Academic Program: UG

Academic Year 2019-20

Syllabus

VII & VIII Semester B.E.

Electronics and Communication Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution recognized 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 2019-20 till further revision.

Principal

Chairman BOS & HOD

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.

Programme Educational Objectives (PEOs):

PEOs are broad statements that describe career and professional accomplishments that the program is preparing the graduates to accomplish after few years of graduation. The PEOs are defined based on core competence, breadth of engineering knowledge, professionalism, learning environment.

The graduates, after 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.

Program Outcomes (POs):

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.

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

Scheme for VII Semester B. E (E&CE)

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	-	-
15UECL704	Project Phase - I	0-0-8	4	50	-	-	50	03
15UECL705	CCN & Embedded System Laboratory	0-0-2	1	50	-	-	50	03
15UECE75X	Elective –V	4-0-0	4	50	100	03	-	-
15UECE76X	Elective –VI	4-0-0	3	50	100	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	-	-

Scheme for VIII Semester B. E. (E&CE)

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	-	-
15UECE884	High Speed System Design	4-0-0	3	50	100	03	-	-
15UECE885	MEMS	4-0-0	3	50	100	03	-	-
15UECE883	Error Control Coding	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)

VII SEMESTER

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 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	**Identify** the principles and characteristics of various applications of real time systems.	14		6
CO-2	**Distinguish** and **demonstrate** performance of various task scheduling algorithms in RTOS.		3,4	13
CO-3	**Illustrate** the features of an example of RTOS and its protocols.	13	3,5	
CO-4	**Explain** the real time communications concept.		14	1
CO-5	**Design** the scheduling operation of real time tasks in multiprocessor.	2,14		4
CO-6	**Review** the concepts of real time data base and its applications.		14	1

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	1.5	2	2.5	3	-	-	-	-	1	-	1.33	2

Pre-requisites:

Basics of digital systems, Basics of operating systems

Course Contents:

1. **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. **05 Hrs.**
2. **Real-Time Task Scheduling** Some Important Concepts, Types of Real Time Tasks and Their Characteristics, Task Scheduling, Clock-Driven Scheduling, Hybrid Schedulers, Event-Driven Scheduling, Earliest Deadline First (EDF) Scheduling, Rate Monotonic Algorithm, Some Issues associated With RMA, Issues in using RMA 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, Different Types of Priority Inversions Under PCP, Important Features of PCP, Some Issues in using a Resource Sharing Protocol, Handling Task Dependencies. **14 Hrs.**
3. **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. **15 Hrs.**
4. **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.**
5. **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. **8 Hrs.**

Activity beyond Syllabus:
Case study and Implementation of RTS

Reference Books:

1. Rajib Mall, “Real Time System Theory & Practice”, Pearson Education Asia.
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, various circuit examples and widely used ASIC tools.

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	**Interpret** the ASIC design flow and its concepts	1	2	
CO-2	**Summarize** the challenges in designing complicated digital circuits	2,1	3	
CO-3	**Develop** the methods to overcome the design challenges	3,4,13	14	2
CO-4	**Apply** the tools available to design ASIC circuits.	4,5,13	3,14	6
CO-5	**Adapt** the floor planning, placement and routing tools to **Evaluate** ASIC circuits	13,3,4	5,2	1
CO-6	**Verify** AC/DC I/Os on ASIC circuits	6,13	2	1

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	2.2	3	2.5	2	-	-	-	-	-	-	3	2

Pre-requisites:

Analog Electronics, Network Analysis, Digital circuits, Basics of CMOS VLSI , HDL programming

Course Contents:

1. **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. **04 Hrs.**
2. **Logic Design**: ASIC Library Design, Datapath elements, Adders, A simple example, Multipliers Other Arithmetic and other datapath 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.**
3. **Logic Verification**: 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. **06 Hrs.**
4. **Logic Synthesis and Verification**: Verilog and logic synthesis-Verilog modeling, delays in Verilog, blocking and non-blocking assignments, combinational logic in Verilog, multiplexers in Verilog, the Verilog case statement, decoders, priority encoder, arithmetic, sequential logic, component instantiation and Logic synthesis. Finite-state machine synthesis in Verilog. Static timing analysis, Formal verification, Design Constraints, Physical Design and Verification. **06 Hrs.**
5. **Floor-planning, placement and routing**: Floor-planning: 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.**
6. **Programmable ASICs**: FPGAs and Memories: FPGA Economics, FPGA **06 Hrs.**

Design Flow, Practical limitations with FPGAs, Specifications, PREP benchmarks The antifuse, Metal-Metal antifuse, Static-RAM, EPROM and EEPROM technology.

7. **FPGA Design Flow**: Example Actel Devices. ACT1 logic module, Shannon's expansion theorem, Multiplexer logic as function generators, ACT2 and ACT 3 logic modules, timing model and critical path, speed grading Actel logic module analysis, Overview of Altera, FPGA and Xilinx **05 Hrs.**
8. **Programmable ASIC I/O pads**: DC output, AC output, DC and AC input, Clock input, power input, boundary scan, other I/O cells. **05 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. Janick Bergeron, "Writing Test benches: Functional Verification of HDL Models".
6. Nazeih M Botros, "HDL Programming-VHDL and Verilog", Deamtech Publications.

15UECC702 Antennas and Wave Propagation (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course starts with an introduction to Antenna basics. 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. Finally, the course ends with a discussion of various aspects of Radio Wave Propagation.

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	**Understand** the basics of Antennas	4,5	3	1,2
CO-2	**Analyze** point sources, their arrays and their characteristics.	4	1,2,3	
CO-3	**Derive** field equations for short dipole, small loop and other types of antennas.	4	1,2,3	
CO-4	**Discuss** the structures, properties and characteristics of various types of antennas.	1,6,13,14	5	
CO-5	**Design** typical Antennas for desired applications.	1,2,3,13,14	5	
CO-6	**Discuss** various modes of radio wave propagation	6,7	1,2,3,4	

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping levels	2.2	2	2.2	2.7	2.3	3	3	-	-	-	-	-	3	3

Pre-requisites:

Field Theory

Course Contents:

1. **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. **8 Hrs.**
2. **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, Nonisotropic and Dissimilar Point Sources, Linear Arrays of n **8 Hrs.**

Isotropic Point Sources of Equal Amplitude and Spacing.

