M. Tech.

Electronics

and

Communication Engineering

CBS w.e.f. 2015-2016

Department of Electronics & Communication Engineering

Semester	Total Credits
I.	**26**
II.	**22**
III.	**14**
IV.	**8**
Grand Total	**70 Credits**

- 04 Contact Hrs per week are required for each theory subject including electives. However 03 Contact Hrs per week are required for Open Electives Subjects.
- 04 Contact Hrs per week are required for each lab.
- 02 Hrs per student per week teaching load will be assigned for thesis work for part I and Part II.

First Semester

List of Compulsory/Core Courses

Sr. No.	Course	Code	Credit	Semester
1	IC Fabrication Technology	ECL-712	4	1st
2	Digital VLSI Design	ECL-713	4	1st
3	Hardware Description Languages	ECL-714	4	1st
4	Embedded System Design	ECL-715	4	1st
5	Signal Processing	ECL-719	4	1st
6	Digital VLSI Design Lab	ECP-716	2	1st
7	HDL Lab	ECP-717	2	1st
8	Embedded System Design Lab	ECP-718	2	1st
		Total Credits	**26**	

Second Semester

List of Compulsory/Core Courses

Sr. No.	Course	Code	Credit	Semester
1	Mobile Communication	ECL-721	4	2nd
2	Advanced Optical Communication Systems	ECL-722	4	2nd
3	Analog IC Design	ECL-723	4	2nd
4	Adaptive Signal Processing	ECL-724	4	2nd
	Elective-I		4	
5	Adaptive Signal Processing Lab	ECP-726	2	2nd
		Total Credits	**22**	

List of Electives-I: The student can opt any one elective from the following list.

Sr. No.	Course	Code
1	Algorithms for VLSI Design Automation	ECL-725(i)
2	Advanced Computer Architecture	ECL-725(ii)
3	MEMS and IC Integration	ECL-725(iii)

Third Semester

List of Compulsory/Core Courses

Sr. No.	Course	Code	Credit	Semester
1	Elective-II		3	3rd
2	Elective-III (Open Elective)		3	3rd
3	Advance VLSI Design Lab	ECP-732	2	3rd
4	Communication System Design Lab	ECP-733	2	3rd
5	Thesis – Part I	ECD-730	3	3rd
6	Seminar	ECD-735	1	3rd
		Total Credits	**14**	

List of Electives-II: The student can opt any one elective from the following list.

Sr. No.	Course	Code
1	Mixed-Signal Design	ECL-731(i)
2	RF Micro-electronics	ECL-731 (ii)
3	VLSI Testing And Testability	ECL-731 (iii)
4	Memory System Design	ECL-731 (iv)
5	Low Power VLSI Design	ECL-731 (v)
6	Embedded System for Wireless & Mobile Communication	ECL-731 (vi)
7	Hardware & Software Co-Design	ECL-731 (vii)
8	Advanced Digital Communication	ECL-731 (viii)
9	Satellite Communication	ECL-731 (ix)

List of Electives-III (Open Elective): The student can opt any one Open elective from the following list. If the no. of students in a particular open elective is less than 15, it will not be offered.

Sr. No.	Course	Code
1	Advanced Printing Technology	MTPT 700
2	Introduction to Soft Computing Techniques	CSE 700
3	Advancements in Communication System	ECE 700
4	Biomedical Instrumentation	BME 700
5	Computer Aided Design & Manufacturing	ME 700

M.Tech (ECE) Fourth Semester

Sr. No.	Course	Code	Credit	Semester
1	Thesis – Part-II	ECD-740	8	4th

Prof. Mridula Gupta 12/7/15

Prof. Sandeep K. Arya 12/7/15

Mr. Manoj Goel

Dr. Sanjeev Dhull 12/7/15

Dr. Deepak Kedia

Mr. Ramnish

Guru Jambheshwar University of Science & Technology, Hisar

Department of Electronics & Communication Engineering

First Semester

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-712	IC Fabrication Technology	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Microelectronics
Course Objectives: This is the very first course for the post-graduate students. This course first gives the knowledge of the necessary environment conditions for the integration technology. All the fabrication processes are then discussed step-by step which includes wafer cleaning, wet etching, ion implantation, oxidation, lithography, chemical Vapour deposition, metal film deposition, etching and then safe packaging.
Course Outcomes:

CO-1 Understanding of different techniques and measures for IC fabrication.
CO-2 Ability to apply fabrication principles in industry as a fabrication engineer.
CO-3 Ability to contribute for further research in IC fabrication.

UNIT-1

Environment for VLSI Technology: Clean room and safety requirements. Wafer cleaning processes and wet chemical etching techniques.
Impurity incorporation: Solid State diffusion modelling and technology; Ion Implantation modelling, technology and damage annealing; characterization of Impurity profiles.

UNIT-2

Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultrathin films. Oxidation technologies in VLSI and ULSI; Characterizations of oxide films; High k and low k dielectrics for ULSI.
Lithography: Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI; Mask generation.

UNIT-3

Chemical Vapour Deposition techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; Epitaxial growth of silicon; modelling and technology.
Metal film deposition: Evaporation and sputtering techniques. Failure mechanisms in metal interconnects; Multi-level metallization schemes.

UNIT-4

Plasma and Rapid Thermal Processing: PECVD, Plasma etching and RIE techniques; RTP techniques for annealing, growth and deposition of various films for use in ULSI. Process integration for NMOS, CMOS and Bipolar circuits; Advanced MOS technology.

Texts/References Books:

1. S.K. Gandhi, VLSI Fabrication Principles, John Wiley Inc., New York, 1994(2nd Edition).
2. S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill, 1988.

3. Plummer, Deal, Griffin “Silicon VLSI Technology: Fundamentals, Practice & Modeling” PH, 2001.
4. P. VanZant, “Microchip Fabrication”, 5th Edition, MH, 2000.

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-713	**Digital VLSI Design**	**Core**	**4**	**4**	**0**

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Digital Electronics
Course Objectives: This course is intended to be used for the first year post- graduate students. This course aims at covering first the basic building block of the VLSI circuits, that is, MOSFET and then the design equations for MOS, transistor sizing, various logic circuits design using MOS transistor. Memory designs and layouts are also covered under this course.
Course Outcomes:

- CO-1 Understanding of building blocks of VLSI circuits and design equations.
- CO-2 Gain knowledge of design principles and layouts of various logic circuits.
- CO-3 Ability to identify and analyze problems in digital VLSI circuits.
- CO-4 Apply subject knowledge of digital circuit design through software tools for advanced research.

UNIT-1

Introduction to MOSFETs: MOS Transistor Theory - Introduction MOS Device, Fabrication and Modeling, Body Effect, Noise Margin; Latch-up.

UNIT-2

MOS Inverter : MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations, Static Load MOS Inverters, Transistor Sizing, Static and Switching Characteristics; MOS Capacitor; Resistivity of **V**arious Layers.
Symbolic and Physical Layout Systems: MOS Layers Stick/Layout Diagrams; Layout Design Rules, Issues of Scaling, Scaling factor for device parameters.

UNIT-3

Combinational MOS Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates, Primitive Logic Gates; Complex Logic Circuits.
Sequential MOS Logic Circuits: SR Latch, clocked Latch and flip flop circuits, CMOS D latch and edge triggered flip flop.

UNIT-4

Dynamic Logic Circuits: Basic principle, non-ideal effects, domino CMOS Logic, high performance dynamic CMOS Circuits, Clocking Issues, Two phase clocking.
CMOS Subsystem Design: Semiconductor memories, memory chip organization, RAM Cells, dynamic memory cell.

Text books:

1. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits: Analysis andDesign, Third Edition, MH, 2002.

Reference books:

1. W. Wolf, Modern VLSI Design: System on Chip, Third Edition, PH/Pearson, 2002.
2. N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design: A SystemsPerspective, Second Edition (Expanded), AW/Pearson, 2001.
3. J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A DesignPerspective, Second Edition, PH/Pearson, 2003.
4. D. A. Pucknell and K. Eshraghian, Basic VLSI Design: Systems and Circuits, Third Edition, PHI, 1994.
5. J. P. Uyemura, CMOS Logic Circuit Design, Kluwer, 1999.
6. J. P. Uyemura, Introduction to VLSI Circuits and System, Wiley, 2002.
7. R. J. Baker, H. W. Li and D. E. Boyce, CMOS Circuit Design, Layout andSimulation, PH, 1997.

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-714	Hardware Description Languages	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Digital Electronics
Course Objective: This course is for first year post graduation students. This course is designed to make students learn VHDL that is one of the popular hardware descriptive languages. The course begins with the introduction of Hardware design and Design Methodologies. Basic and advanced concepts required to write a VHDL code are covered in detail. At the end a brief Introduction of Another popular hardware descriptive language Verilog is included.

Course Outcomes:

CO-1 Gain knowledge of hardware design methodologies using VHDL & Verilog.

CO-2 Ability to white VHDL code in various modelling styles i.e. structural, behavioral and sequential.

CO-3 Ability to develop circuits and project for professional development.

UNIT-1

Introduction to Hardware Design: Digital System Design Process, Hardware Description Languages, Hardware Simulation, Hardware Synthesis, Levels of Abstraction.

VHDL Background: VHDL History, Existing Languages, VHDL Requirements, the VHDL Language.

UNIT-2

Design Methodology Based On VHDL: Elements of VHDL, Top down Design, Top down Design with VHDL, Subprograms, Controller Description, VHDL Operators, Conventions and Syntax.

Basic Concepts In VHDL: Characterizing Hardware Languages, Objects and Classes, Signal Assignments, Concurrent and Sequential Assignments.

UNIT-3

Design Organization and Parameterization: Definition and Usage of Subprograms, Packaging Parts and Utilities, Design Parameterization, Design Configuration, Design Libraries.

Utilities For High-Level Descriptions: Type Declarations and Usage, VHDL Operators, Subprogram Parameter Types and Overloading, Other Types and Type Related Issues, Predefined Attributes, User Defined Attributes.

UNIT-4

Dataflow Descriptions In VHDL: Multiplexing and Data Selection, State Machine Description, Three State Bussing.

Behavioral Description of Hardware: Process Statement, Assertion Statement, Sequential Wait Statements, Formatted ASCII I/O Operations, MSI Based Design.

Verilog: Overview of Digital design with Verilog HDL, Hierarchical modeling concepts, basic concepts, modules & ports.

