) and general packet radio service (GPRS). **10 Hrs**

Unit-IV

Automotive Control System & Model Based development: Control system approach in automotive: Analog and digital control methods, Modelling of linear systems, System responses, Modeling of automotive systems, Simple examples. **Model based Development:** Introduction to MATLAB, Simulink and SIMSCAPE tool boxes. Model-based design for a small system - Motor model, Generator model, Controller model. **08 Hrs**

Unit-V

Active and Passive Safety Systems: ABS, TCS, ESP, Brake assist, Airbag systems. **Advanced Driver Assistance Systems (ADAS):** Examples of assistance applications: Lane departure warning, Collision warning, Automatic cruise control, Pedestrian protection, Headlights control, Connected cars technology and trends towards autonomous vehicles. **Functional Safety:** Need for safety systems, Safety concept, Safety process for product life cycle, Safety by design, Validation **Diagnostics:** Fundamentals of diagnostics: Basic wiring system and multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. **12 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) Nijamuz Zaman, “Automotive Electronics Design fundamentals”, Springer, 2015.

18UECE761	**Optical Fiber Communication**	**(4-0-0) 3**

Contact Hours 52 Hrs

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 detectors with 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 principle 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 and their structures.	-	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 waveguides: Raytheory transmission, Modes in planar guide, Phase and group velocity, And Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single modefibers, Cutoff wavelength, Mode field diameter, effective refractive index. FiberMaterials, Photonic cystal fibers (PCF). **12 Hrs**

Unit-II

Transmission characteristics of optical fiber: Attenuation, Materialabsorption losses, Linear scattering losses, Nonlinear scattering losses, Fiberbend loss, Dispersion, Chromatic dispersion, Intermodal dispersion:Multimode step index fiber.

Optical Fiber Connectors: Fiber alignment and joint loss, Fiber splices,Fiber connectors, Fiber couplers. **10 Hrs**

Unit-III

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

Photo detectors: Physical principles of Photodiodes, Photodetector noise, Detector response time. **10 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 wave length band and transmission distance for single mode fibers, Power penalties, nodal noise and chirping.

Analog Links: Analog links – Introduction, overview of analog links, CNR, multi channel transmission techniques, key link parameters, Radio over fiber links, microwavephotonics. **10 Hrs**

Unit-V

WDM Concepts and Components: Overview of WDM: Operational Principlesof 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. **10 Hrs**

Reference Books:

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

15UECE763	Adaptive Signal Processing	(4-0-0) 3

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on principle of adaptive signal processing 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	**Describe** the principle of adaptive signal processing techniques.	-	1,2	-
CO-2	**Explain** the properties of the quadratic performance surface.	1,2	12	-
CO-3	**Synthesize** FIR digital filter with adaptive modelling techniques.	1,2	-	13
CO-4	**Estimate** gradient and variance for various signal processing techniques.	1,2	12	-
CO-5	**Apply** LMS algorithm for the noise in the weight vector analysis.	-	1,2	-

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

Pre-requisites: Digital Signal Processing

Contents:

Unit-I

Adaptive Systems: Definition and characteristics, General properties, Openand closed-loop adaptation, Areas of applications.

The Adaptive Linear Combiner: General description, Input signal and weight vectors, Desired response and error, the performance function, gradient and minimum mean square error, Example of a performance surface, Alternative expression of the gradient, Decorrelation of error and input components. **10 Hrs**

Unit-II

Searching the Performance Surface: Methods of searching the performance surface, gradient search methods, gradient search algorithm and its solution, Stability and rate of convergence, The learning curve, Gradient search by Newton's method in multidimensional space, Gradient search by the method of steepest descent, Comparison of learning curves. **11 Hrs**

Unit-II

Gradient Estimation and Its Effects on Adaptation: Gradient component estimation by derivate measurement, the performance penalty, Derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight-over solution, excess mean-square error and time constants, misadjustment, comparative performance of Newton's and steepest descent methods. **11 Hrs**