3. **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 **7 Hrs.**
4. **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. **7 Hrs.**
5. **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. **12 Hrs.**
6 **Radio Wave Propagation:** Introduction, Ground wave propagation, Free Space Propagation, Ground Reflection, Surface wave, Diffraction. Tropospheric propagation: Tropospheric scatter, Ionospheric propagation, Electrical properties of the Ionosphere, Effects of earth's magnetic field. **10 Hrs.**

Activity beyond Syllabus:

Seminar on Antennas for various applications.

Reference Books:

1. John D. Krauss, "Antennas and Wave Propagation", 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.
4. Sineon R. Saunders, "Antennas and Propagation for Wireless Communication Systems, John Wiley, 2003.
5. G. S. N. Raju, "Antennas and Wave Propagation", Pearson Education

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 set and various protocols at different layers.

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	**Identify** the need for computer networking and **understand** the various network topologies, modes of communication and types of networks.		1	4
CO-2	**Describe** the layered architecture in the OSI and TCP/IP network models and functionalities of different layers.	1, 4		
CO-3	**Analyze** and **compare** various protocols for framing, error and flow control and medium access control.	1, 2	3, 14	11
CO-4	**Identify** the IEEE standards for wired and wireless networking and the significance of connecting devices.		1, 3,13	1, 2
CO-5	**Distinguish** different ways of addressing in internetworking and recommend suitable routing protocol for a typical case.	2, 3	1	
CO-6	**Analyze** different protocols for process to process delivery of information in a network.		2,3	4

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.17	2.25	2.25	1.67	-	-	-	-	-	-	1	-	2	2

Pre-requisites:

Basics of analog and digital communication

Course Contents:

1. **Introduction:** Data Communication, Networks, The Internet, Protocols and Standards. **2 Hrs.**
2. **Network Models:** Layered tasks, OSI Model, Layers in OSI model, TCP/IP Protocol Suite, Addressing **5 Hrs.**
3. **Using Telephone and cable networks for data transmission**: Telephone networks, Dial up modem, DSL, Cable TV for data transmission. **3 Hrs.**
4. **Data Link Control:** Framing, Flow and error control, Protocols for Noiseless channels and noisy channels. **8 Hrs.**
5. **Multiple Access:** Random access, Controlled access, Channelization. **6 Hrs.**
6. **Wired LANs - Ethernet:** IEEE standards, Standard Ethernet, Changes in the Standards. **4 Hrs.**
7. **Wireless LANs: IEEE 802.11, Bluetooth.** **3 Hrs.**
8. **Connecting LANs, Backbone Networks and Virtual LANs**: Connecting devices, Back bone Networks, Virtual LANs. **5 Hrs.**
9. **Network Layer:** Ipv4 addresses, Ipv6 addresses, Internetworking, Ipv4, Ipv6, and Transition from Ipv4 to Ipv6. **6 Hrs.**
10. **Network Layer - Delivery, Forwarding and Routing:** Delivery, Forwarding, Unicast Routing Protocols **6 Hrs.**
11. **Transport layer** - Process to process Delivery, UDP, TCP. **4 Hrs.**

Activity beyond Syllabus:

Study of campus networking and connecting devices located at different places,
Study of PC to PC communication.

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.

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

Course Learning Objectives (CLOs):

Project work requires creative activity and original thinking. It starts with the formulation of a problem, suggests alternative solutions and then implement one of them. The objectives of final year project are to:

- Allow students to demonstrate the skills learned 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 learned in a number of courses.
- Allow students to develop problem solving, analysis, synthesis and evaluation skills.
- Encourage teamwork.
- Improve students' communication skills through project reports and presentations of their work.

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**	**Level1 Slight**
CO-1	**Identify** societal/technical problem and **analyze** from engineering view point.	1,2		6,7
CO-2	**Search** related material from literature.	4	1	
CO-3	**Define** problem statement and **explore** possible technical solutions.	1,2,3,4	5	13,14
CO-4	**Develop** skill of summarizing technical contents and **organize** the study material in the form of a report.		11	
CO-5	**Present** the work in a systematic way.	10	11	
CO-6	**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 Levels	2.7	3	3	3	2	1	1	3	3	3	2	2	1	1

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

Course Contents:

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.

ELECTIVE V

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 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	**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		
CO-4	**Identify** various communication standards for multimedia and **apply** the same for designing the multimedia protocols.		3	6
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	-	-	-	-	-	-	-	-

Pre-requisites:

Digital Communication, Digital Switching Theory, Information Theory and Coding, Digital Signal Processing.

Course Contents:

1. **Multimedia Information Representation:** Introduction, Text, Images, Audio, Video. **08 Hrs.**
2. **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.**
3. **Text and Image Compression:** Introduction, Compression Principles, Text Compression, Image Compression **10 Hrs.**
4. **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. **10 Hrs.**
5. **Standards for Multimedia Communications:** Introduction, Reference Models, Standards relating to Interpersonal Communications, Interactive Applications over Internet and Entertainment Applications. **08 Hrs.**
6. **Entertainment Networks:** Cable TV Networks, Satellite TV Networks, Terrestrial TV Networks. **06 Hrs.**

Activity beyond Syllabus:

Mini-projects based on Multimedia concepts.

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):

The objective of this course is to introduce simulation, modeling and analysis and focus on the methodology needed for successful simulation.

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	**Understand** and **identify** different simulation models and their applicability.	1,2		
CO-2	**Build** valid and credible simulation models.	1, 2	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		
CO-5	**Interpret** the data using statistical methods.	2	4	
CO-6	**Compare and Comprehend** system configurations.		3,4	

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

Pre-requisites:

System Verilog.

Course Contents:

1. **Basic simulation modeling:** Nature of simulation, System models, discrete event simulation, Steps in sound simulation, modeling **6 Hrs.**

complex system, List Processing in simulation, Simple simulation language: simlib.

2. **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 **7 Hrs.**
3. **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. **10 Hrs.**
4. **Random number generators:** Linear congruential, Other kinds, Testing number generators, Random variate generation: Approaches, Continuous random variates, Discrete random variates, Correlated random variates. **7 Hrs.**
5. **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. **8 Hrs.**
6. **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. **9 Hrs.**
7. **Variance-reduction Techniques: Common** random numbers, Antithetic Variates, Control Variates, Indirect estimation, Conditioning. **5 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, 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	Operation Research	(4-0-0)4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course deals with managerial skills along with mathematical flavor. It focuses on various aspects of analysis so as to drive any organization towards result-oriented culture.