Text Books:

1. J. Bhasker, A VHDL Primer, Third Edition, PH/Pearson, 1999.
2. J. Bhasker, A VHDL Synthesis Primer, Second Edition, Star Galaxy, 1998.
3. J. Bhasker, A Verilog HDL Primer, Second Edition, Star Galaxy, 1999.
4. J. Bhasker, A Verilog Synthesis: A Practical Primer, Star Galaxy, 1998.
5. M. J. S. Smith, Application Specific Integrated Circuits, AW/Pearson, 1997.

Reference Books:

1. Z. Navabi, VHDL: Analysis and Modeling of Digital Systems, Second Edition, MH, 1998.
2. J. Armstrong and F. G. Gray, VHDL Design Representation and Synthesis, Second Edition, PH/Pearson, 2000.
3. P. J. Ashenden, The Designer's Guide to VHDL, Second Edition, Morgan Kaufmann, 2001.
4. D. Naylor and S. Jones, VHDL: A Logic Synthesis Approach, Chapman & Hall, 1997.
5. J. Pick, VHDL: Techniques, Experiments and Caveats, MH, 1996.
6. C. H. Roth, Digital System Design with VHDL, PWS/Brookscole, 1998.
7. M. G. Arnold, Verilog Digital Computer Design: Algorithms to Hardware, PH, 1999.
8. Z. Navabi, Verilog Digital System Design, MH, 1999.
9. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, PH/Pearson, 1996.
10. D. E. Thomas and P. R. Moorby, the Verilog Hardware Description Language, Fourth Edition, Kluwer, 1998.
11. K. Coffman, Real World FPGA Design with Verilog, PH, 2000.
12. D. R. Smith and P. D. Franzon, Verilog Styles for Synthesis of Digital Systems, AW/Pearson, 2001.
13. S. M. Trimberger, FPGA Technology, Kluwer, 1992.
14. J. V. Oldfield and R. C. Dorf, FPGAs: Reconfigurable Logic for RapidPrototyping and Implementation of Digital Systems, Wiley, 1995.
15. R. C. Seals and G. F. Whapshott, Programmable Logic: PLDs and FPGAs, MH, 1998.
16. A.K. Sharma, Programmable Logic Handbook: PLDs, CPLDs and FPGAs, MH, 1998.

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-715	Embedded System Design	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Microprocessor, Basic of C language, Analog & Digital circuits
Course Objectives:

1. To impart in-depth knowledge related to the architecture, interfacing and programming concepts of 8051 micro-controller.
2. To provide thorough coverage to advanced and state-of-the-art micro-controllers like ARM, AVR, PIC and JTAG.
3. To familiarize students with the concepts and techniques of Embedded System Project Management.

Course Outcomes:

CO-1 Understating of detailed architecture of conventional as well as the latest microcontroller.

CO-2 Develop assembly language programs for problem Solvay related to embedded systems.

CO-3 Ability to design and implement an embedded system using model circuits design.

UNIT-1

Introduction to Embedded systems design: Introduction to Embedded system, Embedded System Project Management, ESD and Co-design issues in System development Process, Design cycle in the development phase for an embedded system. Use of target system or its emulator and In-circuit emulator, Use ofSoftware tools for development of an ES.

UNIT-2

8051 Microcontroller: Microprocessor V/s Micro-controller, 8051 Microcontroller: General architecture; Memory organization; I/O pins, ports & circuits; Counters and Timers; Serial data input/output; Interrupts.

UNIT-3

8051 Instructions: Addressing Modes, Instruction set: Data Move Operations, Logical Operations, Arithmetic Operations, Jump and Call Subroutine, Advanced Instructions. 8051 Interfacing and Applications: Interfacing External Memory, Keyboard and Display Devices: LED, 7-segment LED display, LCD.

UNIT-4

Advanced Microcontrollers: Only brief general architecture of AVR, PIC and ARM microcontrollers; JTAG: Concept and Boundary Scan Architecture.

Text Books:

1. Embedded Systems by Raj Kamal, TMH.
2. The 8051 Microcontroller by K.J. Ayala, Penram International.
3. J B Peatman, Design with PIC Microcontrollers, Prentice Hall.

References Books:

1. An Embedded Software Primer by David E. Simon, Pearson Education.
2. Designing Embedded Hardware by John Catsoulis, O’reilly
3. Embedded System Design by Frank Vahid, Tony Givargis,” John Wiley & Sons, Inc
4. Building Embedded Linux Systems by KarimYaghmour, O’reilly
5. Programming Embedded Systems by Michael Barr, O’reilly
6. Real-time systems & software by Alan C. Shaw, John Wiley & sons, Inc.
7. Computers as Components by Wayne Wolf, Harcourt India Pvt. Ltd.
8. Embedded System Design by Peter Marwedel, Kluwer Academic Pub.
9. Programming and Customizing the AVR Microcontroller by DhananjayGadre, MGH
10. Fundamental of Embedded software by Daniel W. Lewis, PHI
11. Bluetooth Technology by CSR Prabhu& A.P. Reddi, PHI
12. John B Peat man “Design with Microcontroller ", Pearson education Asia, 1998
13. Burns, Alan and Wellings, Andy, “Real-Time Systems and Programming Languages", Second Edition. Harlow: Addison-Wesley-Longman, 1997
14. Raymond J.A. Bhur and Donald L.Bialey, " An Introduction to real time systems: Design to networking with C/C++ ", Prentice Hall Inc. New Jersey, 1999
15. Grehan Moore, and Cyliax, " Real time Programming: A guide to 32 Bit Embedded Development. Reading “Addison-Wesley-Longman, 1998
16. Heath, Steve, “Embedded Systems Design ", Newnes 1997

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-719	**Signal Processing**	**Core**	**4**	**4**	**0**

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Signal & System, Engineering Mathematics.
Course Objectives:
To introduce the concepts and techniques associated with the understanding of signal processing. To familiarize with techniques suitable for auditory perception and time delay estimation. To provide with an appreciation of applications for system modeling and identification.
Course Outcomes:

- CO-1 Ability to understand the significance of signal processing in the fields of speech processing.
- CO-2 Ability to gain an appreciation of the technology and the software tools currently available
- CO-3 Ability to study in detail some of the most importantdesign techniques for speech recognition systems.

UNIT-1

Speech Processing : Speech Communication Acoustic Theory of Speech: The Source–filter Model Speech Models and Features Linear Prediction Models of Speech Harmonic Plus Noise Model of Speech Fundamental Frequency (Pitch) Information Speech Coding, Speech Recognition.
Signal Processing and Auditory Perception: Introduction, Musical Notes, Intervals and Scales Musical Instruments Review of Basic Physics of Sounds Music Signal Features and Models Anatomy of the Ear and the Hearing Process Psychoacoustics of Hearing, Music Coding (Compression)High Quality Audio Coding: MPEG Audio.

UNIT-2

Time Delay Estimation: Need for the Time Delay Estimation, System Model, Source Localization strategies, Ideal Model-Free field environment, TDE METHODS: Cross-correlation Function (CCF) method, least mean square (LMS) adaptive filter method, Average square difference function (ASDF) method, Relation between the SNR level and the time delay estimation.

UNIT-3

Channel Equalization and Blind Deconvolution: Introduction and need For Channel Equalization, Types of Equalization Techniques, Decision Feedback Equalization Non-blind Equalization Linear Equalization Blind Equalization General Mathematical Model, Channel Modeling and algorithms

UNIT-4

System modeling and identification: System identification based on FIR (MA), All Pole (AR), Pole Zero (ARMA) system models, Least square linear prediction filter, FIR least squares inverse filter, predictive de convolution, Matrix formulation for least squares estimation: Cholesky decomposition, LDU decomposition, QRD decomposition, GrahmV Schmidt orthogonalization.

Text Books:

1. Siomon S Haykins, "Adaptive Filter Theory"PHI, 3rd Edition
2. Proakis,"Digital Signal Processing"PHI 2nd edition
3. Harry L. Van Trees, "

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECP-716	Digital VLSI Design Lab	Core	2	0	2+2

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Digital Electronics, knowledge of various ICs
Course Objectives:
This course aims at covering first the basic building block of the VLSI circuits, that is, start with MOSFET characteristics and then go through various logic circuits design using MOS transistor (like CMOS inverter, NAND NOR, MUX, DFF, Register) to complete Memory designs and layouts are also covered under this course.
Course Outcomes:
CO-1 Ability to characterize and model the circuit behaviors.
CO-2 Ability to apply theoretical concepts of digital VLSI design in practice through simulation tools.
CO-3 Develop logic circuits using MOS transistors, memory design and layout.
CO-4 Ability to work with industry standard simulation on tools and become a successful design engineer.

List of Experiments

1. Device Characterization
   Description: For the NMOS transistor simulate, observe and calculate the following
   1. Using DC Sweep analysis, plot the ID Vs VDS and ID Vs VGS characteristics for
      a. Keeping the L = 0.18um, for W = 0.18um, 0.36um, 0.5um, 1um
      b. Keeping the W/L constant, say 1, for L = 0.18um, 0.36um, 0.5um, 1um
   2. From the ID Vs VDS plots generated in 1 above, for each of the case calculate the value of, channel length modulation parameter
   3. Measure the value of VT0
   4. Calculate Kn for NMOS Transistor
   5. Measure _ (Gamma), the body effect Parameter
2. Design and simulate the CMOS Inverting amplifier
   Description: For the CMOS Inverter simulate, observe and calculate the following
   1. Using DC Sweep analysis, plot the Vin VsVout CMOS inverter characteristics For:
      a) With the consideration of a Minimum Size inverter in a given Technology.
      b) Keeping the L = 0.18um, for W = 0.18um, 0.36um
      c) Plot the Drain Current in 1.a and 1.b
      d) Determine the noise margins.
   2. Using transient analysis with an input pulse of 200MHz taking size as 1.a and 1.bsimulate the input/output switching characteristics.
      a) Measure the propagation delays.

3. Design and simulate the CMOS NAND/NOR/XOR gates
4. Design and simulate the CMOS 4x1 Mux and 1-bit Full Adder
5. Design and simulate the CMOS SR Latch and D-FF
6. Design and simulate the CMOS Non-Overlapping two phase Clock
7. Design and simulate the CMOS 6T SRAM Cell
8. Design and simulate the CMOS 4x4 SRAM

Note: This list is an indicative list of experiments, which can be expanded depending on the course requirement.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECP-717	HDL Lab	Core	2	0	2+2

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Digital Electronics
Course Objective:
This course is for first year post graduation students. This course is designed to give students inhand practice of writing and simulating a VHDL code. VHDL is one of the popular hardware descriptive language. Various combinational and sequential circuits like simple logic gates, Half Adder, Full Adder, Multiplexer, Demultiplexer, Encoder, decoder, Flip-Flops, Shift Register, Counters are included.
Course Outcomes:
CO-1 Understanding of system and concepts required to write a UHDL code.
CO-2 Ability to simulate UHDL code and develop circuits models.
CO-3 Ability to identify and debug system and logical problems.
CO-4 Ability to address research challenges through circuits analysis and modelling.