Unit-IV

The LMS Algorithm: Derivation of the LMS algorithm, convergence of the weight vector, an example of convergence, learning curve, noise in the weight-vector solution, misadjustment, performance **10 Hrs**

Unit-V

Adaptive Modeling And System Identification: General description, Adaptive modeling of multi path communication channel, adaptive modeling in geophysical exploration, Adaptive modeling in FIR digital filter synthesis. **10 Hrs**

Reference Books:

1) Bernard Widrow and Samuel D. Stearns, "Adaptive Signal Processing", Pearson Education Asia, 2001.
2) Simon Haykin, "Adaptive filter Theory", 4e, Pearson Education Asia, 2002.
3) Jopn R. Treichler C. Richard Johnson, Jr. and Michael G. Larimore, "Theory and Design of Adaptive Filters", Pearson Education, 2002.
4) Uncini, Aurelio, "Fundamentals of Adaptive Signal Processing", Springer International Publishing,2015

15UECE764	**Design for Testability**	**(4-0-0)3**

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on basics of design for testability. The course deals with the significance of testing, various aspects of testability in terms of scan rules/architectures and different fault models. The importance of test generation for combinational circuits is discussed. The techniques for automating the test pattern generation are also included.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be	**Mapping to POs (1,12) / PSOs (13, 14)**

able to:		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Understand** the importance of Testing and Levels of abstraction.	-	1,2,13	3
CO-2	**Apply** the Testability basics and scan design of given circuit.	-	1,2,3	12
CO-3	**Understand and analyze** the fault models at different abstraction levels.	-	1,2,3	12
CO-4	**Implement** the structural and non-structural test generation methods.	-	1,2,3	12,5
CO-5	**Classify** the sequential ATPG methods and faults and understand the importance of test coverage.	-	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: VLSI Design, Digital Circuit Design

Contents:

Unit-I

Importance of Testing: Testing During the VLSI Lifecycle, Challenges in VLSI Testing, Levels of Abstraction in VLSI Testing, Historical Review of VLSI Test Technology. **7 Hrs**

Unit-II

Design for Testability: Introduction, Testability Analysis, Design for Testability Basics, Scan Cell Designs, Scan Architectures, Scan Design Rules, Scan Design Flow, Special-Purpose Scan Designs, RTL Design for Testability. **12 Hrs**

Unit-III

Fault models: Levels of abstraction in Circuits, Fault models at different abstraction Levels, Inductive fault analysis, Relationship among the fault models. **7 Hrs**

Unit-IV

Test generation for combinational circuits, Introduction, Composite circuit representation and value systems, Test generation basics, Implication, Structural test generation: preliminaries, Specific structural test generation paradigms, Non-structural

test generation techniques, Test generation systems, Test generation for reduced heat and noise during test. **12 Hrs**

Unit-V

Automated Test Equipment (ATP) & ATPG: Classification of sequential ATPG methods and faults, Fault collapsing, Fault simulation, Test generation for synchronous circuits, Test generation for asynchronous circuits, Test compaction. Compression and Test Coverage, Design for Test Verification**.** **14 Hrs**

Reference Books:

1) Laung- Terangwang, Cheng-Wen Wu, Xiaoqing Wen, "Design For Testability: VLSI Test Principles and Architectures", Morgan Kaufmann Publishers, imprint of Elsevier.
2) N. K. Jha and S. Gupta, "Testing of Digital Systems", Cambridge University press, 2003.
3) Miron Abramovici, Murra.V Hill, Melvin A. Breuer, Arthur D. Friedman, "Digital systems testing and testable design", AT&T Bell Laboratories, 1990.
4) Michael L. Bushnell, Vishwani D. Agarwal, Kluwer, "Essentials of Electronic Testing", Academic Publishers, 2002.