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	**Recognize** the need for operation research.		2,4	1
CO-2	**Design** alternate solutions for transportation problem.	1,13	2,3	4
CO-3	**Understand** Sequence of various operations in an establishment.	10,	7,8,11,12	6,9
CO-4	**Identify** suitable alternative for optimizing a given parameter in a company.	11	7,9,10	
CO-5	**Evaluate** various replacement models.	3,4	5	13
CO-6	**Explain** the inventory control techniques.		2,3,4	13,14
CO-7	**Device** the CPM and PERT methods for project management.		2,3,4,11, 13	5,9

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2	2	1.75	1.8	2	1	2	2	1.3	2.5	2.3	2	1.75	1

Pre-requisites:

Management, Entrepreneurship and IPRs.

Course Contents:

1. **Introduction to Operations Research:** Basic definitions, scope, objectives, phases, models and limitations of Operations Research. **6 Hrs.**
2. **Linear Programming Problem:** Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M method, two-phase method, degeneracy and unbound solutions. **6 Hrs.**
3. **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. **6 Hrs.**
4. **Assignment model:** Formulation. Hungarian method for optimal solution. Solving unbalanced problem. Traveling salesman problem and assignment problem. **8 Hrs.**
5. **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. **8 Hrs.**
6. **Decision tree and Game 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, minimax (maximin) method of optimal strategies, value of the game. **8 Hrs.**
7. **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. **4 Hrs.**
8. **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. **3 Hrs.**
9. **Project Management:** Phases of project management, guidelines for network construction, CPM and PERT. Resource analysis in network scheduling, updating a project. **3 Hrs.**

Activity beyond Syllabus:

Seminar on professional ethics

Reference Books:

1. Operations Research- An Introduction- Hamdy H Taha, 7e Pearson Education, 2002.
2. A. M. Natarajan, P. Balasubramani, “Operation Research”.
3. J. K. Sharma, “Operation Research – theory and applications”.
4. Wayne L Winston, “Operations Research- Applications and Algorithms”.

15UECE756 Automotive Electronics (3-2-0)4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on the concepts of automotive systems, design cycles, automotive sensors and actuators, microprocessors/microcontrollers in automotive domain, communication protocols, infotainment systems, model based development and safety systems in automobile.

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	**Understand** the role of electronics in vehicle architecture.			1,2
CO-2	**Analyze** the functionality of various sensors and actuators.	1,2		3
CO-3	**Differentiate** between various sensors and actuators.		1,2	
CO-4	**Simulate** models of various automotive control systems.		1,2,5	13
CO-5	**Understand v**arious communication systems, wired and wireless protocols.			1, 2,5
CO-6	**Analyze** advanced driver assisted systems.	1,2	14, 5	

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

Mapping Levels	2	2	1	-	1.7	-	-	-	-	-	-	-	1	2

Pre-requisites:

Knowledge of basic electronics, microcontroller, communication protocols, engine systems.

Course Contents:

1. **Automotive Systems, Design cycle and Automotive industry overview**. **16 Hrs.**

   A) Automotive Systems

   a. Overview of automotive industry, leading players, automotive supply chain, global challenges. Role of technology in Automotive Electronics and interdisciplinary design.
   b. Introduction to modern automotive systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles.
   c. Spark and compression ignition engines: Ignition systems, Fuel delivery systems.
   d. Automotive transmissions: Transmission fundamentals, types MT, AT, CVT and DCT.
   e. Vehicle braking fundamentals: Vehicle dynamics during braking, hydraulic brake system components, Introduction to antilock braking systems.
   f. Steering control: Steering system basics, Fundamentals of electronically controlled power steering: type, electronically controlled hydraulic systems and tire pressure monitoring system.
   g. EMS**:** Engine control functions, Fuel control, Electronic to generate maps, Fuel maps/tables, Ignition maps/table.
   h. Overview of hybrid vehicles.

   B) ECU Design Cycle: V-Model development cycle, Components of ECU, Examples of ECU on chassis, Infotainment, Body electronics and cluster.

2. **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 **10 Hrs.**

sensors, brake pressure sensors, seat occupancy sensor, engine speed, steering wheel angle, vehicle speed sensor, throttle position sensor, turbine speed 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.

3. Microcontrollers/Microprocessors in Automotive domain, Communication protocols, Infotainment systems **10 Hrs.**

A) Microcontrollers/Microprocessors in Automotive domain

a. 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).
b. Criteria to choose the right microcontroller/processor for various automotive applications.
c. Understanding various architectural attributes relevant to automotive applications.
d. Automotive grade processors ex: Renesas, Quorivva, Infineon.

B) Communication protocols

a. Overview of Automotive communication protocols: CAN, LIN, Flex Ray, MOST, Ethernet.
b. Wireless LANs standards such as Bluetooth, IEE802.11x communication protocols for automotive applications.

C) Infotainment Systems: Application of telematics in automotive domain, Global positioning systems (GPS) and general packet radio service (GPRS).

4. Automotive Control Systems and Model Based Development: **8 Hrs.**

A) 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.

B) Model based Development: Introduction to MATLAB, Simulink and SIMSCAPE tool boxes. Model-based design for a small system - Motor model, Generator model, Controller model, Sim driveline intro

simulink simulations, Explore the system response using different control methods. Tune the system, Explore system limitations , Understand and refine motor models, Real time simulations on a simple target (Arduino / Rasberry Pi etc), Study of modeling and simulation of any one of the automotive systems.

5. **Safety Systems in Automobiles and Diagnostic Systems**: **8 Hrs.**

A) Active and Passive Safety Systems: ABS, TCS, ESP, Brake assist, Airbag systems.

B) 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.

C) Functional Safety: Need for safety systems, Safety concept, Safety process for product life cycle, Safety by design, Validation

D) Diagnostics: Fundamentals of diagnostics: Basic wiring system and multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system. Fault finding and corrective measures, Electronic transmission checks and diagnosis, Diagnostic procedures and sequence, On board and off board diagnostics in automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze frames, History memory, Diagnostic tools, Diagnostic protocols : KWP2000 and UDS.

Activity beyond Syllabus:

Design of safety systems using automotive control systems.