List of Experiments:

1. Design all gates using VHDL.
2. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
    a) Half adder
    b) Full adder
3. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
    a) Multiplexer
    b) Demultiplexer
4. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
    a) Decoder
    b) Encoder
5. Write a VHDL program for Single –Bit ALU and check the wave forms and the hardware generated
6. Write a VHDL program for a comparator and check the wave forms and the hardware generated
7. Write a VHDL program for a code converter and check the wave forms and the hardware generated
8. Write a VHDL program for a 9-bit parity generator and check the wave forms and the hardware generated

9. Write a VHDL program for a FLIP-FLOP and check the wave forms and the hardware generated.
10. Write a VHDL program for a counter and check the wave forms and the hardware generated.
    a) 3-bit binary counter
    b) 3-bit Up-Down counter
    c) Decade counter
11. Write VHDL programs for the following circuits, check the wave forms and the hardware generated
    a) register
    b) shift register
12. Implement any three (given above) on FPGA/CPLD kit

Note: This list is an indicative list of experiments, which can be expanded depending on the course requirement.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course No.	Title of course	Core/Elective	Credit	L	P
ECP-718	Embedded System Design Lab	Core	2	0	2+2

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: C languages & basic of digital and analog circuits
Course Objectives:

1. To provide hand-on experience to the students on the industry standard KEIL make embedded Development boards related to 8051, PIC, ARM7, ARM9 processors.
2. To provide students an opportunity to understand the architecture of latest micro-controllers through programming using KEIL software and development boards.
3. To familiarize students with the interfacing of various application boards with development boards.

Course Outcomes:

CO-1 Practical understanding of architect use, interfacing issues and programming skills of latest microcontroller.
CO-2 Hands on experience on industry standard KEIL make development boards related to 8051, PIC, ARM and ARM9 processors.
CO-3 Develop assembly long programs for problem solving as well as interfacing of eternal devices with microcontroller.
CO-4 Ability to design and develop an imbedded system for variety of applications.

List of Experiment:-

1. (a) To familiarize with main features and concepts of programming in KEIL µvision software.
   (b) To familiarize with the architecture of 8051 micro-controller.
2. To write and run 8051 assembly language program to perform addition (8 & 16 bit) operation.
3. To write and run 8051 assembly language program to perform signed and unsigned subtraction operation. Also demonstrate the use of overflow flag.
4. To write and run 8051 assembly language program to perform MUL & DIV operations.
5. To write and run 8051 assembly language program to demonstrate all kind of MOV instructions, Stack related instructions and Data exchange.
6. To write and run 8051 assembly language program to demonstrate all kind of Logical operations along with certain exceptions.
7. To familiarize with architecture of 8051 development board and interfacing with PC to glow on-board LEDs.
8. To write and run C and 8051 assembly language program to glow on-board LEDs in 8051 development board with varying delay and patterns.
9. To interface 7-segment LED display with 8051 development board.
10. To interface LCD display with 8051 development board.
11. To practice basic assembly language programs of ARM using KEIL µvision software.

Note: This list is an indicative list of experiments, which can be expanded depending on the course requirement.

Second Semester

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-721	Mobile Communication	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Communication System
Course Objectives:

1. To develop basic understanding and impart in-depth knowledge of various concepts used in wireless mobile communication.
2. To introduce the concepts, parameters and models of mobile radio propagation.
3. To help students understand the architecture and elements of wireless standards and systems like GSM, GPRS, CDMA, etc.
4. To provide coverage to the advanced, latest and upcoming wireless technologies like OFDM, Multicarrier Modulation, 4-G, Turbo codes and Multi-user detection, etc.

Course Outcomes:

CO-1 Develop thorough understanding of the advanced concepts used in wireless communication i.e. Mobile tail propagation, wireless system and analysis Diversity, etc.

CO-2 In-depth knowledge of the latest and future technologies prevalent in mobile communication industry i.e. Multicarrier, u-u, MUD, MIMO, etc.

CO-3 Develop interest/acumen to pursue further research in the area of broadband wireless comm.

UNIT-1

Introduction to Wireless Communication Systems: Various Generations of wireless mobile communication, The Cellular Concept, Frequency reuse, channel assignment strategies, hand-off strategies, interference and system capacity, improving capacity of cellular system through cell splitting, sectoring, etc.

UNIT-2

Mobile Radio Propagation: Introduction to radio wave propagation, three basic propagation mechanisms, Outdoor & indoor propagation models, small scale multipath propagation, parameters of mobile multipath channel, small scale & large scale fading, their types. **Principles of GSM:** GSM frequency bands, GSM architecture, GSM Interfaces, GSM logical channels and frame structure, GSM bursts, GPRS.

UNIT-3

CDMA System Concepts: Basics of CDMA. Spread spectrum concept. time hopping, Direct Sequence and Frequency Hopped Spread Spectrum, Chirp spread spectrum systems, Hybrid systems, Spreading sequences and their correlation functions, Code generation, Properties and generation of PN sequences, RAKE receiver, Diversity techniques an Rake receiver, Soft handoffs.

UNIT-4

Implementation Issues: OFDM, Multi-Carrier Modulation and Demodulation, Channel Coding and Decoding (Convolutional codes, Turbo codes), Multi-user Detection: Decorrelatingdetector,MMSE detector. Successive Interference Canceller, Parallel Interference Canceller.

Text Books:

1. Mobile Cellular Telecommunications; 2^{nd} ed.; William, C Y Lee McGraw Hill
2. Wireless and Digital Communications; Dr. KamiloFeher (PHI)
3. Principles of Mobile Communication, G.LStuber Kluwer Academic, 1996
4. Wireless Communication; Principles and Practice; T.S.Rappaport

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-722	Advanced Optical Communication Systems	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Physics of optical communication components and applications to communication systems
Course Objectives:
This course deals with the understanding of the optical components and the design and operation of optical fiber communication systems. The principles of wavelength division multiplexed (WDM) systems, SONET, SDH and passive optical networks. The characteristics and limitations of system components (laser diodes, external modulators, optical fiber, optical amplifiers, optical receivers) and the factors affecting the performance of the optical communication systems.
Course Outcomes:
CO-1 Thorough understating of the optical components and design of optical comm. System.
CO-2 Analysis of performances of optical filer comm. System and calculation of various performance parameters of optical link.
CO-3 Ability to apply concepts of optical comm. In further research for last mile affordable connectivity.

UNIT-1

Review: Evolution of Basic Fiber Optic Communication System, Benefits and disadvantages of Fiber Optics, Transmission Windows, Transmission Through Optical Fiber, The Numerical Aperture (NA), The Optical Fiber, Types of Fiber, Different Losses & Issues in Fiber Optics, Attenuation in Optical Fibers, Fiber Optic Loss Calculations, Dispersion, connectors & splices, bending loses, Absorption, scattering, very low loss materials, plastic & polymer-clad-silica fibers. Wave propagation in step index & graded index fiber, fiber dispersion, single mode fibers, multimode fibers, dispersion shifted fiber, dispersion flattened fiber, polarization, cut-off condition and V-parameter.

UNIT-2

Fiber Optic System Design Considerations and Components: Indoor Cables, Outdoor Cables, Cabling Example, Power Budget, Bandwidth and Rise Time Budgets, Electrical and Optical Bandwidth, Connectors, Fiber Optic Couplers.
Dispersion and Nonlinearities Dispersion in single mode and multimode fibers, dispersion shifted and dispersion flattened fibers, attenuation and dispersion limits in fibers, Kerr nonlinearity, self phase modulation, Cross Phase Modulation, FWM.

UNIT-3

Optical Sources: optical source properties, operating wavelength of optical sources, semiconductor light-emitting diodes and laser diodes, semiconductor material and device operating principles, light-emitting diodes, surface-emitting LEDS, edge-emitting LEDS, super luminescent diodes, laser diodes, comparison of LED and ILD. Fiber optic transmitters, basic optical transmitters, direct versus external modulation, fiber optic transmitter applications. **Optical Detectors:** Basic Information on light detectors, Role of an optical detector, Detector characteristics: Responsivity, Noise Equivalent Power, Detectivity, Quantum efficiency, The PN junction photo diode - PIN photodetectors - Avalanche photo diode construction characteristics and properties, APD Specifications, Applications of APD, Optical Receivers .

UNIT-4

Advanced Multiplexing Strategies: Optical TDM, subscriber multiplexing (SCM), WDM and Hybrid multiplexing methods.

Optical Networking: Data communication networks, network topologies, MAC protocols, Network Architecture- SONET/TDH, optical transport network, optical access network, optical premise network.

Text Books:

1. G.P Aggrawal, Fiber-Optic Communication Systems, Wiley-interscience.
2. G. Keiser, Optical Fiber Communication, Tata –McGraw Hill.
3. John Gowar , Optical communication systems, PHI.

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-723	Analog IC Design	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Introduction to microelectronics circuits including bipolar and MOS transistors
Course Objectives:
This Course is for the First year post-graduate students. The pre-requisite for the course is basic knowledge of semiconductor devices and an introduction to analog electronics. This course covers the design and analysis of various linear and non-linear analog circuits like amplifiers, current mirrors, comparators, oscillators, phase-locked loops etc. using both bipolar and MOS transistors. Various design parameters are covered.
Course Outcomes:
CO-1 Design and analysis of various linear and non-linear along circuits.
CO-2 Ability to apply design methodology for the design of various application specific integrated circuits.
CO-3 Gain knowledge of design principles and design parameters related to along IC design.

UNIT-1

Operational Amplifier: Applications of operational Amplifier, theory and Design; Definition of Performance Characteristics; Design of two stage MOS Operational Amplifier, two stage MOS operational Amplifier with cascodes, MOS telescopic-cascode operational amplifiers, MOS Folded-cascode operational amplifiers, Bipolar operational amplifiers. Frequency response & compensation.
Small Signal & large signal Models of MOS & BJT transistor. Analog MOS Process (Double Poly Process)

UNIT-2

MOS & BJT Transistor Amplifiers: Single transistor Amplifiers stages: Common Emitter, Common base, Common Collector, Common Drain, Common Gate & Common Source Amplifiers
Multiple Transistor Amplifier stages: CC-CE, CC-CC, & Darlington configuration, Cascode configuration, Active Cascode. Differential Amplifiers: Differential pair & DC transfer characteristics.