15UECE765	**Pattern Recognition**	**(4-0-0) 3**

Contact Hours: 52

Course Learning Objectives (CLOs):

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

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 principle of various pattern recognition techniques.	-	1,2, 12	-
CO-2	**Apply** a suitable pattern recognition technique for a given data.	2,3	12,13	-
CO-3	**Compare** pattern recognition techniques	2	12	-
CO-4	**Explain** Artificial Neural Networks principle and its application to pattern	**-**	1,2	-

	recognition			
CO-5	**Illustrate** pattern recognition techniques specifically for image signal.	1,2	12	-

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

Pre-requisites: Digital Signal Processing

Contents:

Unit-I

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

10 Hrs

Unit-II

Statistical Decision Making: Introduction, Baye's Theorem, multiple features, conditionally independent features, decision boundaries, and unequal costs of error, estimation of error rates, and the leaving-one-out technique. Characteristic curves, estimating the composition of populations. **11 Hrs**

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 **11 Hrs**

Unit-IV

Artificial Neural Networks: Introduction, nets without hidden layers, Nets with hidden layers, the back propagation algorithms, Hopfield nets an application. **10 Hrs**

Unit-V

Processing of Waveforms and Images: Introduction, gray level, scaling transformations, equalization, geometric image and interpolation, Smoothing, transformations, edge detection, Laplacian and sharpening operators, line selection and template matching, logarithmic gray level sealing, the statistical significance of image features. **10 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”, John Wiley.
3) Christopher M. Bishop “Pattern Recognition and Machine Learning”, Springer, 2006
4) Lars Eldén, “Matrix Methods in Data Mining and Pattern Recognition”, Second Edition, 2019

15UECL705 CCN and Embedded System Laboratory (0-0-2) 1

Contact Hours: 36

Course Learning Objectives (CLOs):

The course focuses on programming aspects for bringing out working of various layers of computer communication protocols and different embedded applications.

Course Outcomes (COs):

Description of the Outcome - Upon completion of the course, the student will be able to:		**Mapping to POs (1-12) / PSOs (13,14)**		
		Level 3 Substantial	**Level 2 Moderate**	**Level 1 Slight**
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	2.33	2.33	2	-	-	-	-	-	-	1	-	-	2

Pre-requisites: Fundamentals of Computer Communication Networks Operating Systems, Knowledge of Embedded Systems

CCN Experiments:

1) Write a C program to simulate bit stuffing and stuffing in data frames.
2) Write a C program to simulate shortest path algorithm.
3) Write a C program to implement Sliding Window protocol.
4) Write a C program to implement Pipelining protocol which allows multiple outstanding frames.
5) Write a C program to compute the polynomial cyclic redundancy check code (CRC Code checksum) for CRC-CCITT.
6) Write a C program to simulate a positive acknowledgement with retransmission protocol.
7) Write a C program for congestion control using leaky bucket algorithm.
8) Write a C program for hamming code (error detection and error correction).

Embedded Experiments:

Note:

- Implement using RTOS Kernel either RTX, uCOS-II or FreeRTOS on LPC2148 ARM-7 kit.
- OS concepts such as task management, IPC, Semaphore, Scheduling can also be demonstrated on Linux platform using gcc.

1) Write a C program to create two tasks one to blink the 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)
2) Demonstrate Producer and Consumer problem using semaphores.
3) Demonstrate IPC using pipes and mailboxes.
4) 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, Keith W. Ross, “Computer Networks”, Pearson education, 2nd Edition, 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.