Reference Books:

1. William B. Ribbens, “Understanding Automotive Electronics”, Fifth Edition.
2. Tom Denton,” Automobile Electrical and Electronic Systems”, Third edition. Year
3. Ronald K Jurgen: "Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, 1999.
4. Allan Bonnick.: “Automotive Computer Controlled Systems” Diagnostic Tools and Techniques". Elsevier Science, 2001.
5. William T.M – Automotive Electronic Systems.
6. Nicholas Navet – Automotive Embedded System Handbook, 2009.

ELECTIVE VI

15UECE761 Optical Fiber Communication (4-0-0)3

Contact Hours: 52

Course Learning Objectives (CLOs):

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

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	**Recognize** and **classify** the structures of Optical fiber and types.			1
CO-2	**Calculate** parameters like Numerical Aperture, Normalized frequency component of Step Index / Graded Index fibers in single mode and Multimode operation.	13		
CO-3	**Illustrate** the optical fiber channel impairments.	13	2	1
CO-4	**Analyze** various types of optical fiber coupling losses.	1, 2 ,4	13	
CO-5	**Classify** the Optical sources and detectors and **discuss** their principles.	4	2	1
CO-6	**Design** Analog & Digital optical fiber link.	13	3	
CO-7	**Explain** SONET/SDH network architecture and **discuss** the working principle of WDM and other passive devices of optical fiber link.			1, 2 ,3 ,13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.4	1.75	1.5	3			-	-	-	-	-	-	2.4	-

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

Course Contents:

1. **Overview of Optical Fiber Communication:** Introduction, general block diagram of optical system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber, single mode fiber, cutoff wave length, mode filed diameter, mode field diameter (MFD) and Numerical problems. **8 Hrs.**
2. **Optical Fibers:** fiber materials, Manufacturing Techniques, Inside and Outside vapor oxidation process and their types, Optical cables. **6 Hrs.**
3. **Transmission characteristics of optical fibers**: Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion. **8 Hrs.**
4. **Optical Sources and Detectors:** Introduction, LED's, LASER diodes, Photo detectors, Photo detector noise, Response time, double hetero junction structure, Photo diodes, comparison of photo detectors and sources. **10 Hrs.**
5. **Optical Receiver:** Introduction, Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection, Analog receivers. **6 Hrs.**
6. **Analog Links**: Analog links – Introduction, overview of analog links, CNR, multi channel transmission techniques, key link parameters, Radio over fiber links, microwave photonics. **6 Hrs.**
7. **Digital links** – Introduction, point–to–point links, System considerations, link power budget, rise-time budget, short wave length band, and transmission distance for single mode fibers, Power penalties, nodal noise and chirping. **4 Hrs.**
8. **Introduction to optical networks:** Network concepts, Network Topologies, Introduction to SONET / SDH networks, Optical Add / Drop Multiplexing, Wavelength Division Multiplexing (WDM) Concepts. **4 Hrs.**

Activity beyond Syllabus:

On field Training Programme at BSNL Hubli Division.

Reference Books:

1. Gerd Keiser, "Optical Fiber Communication", 4/e, MGH, 2008.
2. John M. Senior, "Optical fiber Communications", Peasrson Edun. 2/e, 2004.

3. Ramaswamy & Sivarajan, “Optical Networks 2/e Elsevier publishers
4. Govind P. Agarwal, “Fiber Optic Communication Systems”, 3/e, John Wiley India.

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 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**	**Level1 Slight**
CO-1	**Describe** the principle of adaptive signal processing techniques.	1		13
CO-2	**Explain** the key properties of the quadratic performance surface.	1, 2		
CO-3	**Synthesize** FIR digital filter with adaptive modelling techniques.	2,3	13	
CO-4	**Estimate** gradient and variance for various signal processing techniques.	3	2	
CO-5	**Apply** LMS algorithm for the noise in the weight vector analysis.	2, 3	13	
CO-6	**Differentiate** between various adaptive techniques	1	2	12

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

Pre-requisites:

Signals and systems, Digital signal processing.

Course Contents:

1. **Adaptive Systems:** Definition and characteristics, General properties, Open-and closed-loop adaptation, Areas of applications. **5 Hrs.**
2. **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. **8 Hrs.**
3. **The Adaptive Linear Combiner:** Normal of the input correlation matrix, Eigen values and Eigen vectors of the input correlation matrix, example with two weights, geometrical significance of eigenvectors and Eigen values. **8 Hrs.**
4. **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. **7 Hrs.**
5. **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. **7 Hrs.**
6. **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 **5 Hrs.**
7. **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. **5 Hrs.**
8. **Adaptive Interfacing Canceling:** The concept of adaptive noise canceling, stationary noise-canceling solutions, effects of signal components in the reference input, The adaptive interference canceller as a notch filter, The adaptive interface canceller as a high-pass filter, Effects of finite length and causality, multiple- **7 Hrs.**

reference noise canceling.

Activity beyond Syllabus:
Simulation based projects, Seminar on latest technology.

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. Jophn R. Treichler C. Richard Johnson, Jr. and Michael G. Larimore, “Theory and Design of Adaptive Filters”, Pearson Education, 2002.

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

Contact Hours: 52

Course Learning Objectives (CLOs):
The course focuses on need for design for testability, models for faults, test pattern generation for digital circuits.

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	**Demonstrate** the importance of Testing and Levels of abstraction.	1		
CO-2	**Illustrate** the Testability basics and scan design.	3	2	
CO-3	**Demonstrate** RTL coding for Testability.		3	13
CO-4	**Develop fault** models at different abstraction levels.	3,4		13,14
CO-5	**Establish** the relationship between fault models	2		4
CO-6	**Classify** sequential ATPG methods and faults. **Demonstrate** the importance of coverage.	13		14

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

Mapping Level	3	2.5	2.6	2.5	-	-	-	-	-	-	-	-	1.7	1

Pre-requisites: Knowledge of Digital Circuit Design, HDL and CMOS VLSI Design.

Course Contents:

1. **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.**
2. **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.**
3. **Fault model**s: Levels of abstraction in Circuits, Fault models at different abstraction Levels, Inductive fault analysis, Relationship among the fault models. — **6 Hrs.**
4. **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.**
5. **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**.** — **15 Hrs.**

Activity beyond Syllabus:

Fault simulation of combinational and sequential circuits.