UNIT-3

Current Mirrors, Active Loads & References: Current Mirrors: Simple current mirror, Cascode current mirrors Widlar current mirror, Wilson Current mirror, etc. Active loads, Voltage & current references. Analysis of Differential Amplifier with active load, supply and temperature independent biasing techniques, Frequency Response,

UNIT-4

Nonlinear Analog Circuits: Analysis of four quadrant and variable Tran conductance multiplier, Voltage controlled oscillator, Comparators, Analog Buffers, Source Follower and Other Structures. Phase Locked Techniques; Phase Locked Loops (PLL), closed loop analysis of PLL. Digital-to-Analog (D/A) and Analog-to-Digital (A/D) Converters

OTA & Switched Capacitor filters: OTA Amplifiers. Switched Capacitor Circuits and Switched Capacitor Filters.

Text Books:

1. Paul B Gray and Robert G Meyer, “Analysis and Design of Analog Integrated Circuits”.
2. R Gregorian and G C Temes, Analog MOS Integrated Circuits for Signal Processing, John Wiley, 1986.

Reference Books:

1. D. A. Johns and Martin, Analog Integrated Circuit Design, John Wiley, 1997.
2. R Gregorian and G C Temes, Analog MOS Integrated Circuits for Signal Processing, John Wiley, 1986.
3. BehzadRazavi, “Principles of data conversion system design”, S.Chand and company Ltd, 2000. John Wiley
4. Kenneth R. Laker, Willy M.C. Sensen, “Design of Analog Integrated circuits and systems”, McGraw Hill, 1994.

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-724	Adaptive Signal Processing	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Signals and Systems,Digital Signal Processing
Course Objectives:
To introduce the concepts and techniques associated with the understanding of digital signal processing. To familiarize with techniques suitable for analyzing and synthesizing both continuous-time and discrete time systems. To provide with an appreciation of applications for the techniques and mathematics used in this course.
Course Outcomes:

- CO-1 Ability to understand the significance of signal processing (DSP) in the fields of computing, telecommunications and
- CO-2 Ability to gain an appreciation of the technology and the software tools currently available
- CO-3 Ability to study in detail some of the most importantdesign techniques for DSP systems.

UNIT-1

Basic Of Digital Signal Processing: Signals and Information, Signal Processing Methods, Applications of Digital Signal Processing, Derivation of the z-Transform Properties of z-Transform, Fourier series and Fourier transform. Random variable,Stochastic processes.

UNIT-2

Design of Digital Filters: Introduction, Linear Time-Invariant Digital Filters, Recursive and Non-Recursive Filters, Filtering Operation, Sum of Vector Products, A Comparison of Convolution and Correlation, Filter Structures, Direct, Cascade and Parallel Forms, Linear Phase FIR Filters Design of Digital FIR Filter-banks, Sub-band Filters, Design of Infinite Impulse Response IIR filters, Issues in the Design and Implementation of a Digital Filter.

UNIT-3

Estimation Theory: Bayesian Estimation Theory, Basic Definitions, Bayesian Estimation, Expectation Maximization Method, Generalized Parameter Estimation,Cramer–Rao lower Bound on the variance of estimator, maximum likelihood estimation, Design of Gaussian Mixture Models, Bayesian Classification, Modeling the Space of a Random Process, Detection
AdaptiveFiltering: State-Space Kalman Filters,Recursive Least Square (RLS) Adaptive Filters the Steepest-Descent Method LMS Filter, Different Algorithms and their Variants used in adaptive filtering and their performance criterion, Multirate Signal Processing.

UNIT-4

Applications: Applications of adaptive Digital Signal Processing to Speech, Music and Telecommunications, Parameter estimation, System identification, Noise and Echo cancellation, Acoustic source localization techniques, Channel Equalization**.**

Text Books:

1. Siomon S Haykins, "Adaptive Filter Theory,"PHI, 3rd Edition
2. Proakis,"Digital Signal Processing,"PHI 2nd edition
3. Harry L. Van Trees, "Detection, Estimation, and Modulation Theory, Part 1&3," Wiley 2002
4. Saeed V. Vaseghi, "Advanced Digital Signal Processing and Noise Reduction," Third Edition,2006
5. EberhardHänsler, "Gerhard Schmidt Acoustic Echo and Noise Control: A Practical Approach,"wiley, 2005.

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-725 (i)	Algorithm for VLSI Design Automation	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Deep knowledge of VLSI
Course Objectives:
This course is for first year post graduation students. This course is designed demonstrate the use of data structure to build up the CAD tools for simulation, synthesis and physical VLSI design.
Course Outcomes:

CO-1 Ability to understand various algorithms related VLSI design techniques
CO-2 Ability to understand CAD tools for the design of VLSI circuits.
CO-3 Ability to understand application based routing and compaction process.

UNIT-1

Logic synthesis & verification:
Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High-level synthesis.

UNIT-2

VLSI automation Algorithms:
Partitioning: problem formulation, classification of partitioning algorithms, Group migration algorithms, simulated annealing & evolution, other partitioning algorithms.
Placement, floor planning & pin assignment: problem formulation, simulation base placement algorithms, other placement algorithms, constraint based floor plannning, floor planning algorithms for mixed block & cell design. General & channel pin assignment.
Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches.

UNIT-3

Detailed routing: problem formulation, classification of routing algorithms, single layer routing algorithms, two layer channel routing algorithms, three layer channel routing algorithms, and switchbox routing algorithms.

UNIT-4

Over the cell routing & via minimization: two layers over the cell routers, constrained & unconstrained via minimization
Compaction: problem formulation, one-dimensional compaction, two dimension based compaction, hierarchical compaction

Text Books:

1. NaveedShervani, "Algorithms for VLSI physical design Automation", Kluwer Academic Publisher, Second edition.

Reference Books:

1. ChristophnMeinel& Thorsten Theobold, "Algorithm and Data Structures for VLSI Design", KAP, 2002.
2. Rolf Drechsheler : "Evolutionary Algorithm for VLSI", Second edition
3. Trimburger," Introduction to CAD for VLSI", Kluwer Academic publisher, 2002

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-725(ii)	Advanced Computer Architectures	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Basics of digital electronics and computer organization
Course Objectives:
Understand the architecture of a modern computer with its various processing units. Also the performance measurement of the computer system.In addition to this the memory management system of computer.
Course Outcomes:

- CO-1 Ability to understand the basic architecture of advance computer systems.
- CO-2 Ability to understand storage organization and problem solving.
- CO-3 Ability to understand application oriented designing and assembling of computer system.

UNIT-1

Parallel computer models: The state of computing, Classification of parallel computers, Multiprocessors and multicomputers, Multivector and SIMD computers.
Program and network properties: Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms

UNIT-2

System Interconnect Architectures: Network properties and routing, Static interconnection Networks, Dynamic interconnection Networks, Multiprocessor system Interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.
Advanced processors: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors Pipelining:Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction, Arithmetic Pipeline Design, Computer arithmetic principles, Static Arithmetic pipeline, Multifunctional arithmetic pipelines

UNIT-3

Memory Hierarchy Design:Cache basics & cache performance, reducing miss rate and miss penalty, multilevel cache hierarchies, main memory organizations, design of memory hierarchies.
Multiprocessor architectures: Symmetric shared memory architectures, distributed shared memory architectures, models of memory consistency, cache coherence protocols (MSI, MESI, MOESI), scalable cache coherence, overview of directory based approaches, design challenges

of directory protocols, memory based directory protocols, cache based directory protocols, protocol design tradeoffs, synchronization,

UNIT-4

Scalable point –point interfaces: Alpha364 and HT protocols, high performance signaling layer.

Enterprise Memory subsystem Architecture: Enterprise RAS Feature set: Machine check, hot add/remove, domain partitioning, memory mirroring/migration, patrol scrubbing, fault tolerant system.

Text Books:

1. Kai Hwang, "Advanced computer architecture"; TMH.
2. D. A. Patterson and J. L. Hennessey, "Computer organization and design," Morgan Kaufmann, 2nd Ed.

References:

1. J.P.Hayes, "computer Architecture and organization"; MGH.
2. Harvey G.Cragon,"Memory System and Pipelined processors"; Narosa Publication.
3. V.Rajaranam&C.S.R.Murthy, "Parallel computer"; PHI.
4. R.K.Ghose, RajanMoona&Phalguni Gupta, "Foundation of Parallel Processing"; Narosa Publications.
5. Kai Hwang and Zu, "Scalable Parallel Computers Architecture"; MGH.
6. Stalling W, "Computer Organisation&Architecture";PHI.
7. D.Sima, T.Fountain, P.Kasuk, "Advanced Computer Architecture-A Design space Approach,"Addison Wesley,1997.
8. M.J Flynn, "Computer Architecture, Pipelined and Parallel Processor Design"; Narosa Publishing.
9. D.A.Patterson, J.L.Hennessy, "Computer Architecture :A quantitative approach";Morgan Kauffmann feb,2002.
10. Hwan and Briggs, "Computer Architecture and Parallel Processing"; MGH.VLSI

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-725(iii)	MEMS and IC Integration	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites:IC Fabrication Technology, Analog and Digital VLSI Design
Course Objectives:
This course has been developed due to industry request and as an introduction to a growing and important field in our high technology future. The objectives of this course are to teach critical thinking in micro engineering process, materials and design issues, to build an understanding of micro scale physics for use in designing MEMS applications, review current MEMS, RFMEMS and Bio MEMS applications, use the above knowledge to design and fabricate novel EMS/Bio MEMS /RF MEMS applications as part of a group project.
Course Outcomes:

- CO-1 Ability to Understand CMOS IC fabrication and MEMS applications.
- CO-2 Ability to understand the use of a new set of design and verification tools, in addition to AutoCAD tools.
- CO-3 Ability to understand the materials and processes used to design and fabricate MEMS

UNIT-1

MEMS Fabrication:
Conventional MEMS fabrication using VLSI technology: lithography, chemical etching: isotropic and anisotropic, Plasma etching, Reactive ion etching, Oxidation, Chemical vapor deposition, LPCVD, PECVD, Surface micromachining, LIGA, single layer and higher layer fabrication, Non-conventional MEMS fabrication: laser micromachining and welding micromachining(EDM & ECM), Microstereolithography: scanning process, dynamic mask process, Electronic packaging.

UNIT-2

MEMS Design and Analysis:
Basic concepts of design of MEMS devices and processes, Design for fabrication, Other design considerations, Analysis of MEMS devices, Modeling and Simulation.