15UECL704	**Project Phase - I**	**(0-0-8)4**

Contact Hours:30

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	10	11	-

	form of a report.			
CO-5	**Inculcate** professional ethics, moral responsibilities and develop the spirit of team work.	8,9	12	-

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

VIII Semester

15UECC800	**Wireless Communication**	**(4-0-0) 4**

Contact Hours:52Hrs

Course Learning Objectives (CLOs):

The course focuses on evolution of wired Telecommunication, comparison of wireless 1G, 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 Outcome (COs):

Description of the Outcome - Upon completion of the course, the student will be able to:		**Mapping to POs (1-12) / PSOs (13,14)**		
		Level 3 Substantial	**Level 2 Moderate**	**Level 1 Slight**
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	1	1	1.2	1.6	2	2	2	-	-	1	-	1	2.5	2

levels														

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, 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. **9 Hrs**

Unit-III

Second Generation mobile system (GSM) : GSM and TDMA techniques, GSM system overview, GSM network and system architecture, GSM channel 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 and training, seminar on related latest technology.

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.

15UECE870 Re-Configurable Computing (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on key criteria: power, area, speed, optimization techniques employed, various system architectures considered in the design 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	**Demonstrate** the basics of computing required for processor speed.	-	1,2	13,14
CO-2	**Explain** the techniques of reconfiguration required for RTL synthesis.	-	1,2	-
CO-3	**Understand** FPGA design principles and logic synthesis.	1,2	-	-
CO-4	**Design** strategies for partial reconfiguration computers.	3	13,14	5
CO-5	**Analyze** and **explore** the architectural issues of High performance computers and RC 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

Pre-requisites: Knowledge of FPGA and microcontroller architecture

Contents:

Unit-I

Introduction: History, state of the art, future trends - Basic concepts and related fields of study, RC Architectures, Mapping algorithms to hardware, Field Programmable Gate Arrays, Fine-grained architectures, Coarse-grained architectures. **10 Hrs**

Unit-II

Reconfigurable Computing Systems: Parallel Processing on reconfigurable computers, A survey of RC systems, Systolic Arrays.

Languages and Compilation: Design Cycle, Languages, High level compilation Low level design. **12 Hrs**

Unit-III

Implementation: Integration, FPGA design flow, Logic Synthesis.

High Level Synthesis for reconfigurable devices: Modeling, Temporal Partitioning algorithms. **10 Hrs**

Unit-IV

Partial Reconfiguration Design: Partial Reconfiguration Design, Bitstream Manipulation with JBits, The modular Design flow, The Early Access Design Flow, Creating Partially Reconfigurable Designs, Partial Reconfiguration using Hansel-C Designs, Platform Design. **10 Hrs**

Unit-V

RC Applications: Signal and image processing applications-Reconfigurable computing for DSP, DSP application building blocks, Examples: Beamforming, Software Radio, Image and video processing, Local Neighbourhood functions, Convolution. Network Security- cryptographic algorithms, network protocol security. **10 Hrs**

Reference Books:

1) M. Gokhale and P. Graham, “Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays”, Springer, 2005.
2) C. Bobda, “Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications”, Springer, 2007.
3) C. Maxfield, “The Design Warrior's Guide to FPGAs: Devices, Tools and flows”, Newnes, 2004.
4) P. Lysaght and W. Rosenstiel, “New Algorithms, Architectures and Applications.

15UECE871	**Adhoc Wireless networks**	**(4-0-0) 4**

Contact Hours 52 Hrs

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	**Categorize** and **Study** QoS issues for wireless ad-hoc networks.	-	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	-

Pre-requisites:

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. **12 Hrs**

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. **12 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. **10 Hrs**

Unit-IV

Security: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning. **9 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 QoS solutions. **9 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.

15UECE872	GPU Computing	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

GPU Computing is an elective theory course at undergraduate VIII semester level. Knowledge of Processor architecture and a general-purpose programming language are required as prerequisite. The course focuses on GPU architecture with CUDA as example

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 need for speedy computation. **Inspect** the Parallel computation Architectures and Platforms	1	-	-
CO-2	**Illustrate** Data parallelism and CUDA Programming. **Deduce** the performance considerations with respect to integer and floating-point data, Threads	3	5	4
CO-3	**Demonstrate** the coding skills, while understanding sequential and parallel blocks, using implicit and explicit parallel dialects	-	3	-
CO-4	**Establish** the connection between latency, bandwidth and granularity**.**	-	13,14	-
CO-5	**Appreciate** the evolution of parallel computation and be in pace with technology advancements	1	12	7