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.
3. Miron Abramovici, Murra.V Hill, Melvin A. Breuer, Arthur D. Friedman, “Digital systems testing and testable design”, AT&T Bell Laboratories.

4. Michael L. Bushnell, Vishwani D. Agarwal, Kluwer, “Essentials of Electronic Testing”, Academic Publishers.

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 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	**Explain** the principle of various pattern recognition techniques.	1		
CO-2	**Distinguish** various pattern recognition techniques.	1	12	
CO-3	**Apply** a suitable pattern recognition technique for a given data.	2, 3	13	
CO-4	**Choose** between pattern recognition techniques to satisfy given requirement.	2, 3		12
CO-5	**Illustrate** pattern recognition techniques specifically for image signal.	3		12
CO-6	**Apply** pattern recognition techniques specifically for image signal.	2, 3	13	

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

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

Course Contents:

1. **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. **10 Hrs.**
2. **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. **12 Hrs.**
3. **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. **9 Hrs.**
4. **Clustering:** Introduction, hierarchical clustering, partitioned clustering. **5 Hrs.**
5. **Artificial Neural Networks:** Introduction, nets without hidden layers, Nets with hidden layers, the back propagation algorithms, Hopfield nets an application. **7 Hrs.**
6. **Processing of Waveforms and Images:** Introduction, gray level scaling transformations, equalization, geometric image and interpolation, Smoothing, transformations, edge detection, Laplacian and sharpening operators, line detection and template matching, logarithmic gray level sealing, the statistical significance of image features. **9 Hrs.**

Activity beyond Syllabus:

Problem solving using artificial neural networks.

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.

VIII SEMESTER

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

Contact Hours: 52

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	**Describe** the evolution and history of wireless technology with existing infrastructure of telecommunication networks	4,5,13	3	1,2
CO-2	**Identify and compare** 1G, 2G, 3G and 4G Networks	4,5,13.14	1,2,3	
CO-3	**Apply** the cellular concepts such as frequency reuse, handoff to **evaluate** the signal reception and performance of cellular systems.	4,5,13.14	1,2,3	
CO-4	**Recognize** the GSM techniques and its architecture with time slot structures.	5,6,7,13,14	1,2,3,4,	
CO-5	**Discuss** and **define** CDMA techniques with their channel structures.	5,6,7,13,14	1,2,3,4,	
CO-6	**Describe** modulation techniques in wireless networks	5,6,7,13,14	1,2,3,4,	
CO-7	**Explain** IEEE standards and protocols of wireless networks	5,6,7,13,14	1,2,3,4,	

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping levels	1.8	1.8	4.7	2	3	3	3	--	--	--	--	--	3.0	3.0

Pre-requisites:
Analog Communication, Digital Communication

Course Contents:

1. **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. **6 Hrs.**
2. **Introduction to 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. **6 Hrs.**
3. **Cellular System:** Wireless network architecture and operation, cellular concept, cell fundamentals, capacity expansion techniques, cellular backbone networks, mobility management, radio sources and power management, wireless network security, SS7. **8 Hrs.**
4. **GSM :** GSM and TDMA techniques, GSM system overview, GSM network and system architecture, GSM channel concepts, GSM identifiers **10 Hrs.**
5. **GSM system operation:** System Operation traffic cases, call handoff, roaming, GSM protocol architecture, TDMA systems. **6 Hrs.**
6. **CDMA:** CDMA technology, CDMA overview, CDMA channel concept, CDMA operations. **LTE and 4G architectures, Introduction to 5G.** **8 Hrs.**
7. **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, typical GSM hardware. **4 Hrs.**
8. **Applications:** 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. **4 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.

ELECTIVE VII

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 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	**Demonstrate** the basics of computing required for processor speed	4,13	3	1,2
CO-2	**Explain** the technique of reconfiguration required for RTL synthesis	4,13	2,3	1
CO-3	**Analyze** the bottlenecks for optimization involved in achieving parallelism.	3,13,14	5,2	1
CO-4	**Design** strategies for Hybrid Architectures	3,13,14	1	5,2
CO-5	**Analyze** and explore the architectural issues of High Performance	4,2	13	1

	Computers			
CO-6	**Analyze** the applications of Reconfigurable Computing.	4,13,14	1,2	3

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.33	1.83	2.6	3.0	1.5	-	-	-	-	-	-	-	3.0	3.0

Pre-requisites:

Knowledge of FPGA and microcontroller architecture.

Course Contents:

1. **Introduction:** History, state of the art, future trends - Basic concepts and related fields of study - Performance, power, and other metrics - Algorithm analysis and speedup projections - RC Architectures - Device characteristics - Fine-grained architectures – Coarse-grained architectures . **9 Hrs.**
2. **FPGA Design:** FPGA Physical Design Tools -Technology mapping - Placement & routing - Register transfer (RT)/Logic Synthesis - Controller/Data path synthesis - Logic minimization. **12 Hrs.**
3. **Parallel Processing:** RC Application Design - Parallelism - Systolic arrays -Pipelining - Optimizations - Bottlenecks - High-level Design - High-level synthesis - High-level languages - Design tools. **10 Hrs.**
4. **Architectures:** Hybrid architectures- Communication - HW/SW partitioning - Soft-core microprocessors- System architectures - System design strategies - System services - Small-scale architectures - HPC architectures - HPEC architectures - System synthesis - Architectural design space explorations **11 Hrs.**
5. **Case Study:** Case Studies- Signal and image processing - Bioinformatics - Security - Special Topics - Partial Reconfiguration - Numerical Analysis -Performance Analysis/Prediction - Fault Tolerance. **10 Hrs.**

Activity beyond Syllabus:

Simple examples may be given on the various concepts/algorithms for better understanding of the subject, Mini project on Image processing using Reconfigurable Hardware.

Reference Books:

1. C. Maxfield, “The Design Warrior's Guide to FPGAs: Devices, Tools and flows”, Newnes, 2004.
2. M. Gokhale and P. Graham, “Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays”, Springer, 2005.
3. C. Bobda, “Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications”, Springer, 2007.
4. P. Lysaght and W. Rosenstiel, “New Algorithms, Architectures and Applications for Reconfigurable Computing”, Springer, 2005.
5. D. Pellerin and S. Thibault, “Practical FPGA Programming in C”, Prentice-Hall, 2005.
6. W. Wolf, “FPGA Based System Design”, Prentice-Hall, 2004.