UNIT-3

MEMS Sensors:
Physical Micro Sensors: Classification of physical sensors, Integrated, Intelligent, or Smart Sensors, Sensor Principles and Examples: Thermal Sensors, Electrical Sensor, Mechanical Sensors, Chemical and Biosensors, Application Areas: RF MEMS and Optical MEMS, Medical Devices e.g. DNA-chip, micro-arrays, Pressure sensors with embedded electronics(Analog/Mixed signal): Accelerometer with transducer, Gyroscope,Bolo meter design.

UNIT-4

MEMS Characterization:

Technologies for MEMS characterization, Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Magnetic Force Microscopy, Scanning Electron Microscope.

Text/Reference Books:

1. Gregory T.A. Kovacs, Micromachined Transducers Sourecbook, The McGraw-Hill, Inc. 1998
2. Stephen D. Senturia, Microsystem Design, Kluar Publishers, 2001
3. NadimMaluf, An Introduction to Microelectromechanical Systems Engineering, Artech House, 2000.
4. M.H. Bao, Micro Mechanical Transducers, Volume 8, Handbook of Sensors and Actuators, Elsevier, 2000.
5. MasoodTabib-Azar, Microactuators, Kluwer, 1998.
6. LjubisaRistic, Editor, Sensor Technology and Devices, Artech House, 1994
7. D. S. Ballantine, et. al., Acoustic Wave Sensors, Academic Press, 1997
8. H. J. De Los Santos, Introduction to Microelectromechanical (MEM) Microwave Systems, Artech, 1999.
9. James M.Gere and Stephen P. Timoshenko, Mechanics of Materials, 2nd Edition, Brooks/Cole Engineering Division, 1984

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course No.	Title of course	Core/Elective	Credit	L	P
ECP-726	**Adaptive Signal Processing Lab**	**Core**	**2**	**0**	**2+2**

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Basic of MATLAB, Concept of DSP
Course Objectives:
This course is designed to demonstrate the use of MATLAB software for simulation, synthesis and designing of different processing systems. Apart from this working with the DSP processor hardware is familiarized.
Course Outcomes:
CO-1 Ability to understand various algorithms related to windowing techniques.
CO-2 Ability to understand tools for the design of practical applicable filters.
CO-3 Ability to understand application based signal processing systems.

List of Experiments:

1. Write Matlab statement for algebraic equations.
2. Designing filters from Windowing techniques.
3. Write Matlabprogram to find the Power spectral Density.
4. Matlab Program for ploting different graphs.
5. Filter design with the help of Matlab filter design tool.
6. Simulation of the given model using Simulink tool.
7. Matlab program for cross correlation and auto correlation.
8. Working with DSP Processor &Hardware.

Note: This list is an indicative list of experiments, which can be expanded depending on the course requirement.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECP-727	Advanced Communication Lab	Core	2	0	2+2

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Analog and Digital Communication System
Course Objectives:
In this course student will learn the fundamentals and the techniques for the design and analysis of satellite communication systems. Satellite Communication Systems provide vital and economical fixed and mobile communication services over very large coverage areas of land, sea and air.
Course Outcomes:

CO-1 Ability to understand trends in satellite communications systems.
CO-2 Ability to analyse the performance of satellite communications systems
CO-3 Ability to understand systems design for satellite communications

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List of Experiments:

1. To analyse spectrum analyser.
2. To establish direct communication link between uplink transmitter and downlink receiver using tone signal and communicating a voice signal through satellite.
3. Understanding the principle of GPS satellite.
4. a) To study object counting with the help of RADAR.
   b) To study the detection of vibrations of different tuning forks.
   c) determine the rotation per minute of a moving object (fan).
5. a) To study the concepts of CDMA.
   b) To study the theory of Direct sequence spread spectrum communication.
   c) To study what is spread spectrum modulation & demodulation.

Note: This list is an indicative list of experiments, which can be expanded depending on the course requirement.

Third Semester

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (i)	Mixed-Signal Design	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Analog Electronics and Analog IC design, VLSI Design
Course Objectives:
This course is for Second year post graduation students. This course is designed for upgrading student's design skills in data converters. The purpose of this module is to introduce students to the principle of operation of mixed signal circuits and typical analogue building blocks. Building blocks common to mixed signal systems and a top down digital design methodology will be discussed.
Course Outcomes:
CO-1 Ability to understand the principles of operation of mixed signal circuits and typical analogue building blocks.
CO-2 Ability to understand the various factors that go into design and layout of mixed signal chip.
CO-3 Ability to understand application based design issues related to advance mixed signal design.

UNIT-1

Sinusoidal Signals, The Pendulum Analogy, Describing Amplitude in the x-y Plane , In-Phase and Quadrature Signals, The Complex (*z*-) Plane, Comb Filters ,The Digital Comb Filter ,The Digital Differentiator ,An Intuitive Discussion of the *z*-Plane ,Comb Filters with Multiple Delay Elements ,The Digital Integrator ,The Delaying Integrator , Representing Signals , Exponential Fourier Series , Fourier Transform, Dirac Delta Function, **Sampling:** Impulse Sampling Decimation,The Sample-and-Hold (S/H), S/H Spectral Response and implementation, The Reconstruction Filter, The Track-and-Hold (T/H), Interpolation, Zero Padding, Hold Register, Linear Interpolation, K-Path Sampling, Switched-Capacitor Circuits, Non-Overlapping Clock Generation

UNIT-2

Analog Filters: Integrator Building Blocks : Lowpass Filters , Active-RC Integrators, MOSFET-C Integrators, gm-C (Transconductor-C) Integrators, Common-Mode Feedback Considerations, Discrete-Time Integrators, Exact Frequency Response of an Ideal Discrete-Time Filter, Filtering Topologies: The Bilinear Transfer Function, The Biquadratic Transfer Function, High Q, Q Peaking and Instability, Digital Filters: SPICE Models for DACs and ADCs, The Ideal DAC and ADC: Number Representation, Increasing Word Size , Adding Numbers and Overflow, Subtracting Numbers in Two's Complement Format, Sinc-Shaped Digital Filters, LowpassSinc Filters, Filtering topologies: FIR Filters, The Bilinear Transfer Function The Canonic Form of a Digital Filter, General Canonic Form of a Recursive Filter, The Biquadratic Transfer Function, Comparing Biquads to Sinc-Shaped Filters

UNIT-3

Quantization Noise, Quantization Noise Voltage Spectral Density,Calculating Quantization Noise from a SPICE Spectrum, Power Spectral Density, Signal-to-Noise Ratio (SNR): Effective Number of Bits, Coherent Sampling, Signal-to-Noise Plus Distortion Ratio, Spurious Free

Dynamic Range, Dynamic Range, Specifying SNR and SNDR, Clock Jitter, Using Oversampling to Reduce Sampling Clock Jitter, Stability Requirements, Improving SNR using Averaging , Ideal Signal-to-Noise Ratio, Linearity requirements. **Data Converter Design Basics:** The One-Bit ADC and DAC, Improving SNR and Linearity, Revisiting Switched-Capacitor Implementations, Improving Linearity Using an Active Circuit

UNIT-4

Noise-Shaping Data Converters: First-Order Noise Shaping, Second-Order Noise-Shaping, Noise-Shaping Topologies,**Bandpass Data Converters:** Continuous-Time Bandpass Noise-Shaping, Active-Component Bandpass Modulators, Switched-Capacitor Bandpass Noise-Shaping, **A High-Speed Data Converter:** The Topology, Clock Signals, Path Settling Time, Implementation, Filtering, Practical Implementation

Text Book:

1. R. J. Baker, CMOS Mixed Signal Cicuit Design, Wiley/IEEE, 2002.

Reference Books:

1. Handkiewicz, Mixed-Signal Systems : A Guide to CMOS Circuit Design, Wiley-IEEE, 2002.
2. P. V. A. Mohan, V. Ramachandran and M. N. S. Swamy, Switched CapacitorFilters : Theory, Analysis and Design, PH, 1995.
3. E. Sanchez-Sinencio and A. G. Andreou, Low-Voltage/Low-Power IntegratedCircuits and Systems : Low-Voltage Mixed-Signal Circuits, IEEE, 1999.
4. E. N. Farag and M. I. Elmasry, Mixed-Signal VLSI Wireless Design : Circuitsand Systems, Kluwer, 1999.
5. R. Schaumann and M. E. Valkenburg, Design of Analog Filters, OUP, 2001.
6. Y. Tsividis, Mixed Analog-Digital VLSI Devices and Technology, MH, 1996.
7. R. Unbehauen and A. Cichocki, MOS Switched Capacitor and Continuous-TimeICs and Systems, Springer-Verlag, 1989.
8. S. R. Norsworthy, R. Schreier and G. C. Temes, Delta-Sigma Data Converters : Theory, Design and Analysis, IEEE, 1996.
9. F. Medeiro, B. Perez-Verd and A. Rodroguez-Vazquez, Top-Down Design ofHigh-Performance Sigma-Delta Modulators, Kluwer, 1998.
10. V. Peluso, M. Steyaert and W. M. C. Sansen, Design of Low-Voltage Low-PowerCMOS Delta-Sigma A/D Converters, Kluwer, 1999.
11. S. Rabii and B. A. Wooley, Design of Low-Voltage Low-Power Sigma-DeltaModulators, Kluwer, 1998.
12. P. G. A. Jespers, Integrated Converters: D-A and A-D Architectures, Analysisand Simulation, OUP, 2001.
13. R. Van de Plassche, Integrated Analog-to-Digital and Digital-to-Analog Converters, Kluwer, 1994.
14. Razavi, Principles of Data Conversion System Design, IEEE Press, 1995.

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (ii)	RF Micro-electronics	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Analog Electronics
Course Objectives:
This Course is for the Second year post-graduate students. The objective of this course is to provide students with understanding of modern RF electronics devices employed in RF Transceiver Design. This course is aimed to provide the knowledge of various issues encountered in high-frequency circuits, such as impedance matching, realization of passive components and bandwidth enhancement. Design components of radio-frequency systems, including low noise amplifiers, oscillators, mixers and power amplifiers will be discussed in detail. The effect of individual components performance on overall radio-frequency transmitter and receiver design and performance are also covered in this course plan.
Course Outcomes:

CO-1 Ability to understand the architectures, operation and performance specifications, tradeoff of a RF receiver and its building blocks.

CO-2 Ability to design and analyze various building blocks of receiver like filters, LNA, Mixer, Power Amplifiers, and VCO as per the specifications.

CO-3 Ability to understand the sources of nonlinearity, noise, process technology and its impact on the performance parameters of individual blocks of receiver and on receiver performance.