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

Pre-requisites: Computer Architecture and Programming language such as C/C++ is appreciated

Contents:

Unit -I

GPUs as Parallel Computers: Architecture of a Modern GPU, Need for more Speed / Parallelism Parallel Programming Languages and Models, Overarching Goals;
Evolution of Graphics Pipelines: The Era of Fixed-Function Graphics Pipelines, Evolution of Programmable Real-Time Graphics, Unified Graphics and Computing Processors, GPGPU: An Intermediate Step, GPU Computing, Scalable GPUs, Recent Developments, Future Trends ;
Introduction to CUDA: Data Parallelism, CUDA Program Structure, A Matrix–Matrix Multiplication Example, Device Memories and Data Transfer, Kernel Functions and Threading, Function declarations, Kernel launch, Predefined variables, Runtime API **10 Hrs**

Unit -II

CUDA Threads: CUDA Thread Organization Using blockIdx and threadIdx, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance;
CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, A Strategy for Reducing Global Memory Traffic, Memory as a Limiting Factor to Parallelism **10 Hrs**

Unit -III

Performance Considerations: Wraps and Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Perfecting, Instruction Mix, Thread Granularity, Measured Performance and Summary;
Floating Point Considerations: Floating-Point Format, Normalized Representation of M, Excess Encoding of E, Representable Numbers, Special Bit Patterns and Precision, Arithmetic Accuracy and Rounding, Algorithm Considerations. **10 Hrs**

Unit -IV

Parallel Patterns : Convolution :- 1D Parallel convolution, Constant Memory and Caching, Tiled 1D Convolution with Halo elements, A simpler Tiled 1D Convolution—General Caching;

Parallel Patterns : Prefix Sum :- A Simple Parallel Scan, Work efficiency and Considerations, A work efficient Parallel Scan, Parallel Scan for Arbitrary-Length Inputs; ;

Parallel Patterns : Sparse Matrix- Vector Multiplication:- Parallel SpMv using CSR, Padding and Transposition, Using Hybrid to control padding, Sorting and Partitioning for regularization.

Parallel Programming and Computational Thinking: Goals of Parallel Computing, Problem Decomposition, Algorithm selection, Computational Thinking **12 Hrs**

Unit -V

An Introduction to Open CL: Data Parallelism Model, Device Architecture, Kernel functions, Device Management and Kernel launch, Electrostatic Potential Map in Open CL;

Parallel Programming with Open ACC: Open ACC Versus CUDA C, Execution Model, Memory Model, Basic Open ACC Programs, Future directions of OpenACC. **10 Hrs**

Reference Book:

1) David B . Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-on Approach",Third Edition, Elsevier publishers,2010
2) M. Osman Tokhi, M. Alamgir Hossain, M. Hasan Shaheed ,"Parallel Computing for Real-time Signal Processing and Contro", Springer Publication,2012
3) http://www.cs.utah.edu/~mhall/cs6963s10/
4) https://developer.nvidia.com/cuda-education-training
5) https://developer.nvidia.com/udacity-cs344-intro-parallel-programming

15UECE874	Satellite Communication	(4-0-0) 4

Contact hours: 52 Hrs

Course Learning Objectives (CLOs):

This course focuses on satellite orbits, radio wave propagation, space and earth stations, signal transmission, satellite access and satellite services.