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

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on functions and protocols of Adhoc Wireless Networks.

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	**Describe** typical issues in ad-hoc/sensor networks.		13	1,2
CO-2	**Discuss** and **analyze** the challenges in designing MAC protocols and **classify** them for ad-hoc wireless networks.	1,2,13	3	
CO-3	**Discuss** and **analyze** the challenges in designing routing protocols and **classify** them for ad-hoc wireless networks.	1,2,13	3	
CO-4	**Discuss** the challenges in designing transport layer protocols for wireless ad-hoc/sensor networks.		1,2,3,13	
CO-5	**Describe** security issues and QoS requirements and **Classify** QoS		3,13	1,2

	solutions.			

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

Pre-requisites:

Computer Communication Networks, Basic Wireless Communication Concepts

Course Contents:

1. **Ad Hoc Networks:** Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet. **8 Hrs.**
2. **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, Classification of MAC protocols, Contention - based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols. **16 Hrs.**
3. **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. **16 Hrs.**
4. **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. **4 Hrs.**
5. **Security:** Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning. **4 Hrs.**
6. **Quality Of Service In Ad Hoc Wireless Networks:** Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions. **4 Hrs.**

Activity beyond Syllabus:

Simulation of Protocols using open source software.

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.
3. Cheng, Xiao Hung, Ding- Zhu Du, Kluwer, “Adhoc wireless Networking”, Xiuzhen Academic publishers.

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

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on architecture of modern GPU as parallel computers and evolution of graphic pipelines with CUDA as an execution environment.

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	**Demonstrate** the need for speed in modern computations and establish the path towards it	1		
CO-2	**Demonstrate** the floating point representation and operations.	1		
CO-3	**Illustrate** Data parallelism and CUDA Programming	3	5	4
CO-4	**Demonstrate** the coding skills, while understanding sequential and parallel blocks, using implicit and explicit parallel dialects		3	
CO-5	**Establish** the connection between latency, bandwidth and granularity**.**		13,14	
CO-6	**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	-	2.5	1	1	-	-	-	-	-	-	2	2	2

Pre- requisite:

Knowledge of computer organization and architecture**.**

Course Contents:

1. **GPUs as Parallel Computers:** Architecture of a Modern GPU, Why More Speed or Parallelism?, Parallel Programming Languages and Models, Overarching Goals **3 Hrs.**
2. **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 **4 Hrs.**
3. **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 **8 Hrs.**
4. **CUDA Threads:** CUDA Thread Organization Using blockIdx and threadIdx, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance **7 Hrs.**
5. **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. **8 Hrs.**
6. **Performance Considerations:** More on Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of SM Resources, Data Perfecting, Instruction Mix, Thread Granularity, Measured Performance and Summary **12 Hrs.**
7. **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.**

Reference Books:

1. David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors: A

Hands-on Approach", Elsevier publishers.
2. http://www.cs.utah.edu/~mhall/cs6963s10
3. https://developer.nvidia.com/get started parallel computing (free course on Udacity)

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

Contact Hours: 52

Course Learning Objectives (CLOs):

The 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)**		
		Level 3 Substantial	**Level 2 Moderate**	**Level 1 Slight**
CO-1	**Identify** various components of satellite communication systems.		1, 3,	6,11
CO-2	**Explain** principle of operation of each component involved in satellite Communication.	1	2,3	11
CO-3	**Apply** various principles of orbital mechanics, antenna design and modulation techniques to **design** the satellite communication systems.	1,2,3	13	4
CO-4	**Analyze** various amplification and modulation techniques	2		1,3
CO-5	**Analyze** the effects of channel noise and interference on communication.	2	1	3
CO-6	**Identify** various technologies and applications of Satellite Communication in day to day life		3,12	7,11

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.2	2.7	1.8	1	-	1	-	-	-	-	1	2	2	-

Pre-requisites:

Knowledge of Analog Communication, Digital Communication and Antenna Theory

Course Contents:

1. **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. **10 Hrs.**
2. **Radio wave Propagation and Antennas:** Frequency bands, Atmospheric Losses, Ionospheric effects, Rain Attenuation, Reciprocity theorem, Radiation Patters, Antenna parameters, Dipole antenna, Horn antenna, Reflector antenna. Antenna Polarization. **8 Hrs.**
3. **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.**
4. **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, Intermodulation Noise. **10 Hrs.**
5. **Signal Transmission and Satellite Access:** The analog telephony and Color Television signals, Frequency Modulation, Digital baseband signals, TDM, Bandwidth Requirements, Digital Carrier Systems. **10 Hrs.**
6. **Satellite Services**: DBS Television Satellite information and Home-Receiver Indoor- Outdoor Units, Satellite mobile services, VSATs, Radarsat, GPS System. **4 Hrs.**

Activity beyond Syllabus:

Organizing video lectures.

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.

ELECTIVE VIII

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

Contact Hours: 52

Course Learning Objectives (CLOs):

This course deals with the techniques of power saving in design of VLSI circuits.

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	**List** the factors affecting the power requirement in design of VLSI circuits.	2,3,13		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** switched capacitance minimization approaches	1,2	1,2	
CO-6	**Investigate** leakage power minimization techniques	2,4	2,4	

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

Pre-requisites:

Basics of CMOS digital circuits and Analog Mixed Mode Design.

Course Contents:

1. **Basics of MOS circuits:** MOS Transistor structure and device modeling, MOS Inverters, MOS Combinational Circuits - Different Logic Families **12 Hrs.**
2. **Sources of Power dissipation:** Dynamic Power Dissipation, Short Circuit Power, Switching Power, Glitching Power, Static Power Dissipation, Degrees of Freedom **8 Hrs.**
3. **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. **8 Hrs.**
4. **Switched Capacitance Minimization Approaches:** Hardware Software Tradeoff, Bus Encoding, Two's complement Vs Sign Magnitude, Architectural optimization, Clock Gating, Logic styles. **8 Hrs.**
5. **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) **8 Hrs.**
6. **Special Topics:** Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, CAD tools for low power synthesis. **8 Hrs.**

Activity beyond Syllabus:

Low power architectures design using Cadence and Xilinx tools, 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.
5. A. Bellamour and M. I. Elmasri, "Low power VLSI CMOS circuit design" Kluwer Academic, 1995.