UNIT-1

Introduction to RF and Wireless Technology: Complexity, design and applications. Choice of Technology.
Basic concepts in RF Design: Nonlinearly and Time Variance, intersymbol Interference, random processes and Noise. Definitions of sensitivity and dynamic range, conversion Gains and Distortion.

UNIT-2

Analog and Digital Modulation for RF circuits: Comparison of various techniques for power efficiency. Coherent and Non coherent defection.Mobile RF Communication systems and basics of Multiple Access techniques. Receiver and Transmitter Architectures and Testing heterodyne, Homodyne, Image-reject, Direct-IF and sub-sampled receivers. Direct Conversion and two steps transmitters. BJT and MOSFET behavior at RF frequencies Modeling of the transistors and SPICE models. Noise performance and limitation of devices. Integrated Parasitic elements at high frequencies and their monolithic implementation.

UNIT-3

Basic blocks in RF systems and their VLSI implementation: Low Noise Amplifiers design in various technologies, Design of Mixers at GHz frequency range. Various Mixers, their working and implementations, Oscillators: Basic topologies VCO and definition of phase noise. Noise-Power trade-off.Resonatorless VCO design.Quadrature and single-sideband generators.

UNIT-4

Radio Frequency Synthesizes: PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifiers design. Linearisation techniques, Design issues in integrated RF filters. Some discussion on available CAD tools for RF VLSI designs.

Texts/Reference Books:

1. B.Razavi, RF Microelectronics, Prentice-Hall PTR,1998
2. T.H.Lee, The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 1998.
3. R.Jacob Baker,H.W.i, and D.E. Boyce, CMOS Circuit Design Layout and Simulation, Prentice-Hall of India,1998.
4. Y.P. Tsividis Mixed Analog and Digital VLSI Devices and Technology, McGraw Hill,1996.

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit.. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (iii)	VLSI Testing & Testability	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: VLSI
Course Objectives:
Very-large-scale integration (VLSI) is the process of creating an integrated circuit (IC) by combining thousands of transistors into a single chip. At the completion of this course, a student is expected to be able to design and analyze digital circuits, understand transistor operations, circuit families, area-power-performance analysis, layout design techniques, signal integrity analysis, memory design and clocking issues. Students are also expected to understand various design methodologies such as custom, semi-custom, standard cell, arrayed logic, sea-of-gates. The goal of the course is to introduce architecture and design concepts underlying modern complex VLSIs and system-on-chips. The lectures build upon student's prior knowledge of digital circuits, digital logic, and computer architecture concepts to teach how complex chip-scale systems can be designed. This course contributes to the Educational Objectives 1 (Fundamental Knowledge), 2 (Specialization), 3 (Design Skills), 4 (Professional Skills) and 5 (Self-Learning).
Course Outcomes:
Upon completion of this course, students should be able to:
CO-1 Ability to analyze the CMOS layout levels, how the design layers are used in the process sequence, and resulting device structures (i.e. cross-sectional views).
CO-2 Ability to Implement digital logic designs of various types (i.e. combinational logic, multiplexers).
CO-3 Ability to analyze performance issues and the inherent trade-offs involved in system design (i.e. power vs. speed).

UNIT-1

Introduction: The need for testing, the problems of digital and analog testing, Design for test, Software testing Faults in Digital circuits:General introduction, Controllability and Observability.. Fault models - Stuck-at faults, Bridging faults, intermittent faults

UNIT-2

Digital test pattern generation :Test pattern generation for combinational logic circuits, Manual test pattern generation, Automatic test pattern generation - Roth's D-algorithm, Developments following Roth's D-algorithm, Pseudorandom test pattern generation, Test pattern generation for sequential circuits , Exhaustive, non-exhaustive and pseudorandom 70 test pattern Generation, Delay fault testing

UNIT-3

Signatures and self-test: Input compression Output compression Arithmetic, Reed-Muller and spectral coefficients, Arithmetic and Reed-Muller coefficients,Spectral coefficients, Coefficient test signatures, Signature analysis and onlineself-test.

UNIT-4

Testability Techniques: Partitioning and ad hoc methods and Scan-path testing, Boundary scan and IEEE standard 1149.1, Offline built in Self-Test (BIST), Hardware description languages and test

Testing of Analog and Digital circuits: Testing techniques for Filters, A/D Converters, RAM, Programmable logic devices and DSP

Text Books:

1. VLSI Testing: digital and mixed analogue digital techniques Stanley L. Hurst Pub:Inspec/IEEE,1999

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit.. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (iv)	Memory System Design	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Digital Circuit Design
Course Objectives:
This course is for Second year post graduation students. This course is designed for memory system organization, memory technologies, and characterization techniques for memory for low power.
Course Outcomes:

CO-1 Ability to demonstrate characterization and mathematical modeling
CO-2 Ability to understand various memory system organization.
CO-3 Ability to understand advance application based ultra-low power memory circuits.

UNIT-1

Introduction to Memory Chip Design: Internal Organization of Memory Chips, Memory Cell Array, Peripheral Circuit, I/O Interface Categories of Memory Chip, History of Memory-Cell Development, Basic Operation of The 1-T Cell, Basic Operation of a SRAM Cell, Trends in Non-Volatile Memory Design and Technology, Basic Operation of Flash Memory Cells, Advances in Flash-Memory Design and Technology,
Basics of RAM Design and Technology: Devices, NMOS Static Circuits, NMOS Dynamic Circuits, CMOS Circuits, Basic Memory Circuits, Scaling Law.

UNIT-2

DRAM Circuits: High-Density Technology, High-Performance Circuits, Catalog Specifications of the Standard DRAM, Basic Configuration and Operation of the DRAM Chip, Chip Configuration, Address Multiplexing, Fundamental Chip, Multi-divided Data Line and Word Line, Read and Relevant Circuits, W rite and Relevant Circuits, Refresh-Relevant Circuits, Redundancy Techniques, On-Chip Testing Circuits, High Signal-to-Noise Ratio DRAM Design and Technology, Trends in High S/N Ratio Design, Data-Line Noise Reduction, Noise Sources.

UNIT-3

On-Chip Voltage Generators: Substrate-Bias Voltage (VBB) Generator, Voltage Up-Converter, Voltage Down-Converter, Half-VDD Generator, Examples of Advanced On-Chip Voltage Generators.
High-Performance Subsystem Memories: Hierarchical Memory Systems, Memory-Subsystem Technologies, High-Performance Standard DRAMs, Embedded Memories.

UNIT-4

Low-Power Memory Circuits: Sources and Reduction of Power Dissipation in a RAM Subsystem and Chip, Low-Power DRAM Circuits, Low-Power SRAM Circuits.

Ultra-Low-Voltage Memory Circuits: Design Issues for Ultra-Low-Voltage RAM Circuits, Reduction of the Subthreshold Current, Stable Memory-Cell Operation, Suppression of, or Compensation for, Design Parameter Variations, Power-Supply Standardization, Ultra-Low-Voltage DRAM Circuits, Ultra-Low-Voltage SRAM Circuits, Ultra-Low-Voltage SOI Circuits.

Text Books:

1. K.Itoh, "VLSI Memory Chip Design', Springer, 2001.

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit.. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (v)	Low Power VLSI Design	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Digital Integrated circuits
Course Objectives:
This course is meant for the final year post- graduate students. The objective of the course is to provide the students with the understanding of the need for Low power VLSI chips and various sources of power dissipation in the CMOS IC at different abstraction levels.
Course Outcomes:
CO-1 Ability to mathematical model to evaluate low power VLSI circuits.
CO-2 Ability to understand the various sources of power dissipation and their optimization.
CO-3 Ability to understand low power architecture.

UNIT-1

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches. Physics of power dissipation in CMOS devices.
Device & Technology Impact on Low Power
Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

UNIT-2

Power estimation
Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems. Monte Carlo simulation.
Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.

UNIT-3

Low Power Design
Circuit level: Power consumption in circuits. Flip Flops & Latches design, high capacitance nodes, low power digital cells library **Logic level:** Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic
Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design.

UNIT-4

Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network

Algorithm & architectural level methodologies: Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis.

Text Books:

1. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, KAP, 2002
2. Rabaey, Pedram, “Low power design methodologies” Kluwer Academic, 1997

Reference Books:

1. Kaushik Roy, Sharat Prasad, “Low-Power CMOS VLSI Circuit Design” Wiley, 2000

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit.. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (vi)	**Embedded System for Wireless & Mobile Communication**	**Elective**	**4**	**4**	**0**

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Communication system and Computer Networks
Course Objectives:

1. This elective course is a blend of the concepts developed in the core courses Embedded System design and Mobile Communication. This subject mainly focuses on the following objectives:
2. To develop basic understanding and impart in-depth knowledge of various topics like wireless communication technologies, Bluetooth protocol, its hardware, etc.
3. To introduce the concepts, architecture and programming related to JAVA.

Course Outcomes:

CO-1 Ability to develop basic understanding and impart in-depth knowledge of various topics like wireless communication technologies, Bluetooth protocol, its hardware, etc.
CO-2 Ability to understand the concepts, architecture and programming related to JAVA and various mobile applications.
CO-3 Ability to understand various kinds of antennas used for mobile applications.

UNIT-1

Introduction to wireless technologies: WAP services, Serial and Parallel Communication, Asynchronous and synchronous Communication, FDM,TDM, TFM, Spread spectrum technology

UNIT-2

Introduction to Bluetooth: Specification, Core protocols, Cable replacement protocol.
Bluetooth Radio: Type of Antenna, Antenna Parameters, Frequency hoping. Bluetooth Networking: Wireless networking, wireless network types, devices roles and states, adhoc network, scatternet.

UNIT-3

Connection establishementprocedure, notable aspects of connection establishement, Mode of connection, Bluetooth security, Security architecture, Security level of services, Profile and usage model: Generic access profile (GAP), SDA, Serial port profile, Secondary bluetooth profile
Hardware: Bluetooth Implementation, Baseband overview, packet format, Transmission buffers, Protocol Implementation: Link Manager Protocol, Logical Link Control Adaptation Protocol, Host control Interface, Protocol Interaction with layers

UNIT-4

Programming with Java: Java Programming, J2ME architecture, Javax.bluetooth package Interface, classes, exceptions, Javax.obex Package: interfaces, classes

Bluetooth services registration and search application, bluetooth client and server application. Overview of IrDA, HomeRF, Wireless LANs, JINI

Text Books:

1. Bluetooth Technology by C.S.R. Prabhu and A.P. Reddi; PHI

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit.. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (vii)	Hardware & Software Co-Design	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Basic Languages (Java, C), Digital Circuit Design
Course Objectives:
This course is for Second year post graduation students. This course is designed to demonstrate the system design in two main domain: Hardware and Software. Co design Concept, system representation and performance evaluation.
Course Outcomes:
CO-1 Ability to understand the issues related with hardware software co-design with introduction, co design concept, performance evaluation, etc.
CO-2 Ability to compare the performance evaluation of VLSI circuits.
CO-3 Ability to design and develop application based hardware and software model.