Course Outcomes (COs):

Description of the Outcome - Upon completion 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** different orbital elements and use various principles of orbital mechanics, to **design** the satellite communication systems.	13,14	1,2,3	4,12
CO-2	**Analyze** different propagation effects and **Discuss** different antenna types and their parameters in satellite communication.	-	1,2,3,13	4,12
CO-3	**Identify** various components of satellite communication systems and **Explain** its principles of operations in satellite Communication.	-	11,13	1,2,3,4,12
CO-4	**Calculate** different transmission loss, noise parameters for the uplink and downlink design in satellite communication.	1,2,3	4,11	12
CO-5	**Analyze** various amplification and modulation techniques and **Identify** various technologies with their applications of Satellite Communication in day to day life.	-	13,14	2,5,6,7,12

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2	1.8	2	1.25	1	1	1	-	-	-	2	1	2.25	2

Pre-requisites: Analog Communication, Digital Communication, Antenna Theory

Contents:

Unit-I

Satellite Orbits : Kepler's Laws, Definitions of all orbit related terms, Orbital Elements, Apogee and Perigee Heights, Orbital Perturbations, Inclined Orbits, Geostationary orbits, Visibility Test and Look angle determination, Satellite Eclipses, Launching Orbits. **12 Hrs**

Unit-II

Radio wave Propagation and Antennas: Frequency bands**,** Atmospheric Losses, Ionosphere effects, Rain Attenuation, Reciprocity theorem, Radiation Patters, Antenna parameters, Dipole antenna, Horn antenna, Reflector antenna,AntennaPolarization. **10 Hrs**

Unit-III

Satellite Space segment and Earth Segment: Power Supply, Attitude Control, Station keeping, Thermal Control, TTC&M, Transponders, The antenna subsystem, Receive only Home TV systems, Master antenna TV systems, Community antenna TV systems, Transmit-Receive Earth Stations. **10 Hrs**

Unit-IV

The Space Link: EIRP, Transmission Losses, The link power budget equation, System Noise, C/N Ratio, The uplink, The downlink, Effects of Rain, Combined C/N Ratio, Intermediation Noise. **10 Hrs**

Unit-V

Signal Transmission and Satellite Access: Theanalog telephony and Color Television signals, Frequency Modulation, Digital baseband signals, TDM, Bandwidth Requirements, Digital Carrier Systems.

Satellite Services: DBS Television Satellite information and Home-Receiver Indoor-Outdoor Units, Satellite mobile services, VSATs, Radarsat, GPS System. **10 Hrs**

Reference Books:

1) Dennis Roody, “Satellite Communications”, 4/e, McGraw-Hill International edition, 2006.
2) Timothy Pratt, Charles W. Bostian, “Satellite communication”, John Wiley & Sons Publication, 2003.
3) J.J. Spilker, “Digital Communication by satellite”, PHI Publication, 1997.
4) J. Martin, “Communication satellite Systems”, PHI publication, 2001.

15UECE880	Low Power VLSI Design	(4-0-0) 3

Contact hours: 52

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 Outcome - Upon the completion of the course, the student will be able to:		Mapping to POs (1-12) / PSOs (13,14)		
		Level 3 Substantial	**Level 2 Moderate**	**Level 1 Slight**
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** thefeatures of synthesis tools forLow 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	-

Pre-requisites: Basics of CMOS digital circuits and Analog Mixed Mode Design.

Course Contents:

Unit I

Basics of MOS circuits: MOS Transistor structure and device modeling, MOS Inverters, MOS Combinational Circuits - Different Logic Families. **10 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. **12 Hrs**

Unit III

Switched Capacitance Minimization Approaches: Hardware Software Tradeoff, Bus Encoding, Two's complement Vs Sign Magnitude, Architectural optimization, Clock Gating, Logic styles. **10 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). **10 Hrs**

Unit V

Special Topics: Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, CAD tools for low power synthesis. **10 Hrs**

Activity beyond Syllabus:

1. Low power architectures design using Cadence and Xilinx tools
2. Seminar on low power processors and controllers.

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.