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 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	**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	13,4		3
CO-6	**Recognize** high speed I/O interfaces**.**	1		7

POs/PSOs	1	2	3	4	5	P6	7	8	9	10	11	12	13	14
Mapping Level	1	1	0.7	2.7	-	-	-	-	-	-		-	2.5	-

Pre-requisites:

1. Fundamentals of Transmission Lines.
2. Fundamentals of Digital circuits.

Course Contents:

1. **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. **6 Hrs.**
2. **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. **8 Hrs.**
3. **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
4. **Terminations :**End Terminations, Source Terminations, Middle terminations, AC biasing for end terminators, Resistor Selection, Cross Talk in Terminators **6 Hrs.**
5. **Vias:** Mechanical Properties of Vias, Capacitance of Vias, Inductance of Vias ,Return Current and its relation to Vias **4 Hrs.**
6. **Power Systems:** Providing a Stable Voltage Reference, Distributing Uniform Voltage, Every Day Distribution Problems, Choosing a Bypass Capacitor **6 Hrs.**
7. **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. **8 Hrs.**
8. **I/O Interfacing**: High speed serial I/O, high speed serial buses, PCI Express, USB, STATA, DPA, HDMI **6 Hrs.**

Activity beyond Syllabus:
Case study of high speed system design

Reference Books:
1. Howard W. Johnson, Martin Graham, "High Speed Digital Design A Handbook of Black Magic", Pearson Education India, 1993.
2. Online resources on high speed systems.

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 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	**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 being 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 softwares and perform simulations.	5	2,3	-

CO-5	**Classify** various micro system packaging technologies related to MEMS.	2	3	-
CO-6	**Identify** the technological changes involved in the transformation from MEMS to next generation NEMS.	-	2	12,14

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

Pre-requisites:

Physics, Electronics, Engineering Mathematics, Material Science, Basic Mechanical principles

Course Contents:

1. **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. **8 Hrs.**
2. **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. **8 Hrs.**
3. **Transduction Principles in MEMS & Microsystems:** Introduction, Micro sensors- thermal, radiation, mechanical, magnetic and bio-sensors, Micro actuation, MEMS with micro actuators. **8 Hrs.**
4. **Microsystems Fabrication Process:** Introduction, Photolithography, Ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, Some MEMS fabrication processes: surface micro-machining, bulk micromachining, LIGA process, LASER micro machining, MUMPS. **8 Hrs.**

5. **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 (MOEMS), Design and Modeling: case studies - i) Cantilever beam ii) Micro switches **12Hrs.**
6. **Micro system packaging:** Over view of mechanical packaging of micro electronics micro system packaging, Interfaces in micro system packaging, Packaging technologies **8 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.

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

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on various error detection and error correction coding techniques.

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	**Apply** and **calculate** Galois field arithmetic for error control coding techniques in digital communication and data storage systems	3,4,13,14	1,2,6	
CO-2	**List** and **state** structural, distance	4,13	1,3	

	properties of error control codes.			
CO-3	**Explain** and **analyze** different error control codes like, Linear block codes, cyclic codes, BCH codes, MLD codes, convolution codes, Concatenated, Turbo and burst error correcting codes	3,13	1,2	
CO-4	**Design** and **Implement** different error control codes.	3,4,13,14	1,2	
CO-5	**Choose** and **adapt** error control coding techniques for different applications.	3,4,13	1,2	

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

Pre Requisites:
Digital communication

Course Contents:

1. **Introduction to Algebra:** Groups, Fields, Binary Field Arithmetic, Construction of Galois Field GF (2m) and its basic properties, Computation using Galois Field GF (2m) Arithmetic, Vector spaces and Matrices. **12 Hrs.**
2. **Linear Block Codes:** Generator and Parity check Matrices, Encoding circuits, Syndrome and Error Detection, Minimum Distance Considerations, Error detecting and Error correcting capabilities, Standard array and Syndrome decoding, Decoding circuits, Hamming Codes, Reed – Muller codes, The (24, 12) Golay code, Product codes and Interleaved codes. **6 Hrs.**
3. **Cyclic Codes:** Introduction, Generator and Parity check Polynomials, Encoding using Multiplication circuits, Systematic Cyclic codes – Encoding using Feedback shift register circuits, Generator matrix for Cyclic codes, Syndrome computation and Error detection, Meggitt decoder, Error trapping decoding, Cyclic Hamming codes, The (23, 12) Golay code, Shortened cyclic codes. **8 Hrs.**

4. **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. **12 Hrs.**
5. **Majority Logic Decodable Codes:** One – Step Majority logic decoding, one – step Majority logic decodable Codes, Two – step Majority logic decoding. **5 Hrs.**
6. **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. **9 Hrs.**

References:

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.

15UECL801	Seminar	(0-0-2) 2

Course Learning Objectives (CLOs):

The objective of seminar is to prepare the students for independent study of the state of the art topics in a broad area of interest. The students are exposed to the aspects of seminar presentation such as literature survey, organization of the material, technical writing and presentation skills.

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	**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		
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 Levels	2.5	2.5	-	-	-	1	1	3	3	3	-	1	-	-

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

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.
- Improve students' communication skills by writing two professional reports (one at the end of odd semester and another at the end of even semester) and by giving presentations on their work.

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	**Level 2**	**Level 1**

		Substantial	Moderate	Slight
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	1 0	11	12	13	14
Mapping level	3	3	3	2.5	1	2	2	3	3	2.5	2.5	1.3	3	3

15UMAE875 Applied Numerical Methods (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

Study the numerical methods to solve algebraic, transcendental equations, partial differential equations and boundary value differential equations.

Course Outcomes(COs):

At the end of this course, students should meet the learning objectives through following observable and measurable outcomes by undergoing various tests planned by the course teacher as a part of course plan.

COs	Description of course outcomes
CO-1	**Obtain** the solution of algebraic and Transcendental equations.

CO-2	**Employ** interpolation and extrapolation to **analyze** the experimental data and predict.
CO-3	**Apply** Numerical method to solve boundary valued differential equation.
CO-4	**Apply** Numerical Integration to Compute Area and Volume.
CO-5	**Apply** the concept of Rank to solve Engineering Application Problem
CO-6	**Apply** suitable Numerical methods to solve partial differential equation.