UNIT-1

Introduction: Motivation hardware & software co-design, system design consideration, research scope & overviews
Hardware Software back ground: Embedded systems, models of design representation, the virtual machine hierarchy, the performance3 modeling, Hardware Software development.

UNIT-2

Hardware Software co-design research: An informal view of co-design, Hardware Software tradeoffs, crosses fertilization, typical co-design process, co-design environments, limitation of existing approaches, ADEPT modeling environment.
Co-design concepts: Functions, functional decomposition, virtual machines, Hardware Software partitioning, Hardware Software partitions, Hardware Software alterations, Hardware Software tradeoffs, co-design.

UNIT-3

Methodology for co-design: Amount of unification, general consideration & basic philosophies, a framework for co-design.
Unified representation for Hardware &Software: Benefits of unified representation, modeling concepts
An abstract Hardware & Software model : Requirement & applications of the models, models of Hardware Software system, an abstract Hardware Software models, generality of the model.

UNIT-4

Performance evaluation: Application of the abstract Hardware & Software model, examples of performance evaluation
Object oriented techniques in hardware design: Motivation for object oriented technique, data types, modeling hardware components as classes, designing specialized components, data decomposition, Processor example.

Text Books:

1. Sanjaya Kumar, James H. Ayler "The Co-design of Embedded Systems: A Unified Hardware Software Representation", Kluwer Academic Publisher, 2002

Reference Books:

1. Gomaa, Software Design Methods for Concurrent and Real-time Systems, Addison-Wesley, 1993.
2. H. Kopetz, Real-time Systems, Kluwer, 1997.
3. R. Gupta, Co-synthesis of Hardware and Software for Embedded Systems, Kluwer 1995.
4. S. Allworth, Introduction to Real-time Software Design, Springer-Verlag, 1984.
5. C. M. Krishna, K. Shin, Real-time Systems, Mc-Graw Hill, 1997.
6. Peter Marwedel, G. Goosens, Code Generation for Embedded Processors, Kluwer Academic Publishers, 1995.
7. Additional reading from selected journal papers.

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit.. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (viii)	Advanced Digital Communication	Elective	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Communication system
Course Objectives:

The aim of this subject is to develop a thorough understanding of the main concepts, techniques and performance criteria used in the analysis and design of digital communication systems.

Topics include:-

1. Introduction of digital communication system.
2. Digital modulation techniques.
3. Reception of digital signal.
4. Information theory and coding.

Course Outcomes:

After completion of the course, the student will be able to

CO-1 Ability to understand the working principles of existing and advanced digital communication techniques.

CO-2 Ability to understand basic techniques suitable to understand, design and evaluate the main elements of a modern digital communication system.

CO-3 Ability to recognize the broad applicability of digital communication systems in society

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UNIT-1

Introduction: Elements of Digital Communication system, Bandpass and Lowpass signal representation, Comparison between analog & Digital Communication, Performance parameters of Digital Communication, Concept of Constellation, BER, etc.

UNIT-2

Digital Modulation Techniques: Mathematical expressions, transmitter & receiver structure of ASK, FSK, BPSK, QPSK, M-ary PSK, MSK, QAM.

UNIT-3

Reception of Digital Signal: Baseband signal reception, Probability of error, Optimum filter receiver, Matched filter receiver, Coherent reception, calculation of error probability for PSK, MSK, ISI, Pulse Shaping Techniques.

UNIT-4

Information Theory & Coding: Measures of information, Entropy, Information rate, Channel Capacity, Source Coding (Huffman, Shannon-Fano, Lempel-Ziv), Channel coding (Block codes, Convolution codes, Turbo codes).

Text Books:

1. Digital Communications by J.G Proakis& M Salehi, 5th Edition McGraw Hill

2. Principle of Communication systems –Taub&Schilling,TataMcGraw Hill
3. Digital Communication –Simon Haykins,John Wiley & Sons.
4. Digital Communications: Fundamentals and applications- Bernard Sklar, PHI
5. B.P.Lathi,Modern Digital and analog communication systems,3rd Edition, Oxford
6. University Press,1998.

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit.. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECL-731 (ix)	**Satellite Communication**	**Elective**	**4**	**4**	**0**

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Communication System
Course Objectives:
Satellite Communication Systems play a vital role in the global telecommunication system. It provides an essential and economical fixed and mobile communication services over broad coverage areas of land, sea and air. The course goal for Satellite Communications is to provide the student with the basic understanding and an in-depth knowledge of various concepts used in a satellite communication system. In this course, you will learn the about the science behind the orbiting satellites, link design and calculation, various multiplexing schemes and earth station parameters used for satellite communication. In the end various applications of satellite communication will be discussed.
Course Outcomes:
CO-1 Ability to demonstrate an understanding of the basic principles of satellite orbits, placement and control, satellite link design and the communication system components.
CO-2 Ability to specify systems design and analyze the performance of satellite communications systems.
CO-3 Ability to implement the satellite communication techniques for industry, social problems etc.

UNIT-1

Orbital Parameters:
Orbital parameters, Orbital perturbations, Geo stationary orbits, Low Earth and Medium orbits. Frequency selection, Frequency co-ordination and regulatory services, Sun transit outages, Limits of visibility, Attitude and orientation control, Spin stabilization techniques, Gimbal platform

UNIT-2

Link Calculations:
Space craft configuration, Payload and supporting subsystems, Satellite uplink -down link power budget, C/No, G/T, Noise temperature, System noise, Propagation factors, Rain and ice effects, Polarization calculations
Earth Station Parameters:
Earth station location, propagation effects of ground, High power transmitters-Klystron Crossed field devices, Cassegrania feeds, Measurements on G/T and Eb/No

UNIT-3

Access Techniques:
Modulation and Multiplexing: Voice, Data, Video, Analog and Digital transmission systems, multiple access techniques: FDMA, TDMA, T1-T2 carrier systems, SPADE, SS-TDMA,

CDMA, Assignment Methods, Spread spectrum communication, Compression-Encryption and Decryption techniques

UNIT-4

Satellite Applications:

INTELSAT Series, INSAT, VSAT, Remote sensing, Mobile satellite service: GSM. GPS, INMARSAT, Satellite Navigation System, Direct to Home service (DTH), Special services, E-mail, Video conferencing and Internet connectivity

Text Books:

1. Bruce R. Elbert," The Satellite Communication Applications Hand Book, Artech House Boston, 1997.
2. Wilbur L.Pritchard, HendriG.Suyderhood, Robert A.Nelson, "Satellite Communication Systems Engineering" ,IIEdition, Prentice Hall, New Jersey.1993
3. Dennis Rody," Satellite Communication", Regents/Prentice Hall, Eaglewood Cliff, New Jersey, 1983
4. Tri T.Ha, "Digital satellite communication", 2nd Edition, McGraw Hill, New york.1990
5. K.Feher, Digital communication satellite / Earth Station Engineering, prentice Hall Inc.,
6. New Jersey, 1983

Note: The Examiner will set nine questions. First question will be compulsory, covering the entire syllabus. Apart from Question No. 1, rest of the paper will consist of four units as per the syllabus taking two questions from each unit.. However, student may be asked to attempt only 1 question from each unit. All questions will carry equal marks.

Advanced Printing Technology

Course Code: MTPT 700 Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objective

The objective of this course is to impart the basis knowledge of different printing processes along with their role, importance and applications.

Course Outcome

The learning outcome of this course is expected that after completion of this course the students will be having the detail knowledge of various printing processes and the recent development in this industry and they will implement their knowledge for print production operations.

Unit-1

1. Historical development in Printing Technology. Recent trends in the field of printing and allied technologies.
2. Pre-Press, Press and Post press operations

Unit-2

3. Letterpress Printing Process; Characteristics, role, importance and applications.
4. Offset Printing Process; Characteristics, role, importance and applications.

Unit-3

5. Flexography Printing Process; Characteristics, role, importance and applications.
6. Gravure Printing Process; Characteristics, role, importance and applications.

Unit-4

7. Screen Printing Process; Characteristics, role, importance and applications.
8. Digital Printing Process; Characteristics, role, importance and applications.**References:**

1. Sheet-Fed Offset Technology, By Sh. Anjan Kumar Baral
2. Letterpress Printing, By C.S. Mishra
3. On demand printing, By Havoed M Fenton, Frank J. Romao
4. Printing Technology, By Adams Fox

Introduction to Soft Computing Techniques

General Course Information:

Course Code: CSE 700 Course Credits: 3 Type: Open Elective Contact Hours: 4 hours/week Mode: Lectures	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Pre-requisites:

Basic knowledge of Probability Theory, Set Theory, programming skills and Data Structure and Computer Algorithms

The objectives of this course are to:

1. introduce the soft computing techniques to students of different Engineering Departments.
2. develop the ability to apply the soft computing techniques like genetic algorithms, fuzzy logic and neural networks in diverse Engineering domains.

By the end of the course a student is expected to:

I. be able to apply Genetic Algorithms, Neural Networks, Fuzzy Logic or a combination of these as computational tools to solve a variety of problems related to optimization in different domains.
II. acquire knowledge of the tools like MATLAB and R to implement soft computing techniques

Syllabus

Unit I

Working of a simple Genetic Algorithm and the related definitions: Block diagram of working of a Genetic Algorithm, Representation/Encoding Schemes, initialising a GA population, evaluation function, genetic operators, study of parameters of genetic algorithms and its performance, sampling and selection mechanisms, Optimizing numerical functions using GA.

Unit II

Genetic Algorithm variations: Scaling fitness, Multi-Objective Genetic Algorithms, Master Slave and Distributed Genetic Algorithms, Designing GAs for numerical optimization, knapsack problem, travelling salesperson and other similar problems.

Unit III

Neural networks: Basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Characteristics of neural networks, Learning methods, Rosenblatt's Perceptron, Fixed increment perceptron learning algorithm for a classification problem, Examples of learning of AND/OR gate by perceptron, XOR problem.

Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation learning, Delta or gradient descent learning rule and effect of learning rate, Back propagation learning algorithm.