15UECE883	Error Control Coding	(4-0-0) 3

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on groups, fields and various encoding and decoding techniques namely linear block codes, BCH codes, majority logic decodable codes and convolution coding 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	**Apply** modern algebra and probability theory for the coding.	-	1,2	3
CO-2	**Design** linear block codes and cyclic codes	-	1,2	5,13
CO-3	**Analyze** and **implement** different Block code encoders and decoders.	-	1,2	3
CO-4	**Implement** majority logic decodable codes**.**	3	1,2	-
CO-5	**Adopt** encoding and decoding techniques for convolution codes.	-	1,2	-

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

Pre-requisites: Probability theory, Information theory and coding

Contents:

Unit-I

Introduction to Linear Algebra: Groups, Fields, Binary Field Arithmetic, Construction of Galois Field GF (2^m) and its basic properties, Computation using Galois Field GF (2^m) Arithmetic, Vector spaces and Matrices. **12 Hrs**

Unit-II

Linear Block Codes: Decoding circuits, Hamming Codes, Reed – Muller codes, The (24, 12) Golay code, Product codes and Interleaved codes.

Cyclic Codes: Meggitt decoder, Error trapping decoding, Cyclic Hamming codes, The (23, 12) Golay code, Shortened cyclic codes. **12 Hrs**

Unit-III

BCH Codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field Arithmetic, Implementation of Error correction. Non – binary BCH codes: q–ary Linear Block Codes, Primitive BCH codes over GF (q), Reed – Solomon Codes. **10 Hrs**

Unit-IV

Majority Logic Decodable Codes: One – Step Majority logic decoding, one–step Majority logic decodable Codes, Two–step Majority logic decoding. **09 Hrs**

Unit-V

Convolutional Codes: Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi Decoding Algorithm for decoding, Soft–output Viterbi Algorithm, Stack and Fano sequential decoding Algorithms. **09 Hrs**

Reference Books:

1) Shu Lin & Daniel J. Costello, Jr. "Error Control Coding", Pearson/Prentice Hall, Second Edition, 2004.
2) Blahut R.E., "Theory and Practice of Error Control Codes", Addison Wesley, 1984.
3) Satyanarayana P.S., "Concepts of Information Theory & coding", Dynaram Publications, Bangalore, 2005.
4) Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill Publication, 2002.

15UECE884 High Speed System Design (4-0-0) 3

Contact Hours: 52

Course Learning Objectives (CLOs):

The Course focuses on choice of components, analysis and design of high speed systems on different platforms.

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	**Define** the concept of high-speed system design. **Demonstrate** the kinds of reactance's and their impact on Speed of System**.**	1	-	-
CO-2	**Outline** the shortcomings of point to point wiring defend the importance of transmission line theory in **analyzing** high speed systems.	4	2	3
CO-3	**Illustrate** the estimation of decay time, propagation delay, role of terminations in high speed systems	-	13, 4	3
CO-4	**Survey** methods of layer stacking, vias and power systems used in high speed design.	4	-	3

CO-5	**Estimate** the timing margin and **Demonstrate** clock distribution schemes and recognize high speed interfaces	1,4,13	1,2	3,7

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.6	2	3	2.75	-	-	1	-	-	-	-	-	2.5	-

Contents:

Unit-I

Fundamentals of High Speed Design : Frequency and Time, Time and Distance, Lumped versus Distributed Systems, A note about 3dB and RMS frequencies, Four Kinds of reactance, Ordinary Capacitance, Ordinary Reactance, A better method for estimation decay time, Mutual Capacitance, Mutual Inductance

Transmission Lines: Short comings of Ordinary point to point wiring, Infinite Uniform Transmission line, Effects of Source and Load impedance, Special Transmission Line cases, Line Impedance and Propagation Delay. **12 Hrs**

Unit-II

Ground Planes and Layer Stacking : High Speed current follows the path of least inductance, Cross Talk in solid ground planes, Cross Talk in Cross Hatched Ground planes, Cross Talk with power and ground fingers ,Guard Traces, Near-End and Far-End Cross Talk, How to stack Printed Circuit Board Layers.