Contents:

1. **Numerical solution of Algebraic and Transcendental equations:** Fixed point iteration method, Aitken's process method, Newton-Raphson method for a system of two simultaneous equations. Homer's method, Grafee's root squaring method, Birge-Vietta method. **10 Hrs**
2. **Interpolation:**
   Central differences, central difference interpolation formulae. Gauss's forward interpolation formula. Gauss's backward interpolation formula, Stirling's interpolation formula, Everett's interpolation formula, Bessel's interpolation formula. Hermite and Cubic Spline interpolation. Richardson extrapolation. **12Hrs**
3. **Numerical Differentiation and Integration:**
   Derivatives using Stirling's formula, Bessel's formula. Romberg integration. Gaussian quadrature, double integration by Trapezoidal and Simpson's $1/3^{rd}$ rules.
4. **Numerical solution of ODE:**
   Picard's method. Taylor's series method for simultaneous first order ordinary differential equations and second order O.D.E's. Runge-Kutta method for simultaneous first order O.D.E and second order O.D.E, Linear Shooting method, Finite difference method and Rayleigh -Ritz method. **10 Hrs**
5. **Linear Algebra:**
   Condition number of a matrix, Matrix inversion method, LU factorization method **(C**routs method), Partition method. Relaxation method, Bounds for Eigen values, Jacobi's method. Given's method. **10 Hrs**
6. **Numerical solution of PDE:**
   Numerical solution of one dimensional heat equation. Bendre-Schmidt's method. Crank Nicolsen method. Numerical solution of one dimensional

wave equation; explicit method- problems. Numerical solution of two dimensional Laplace equation. Gauss-Seidel method problems. **10 Hrs**

Reference Books:

1. Richard. L. Burden, J. Douglas Faires, Numerical Analysis, Thompson Publishing Company edition - 2001.
2. M.K. Jain, S.R.K. lyengar and R.K. Jain - Numerical methods for scientific and Engineering computation New Age Internationa! Publisher - 5lh edition - 2007.
3. Anthony Ralston, Philip Rabinowitz - A first course in Numerical Analysis - McGraw Hill Publication - 2"J edition – 2001
4. B.S.Grewal-Numerical methods in engineering and science- Khanna Publishers 9th edition- 2010.
5. Thomas G.B. and Finney R.L."Calculus and Analytical Geometry" 9th Edition, Pearson, 2012.

15UPHE876	Nanotechnology	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn about the fundamentals and integrated multidisciplinary nature of nanotechnology and to understand the importance of materials at the nanoscale, size and shape dependent properties, classification of materials, different methods to prepare nanostructures. The course covers the various nanofabrication and hybrid fabrication approaches and characterization techniques. Finally, they are expected to be acquainted with the significance of nanomaterials.

Course Outcomes (COs): At the end of the course, the student will be able to **:**

COs	Description of the course outcomes
CO-1	**Specify** the holistic view of nanoscience, nanotechnology and the effect of quantum confinement in nanostructures.
CO-2	**Describe** the importance of basic scientific concepts related to the behavior of matter at the nanoscale.
CO-3	**To impart** the basic knowledge on various preparation techniques involved in nanotechnology and interpret the importance of carbon

	clusters.
CO-4	**Demonstrate** the different lithographic techniques and applications of characterization techniques.
CO-5	**Evaluate** the merit of nanocomposites materials and different applications of nanomaterials.

Course Contents:

1. **Basics of Nanoscale Materials:** **12 Hrs.**

   Introduction: Nanoscale materials, concepts of nanoscience and nanotechnology, importance of nanotechnology. classification of nanomaterials – shape and intrinsic. Physics of nanomaterials – size and surface effects, variation of density of states, size and shape dependent properties of nanomaterials.

   Metal and Semiconductor Nanocrystals:

   Metal nanocrystals – Plasmons, Surface Plasmon Resonance (SPR) - Gold, silver & iron nanoparticles. Semiconductor nanocrystals (Quantum Dots) and their importance – Variation of energy gap with particle size. Organic capping, core shell structures and self assembly-Intermolecular forces.

2. **Carbon Nanoclusters and Synthesis of Nanomaterials:** **12 Hrs.**

   Carbon clusters: Fullerenes, graphene and carbon nanotubes - types of carbon nanotubes: Synthesis, Properties - electrical, thermal, Mechanical and chemical properties. Importance of carbon clusters.

   Top-down and Bottom-up approaches: Chemical vapour deposition (CVD), ion sputtering, laser ablation, molecular beam epitaxy, chemical precipitation, solvothermal synthesis, micelles & green nanotechnology.

3. **Fabrication and Characterization of Nanostructures:** **12Hrs**

   Nanolithography: Introduction, photo lithography (Optical, UV & EUV), Electron beam, X- ray lithography, Dip-pen lithography, immersion lithography, Nanoimprint lithography and Soft lithography.

   Characterization Techniques: Optical and photoluminescence spectroscopy, field emission scanning electron microscopy (FESEM), Scanning Tunneling Microscopy, transmission electron microscopy (TEM), HR TEM, SAED, EDAX, X-ray diffraction and electron

diffraction, Atomic Force Microscopy, Scanning Tunneling Microscopy.

4. **Nanocomposite Materials:** **08 Hrs.**
   Introduction - Ceramic based composites, metal-matrix nanocomposites, polymer-based nanocomposites, graphene and carbon nanotube based nanocomposites. Thermal and electrical properties nanocomposites.
5. **Applications of Nanomaterials:** **08 Hrs.**
   Fundamentals of Charge transport, concept of mobility, self-assembly, assembly components Coulomb Blockade and single-electron tunneling. Hybrid solar cells based on different types of nanostructures. Fuel cells and nanosensors.

Activity beyond Syllabus: Seminars on relevant topics.

References Books:

1. Sulabha K Kulkarni, Nanotechnology-Principles and Practices, Capital Publishing Company, 2007.
2. T. Pradeep, “Nano: The Essentials” Tata McGraw Hill Education Pvt Ltd., 2013.
3. James Murday, “Textbook of Nanoscience and Nanotechnology” Universities Press-IIM, 2012.
4. Charles. P. Poole and F. J. Owens, Introduction to Nanotechnology, John Wiley & Sons, Inc. 2003.
5. P. Mukhopadhyay and R. K. Gupta, Graphite, Graphene and their polymer nanocomposites. CRC Press, Taylor & Francis Group. 2012