Terminations : End Terminations, Source Terminations, Middle terminations, AC biasing for end terminators, Resistor Selection, Cross Talk in Terminators. **10 Hrs**

Unit-III

Vias: Mechanical Properties of Vias, Capacitance of Vias, Inductance of Vias ,Return Current and its relation to Vias.

Power Systems: Providing a Stable Voltage Reference, Distributing Uniform Voltage, Every Day Distribution Problems, Choosing a Bypass Capacitor. **10 Hrs**

Unit-IV

Clock Distributions : Timing Margin, Clock Skew, Using Low Impedance, Drivers, Using Low Impedance Drivers, Using Low Impedance Clock distribution Lines, Source Termination of Multiple Clock Lines, Controlling Cross Talk on Clock lines, Delay

Adjustments, Differential Distribution, Clock Signal Duty Cycle, Cancelling Parasitic capacitance of Clock repeater, Decoupling clock receivers from clock bus. **12 Hrs**

Unit-V

I/O Interfacing: High speed serial I/O, high speed serial buses, PCI Express, USB, STATA, DPA, HDMI. **10 Hrs**

Reference Books:

1) Howard W. Johnson, Martin Graham, "High Speed Digital Design A Handbook of Black Magic", Pearson Education India, 1993.
2) James A. McCall Stephen H. Hall, Garrett W. Hall, "High Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", Wiley Publication, 2014.
3) Justin Davis, "High-Speed Digital System Design (Synthesis Lectures On Digital Circuits And Systems, M & C Publishers,2006.
4) Feng Zhang, "High-speed Serial Buses in Embedded Systems", Springer ,2020
5) Martin Plonus, "Electronics and Communications for Scientists and Engineers",Second Edition,Elsvier,2020.

15UECE885 MEMS (4-0-0) 3

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the study of various electromechanical sensors, actuators and their transduction principles at micro and nanoscale. The course covers the advanced domains of electronics, material science and mechanics at research level.

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 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

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, The multidisciplinary nature of Microsystems design and manufacture, Applications of Microsystems in automotive industry, health care industry, aerospace industry, industrial products, consumer products and telecommunications.
Scaling Laws in Miniaturization: Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling electrostatic forces, electromagnetic forces, electricity, scaling in fluid mechanics & heat transfer. **12 Hrs**

Unit-II

Transduction Principles in MEMS & Microsystems: Introduction, Micro sensors-SAW, thermal, radiation, mechanical, magnetic and bio-sensors, Various Micro actuation principles, MEMS with micro actuators, Micro accelerometers, Micro gyroscopes. **10 Hrs**

Unit-III

Microsystems Fabrication Process: Introduction, Photolithography, Ion-implantation, diffusion, oxidation, CVD, PVD, etching and materialsused for MEMS,

Some MEMS fabrication processes: surface micro-machining, bulk micromachining, LIGA process. **10 Hrs**

Unit-IV

Micro System Design and Modeling: Introduction, Design considerations: Process design, Mechanical design, Modeling using CAD tools: Multiphysics or Intellisuite or 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 **10 Hrs**

Unit-V

Micro system packaging: Over view of mechanical packaging of micro electronics micro system packaging, Interfaces in micro system packaging, Packaging technologies **10 Hrs**

Reference Books:

1) 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. Vardan, "Micro Sensors MEMS and SMART Devices", John Wiley, 2002 N. Maluf, "Introduction to Micro Mechanical Systems Engineering, Artech House", Norwood, MA, 2000.
4) Foundation of MEMS, by Chang Liu. Pearson Education. (ISBN: 9788131764756)

15UECL801	**Seminar**	**(0-0-2) 2**

Contact Hours: 30

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
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	-

15UECL802 Project Phase - II (0-0-16)10

Contact Hours: 30

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	3,4,9,13,	5,6,7	12

	form of development of software and/ or hardware prototype.	14		
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