Unit IV

Fuzzy sets: Basic terminology and definitions, Operations on Fuzzy sets, MF formulations and parameterisation, Derivatives of parameterised MFs, Fuzzy numbers, Extension principal and fuzzy relations, Linguistic variables, Fuzzy If-Then Rules, Fuzzy reasoning and compositional rule of inference.

Software and Tools to be learnt: MATLAB tool boxes on global optimization, neural networks and fuzzy logic, R Programming, GALIB 247 and KEEL

T**ext and Reference Books:**

1. David.E. Goldberg, Genetic Algorithms in Search, Optimization and machine learning, Addison Wesley, 1999.
2. Zbigniew Michalewicz, Genetic algorithms +Data Structures = Evolution Programs, Springers-Verlag, 1999.
3. M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall, 1998.
4. S. Rajasekaran & G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, PHI, 2003.
5. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007.
6. J-S. R. Jang, C.-T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 1997.
7. Simon O. Haykin, Neural Networks, A Comprehensive Foundation, PHI, 1994.

Advancements in Communication Systems

Course Code: ECE 700 Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Syllabus

Course Assessment Methods: Both Continuous & Semester End Assessment

Course Objective

1. The objective of this course is to study about the advancement in communication systems.
2. Study about the digital communication & basic concepts of mobile communication.
3. Study of optical communication & multiplexing techniques.
4. To understand basics of navigation devices like Radar, Sonar.

Course Outcomes:

CO-1 Ability to understand about the advanced communication systems.
CO-2 Students get introduction about navigational techniques.
CO-3 Satellite is the core of modern communication. Students get the introduction about satellite by this subject.

UNIT I

The essentials of a Communication system, Amplitude modulation, Phase modulation (PM) & frequency modulation (FM),Demodulation, ASK, FSK, BPSK, QPSK, Introduction to GSM, CDMA, Architecture of GSM, CDMA, Frequency Reuse concept, ISDN (Integrated Services digital Networks)

UNIT 2

Introduction to optical communication system: Electromagnetic spectrum used for optical communication, block diagram of optical communication system, Advantages of optical fiber communication, Optical fibers structures and their types, fiber characteristics, Basic principles of light propagation, Total internal reflection, Acceptance angle, Numerical aperture, Optical sources, Optical Detectors, Principles of optical detection, Optical Networks, why optical Networks? , SONET/SDH, WDM optical networks.

UNIT3

Communication signal multiplexing, Time division multiplexing, Frequency division multiplexing, Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access.

UNIT 4

Block Diagram and operation of RADAR, SONAR, Simple form of Radar Equation, Pulse Repetition frequency, VSAT(data broadband satellite), MSAT (Mobile Satellite Communication technique), Sarsat (Search & Rescue satellite) & LEOs (Lower earth orbit satellite), Satellite communication with respect to Fiber Optic Communication, LANDSAT, Defense satellite Beam Acquisition, Tracking & Positioning.

Text and Reference Books:

1. Communication systems (4th edn.): Simon Haykins; John wiley & sons.
2. Electronic Communication systems: Kennedy; TMH.
3. Optical Fiber Communications: John M Senior; PHI.
4. Wireless Communications: Theodore S. Rappaport; Pearsons.
5. Introduction to Radar Systems: Merrill I. Skolnik, ; MGH
6. Satellite Communication: D.C. Aggarwal; Khanna.

BIOMEDICAL INSTRUMENTATION

Course Code: BME 700 Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Objectives:

1. To learn about the basics, design and operation of biomedical instruments, and their role in medical science and health sector.
2. To encourage the students of various branches for their possible contribution in biomedical engineering.

Expected outcomes:

1. Learners are expected to get acquainted with the construction and operation of biomedical equipment and their significance in health care sector.
2. Stimulation among the students to start research and development in biomedical instrumentation and engineering.

Unit-I

Biomedical Instrumentation- Man-Instrument System, Origin of Biosignals, Classification of Biomedical Instruments, Performance Parameters of Instruments, Physiological Systems

Bio-Potential Electrodes- Electrode-Electrolyte Interface, Half-cells and Their Potentials, Biomedical Recording Electrodes, Equivalent circuit model of Electrode, Bioelectric Amplifiers

Physiological Sensors and Transducers- Classification and Characteristics, Transducers for Displacement, Position and Motion, Pressure and Temperature, Photoelectric Transducers, Pulse Sensors, Biosensors

Unit-II

Biomedical Equipment and Measurements

Cardiovascular Measurements- Blood Pressure Measurement, Blood Flowmeters, Electrocardiograph (ECG), Vectorcardiography (VCG), Phonocardiograph (PCG)

Neuromuscular and Nervous Measurements- Electroencephalograph (EEG), Electromyography (EMG)

Sensory and Behavioral Measurements- Audiometer, Skin Resistance Measurement, Biofeedback Instrumentation

Respiratory System Measurements- Spirometry, Measurement of Functional Residual Volume

Unit-III

Analytical Instruments- Blood Gas Analyzers, Blood-Cell Counters, Auto-Analyzers, Colorimeter, Spectrophotometer, Flame Photometer, Electrophoresis

Medical Imaging System- X-ray Machine and Digital Radiography, Computed Tomography (CT) Scan, Magnetic Resonance Imaging System, Ultrasonic Imaging System, Thermal Imaging System

Unit-IV

Therapeutic Equipment- Cardiac Pacemakers, Need and Types of Pacemakers, Defibrillation, Need and Types of Defibrillators, Need and Types of Diathermy, Hemodialysis, Dialyzer and Its Need, Ventilators and Their Types, Endoscopes

Patient Safety and Ethical Issues- Physiological Effects of Electricity, Shock Hazards, Safety Standards, Accident Prevention Methods, Biomedical Safety Standards and Ethical Issues

Text Books

1. Khanpur R.S. Handbook of Biomedical Instrumentation, TMH
2. Cormwell L., Biomedical Instrumentation & Measurements, PHI
3. John G Webster, Bioinstrumentation, John Wiley and Sons, New York
4. Enderle John, Blanchard Susan and Bronzino Joseph, Introduction to Biomedical Engineering, Academic Press (Elsevier)

COMPUTER AIDED DESIGN & MANUFACTURING

Course Code: ME700 Course Credits: 3 Type: Open Elective Contact Hours: 3 hours/week Mode: Lectures	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course objective:

- To understand the basic parametric fundamentals that are used to create and manipulate geometric models.
- *To learn about the concepts of surface modeling and solid modeling.*
- *To implement CNC programs for milling and Turning machining operations,*
- *To create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM system*

UNIT – I

Introduction: Introduction to CAD/CAM, Historical developments, Industrial look at CAD/CAM, Introduction to CIM; Basics of geometric and solid modeling, explicit, implicit, intrinsic and parametric equations, coordinate systems.

Transformations: Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations, orthographic and perspective projections, reconstruction of 3-D objects.

UNIT – II

Curves: Algebraic and geometric forms, tangents and normal, blending functions reparametrization, straight lines, conics, cubic splines, Bezier curves and B-spline curves.

Surfaces: Algebraic and geometric forms, tangents and normal, blending functions, reparametrization, sixteen point form, four curve form, plane surface, ruled surface, surface of revolution, tabulated cylinder, bi-cubic surface, Bezier surface, B-spline surface.

Solids: Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation, cell decomposition, spatial occupancy enumeration.

UNIT – III

Automation and Numerical Control: Introduction, fixed, programmable and flexible automation, types of NC systems, MCU and other components, NC manual part programming, coordinate systems, G & M codes, Part program for simple parts, computer assisted part programming.

UNIT – VIII

Group Technology: Part families, part classification and coding, production flow analysis, Machine cell design, Advantages of GT

Flexible Manufacturing Systems & Computer aided process planning: Introduction, FMS components, types of FMS, FMS layouts, planning for FMS, advantages and applications Coventional process planning, types of CAPP, Steps in variant process planning, planning for CAPP.

Course Outcomes:

- *Students would learn about the concepts of surface modeling, physically based modeling and surface visualization.*
- *Students would be able Implement CNC programs for milling and turning machining operations*

Books:

1. CAD/ CAM by Groover and Zimmer, Prantice Hall.
2. CAD/ CAM Theory and Practice by Zeid, McGraw Hill
3. CAD/CAM (Principles, Practice & Manufacturing Management) by Chirs Mc Mohan & Jimmie Browne, Published by Addison- Wesley.
4. Numerical Control and Computer Aided Manufacturing by Kundra, Rao & Tiwari, TMH.
5. Automation, Production Systems and Computer Integrated Manufacturing, Groover M.P, Prentice Hall of India.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECP-732	Advance VLSI Design Laboratory	Elective	2	0	2+2

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Analog Circuit Design
Course Objectives:
The course intends to provide an overview of the principles, operation and application of the analog building blocks like diodes, BJT, FET, and MOSFET etc. for performing various functions. To understand the basics of MOS Circuit Design & modeling.
Course Outcomes:
CO-1 Introduce the technology, design concepts, electrical properties and modeling of Very Large Scale Integrated circuits.
CO-2 Ability to understand concepts of modeling a digital system using Hardware.
CO-3 Ability to design application oriented hardware.

List of Experiments:

1. MOS Device Characterization.
2. Design and simulate the CMOS Inverting amplifier.
3. Design and simulate layout of CMOS inverter.
4. Design, simulate, layout, and test various current-mirror circuits. Design a Low-voltage cascode current mirror.
5. Design, simulate, and layout various differential pairs used in different types of differential amplifiers such as operational transconductance amplifiers and operational amplifiers.
6. Design, simulate, and layout an operational transconductance amplifier.
7. Design, simulate, layout, and test a three-stage operational amplifier.
8. Design, simulate, layout, and test various ADC topologies

Note: This list is an indicative list of experiments, which can be expanded depending on the course requirement.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECP-733	Communication System Design Lab	Elective	2	0	2+2

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Communication System
Course Objectives: The course provides an overview of optical communication, particularly fibre optics and deals with both the function of related components and with system performance. Various basic structures like wired, wireless, wireless sensor and adhoc network etc. also analysed at the end of the course.
Course Outcomes:
CO-1 To demonstrate and design WDM high bit-rate fibre optic communication systems.
CO-2 To analyse, model and implement advanced optical communication systems.
CO-3 To use optical communications simulation tools to assess the results obtained from theoretical studies.

List of Experiment:

1. To study dispersion with and without compensation.
2. To study BER (Bit error rate) in optical transmitter link of 100 Km.
3. To study four channels WDM using computer system using two spans of dispersion shifted fiber of opposite dispersion value.
4. To study DQPSK modulation technique using RZ pattern.
5. To study fiber linear effects (Polarization mode dispersion).
6. To study fiber non-linear effects (self-phase modulation).
7. To study fiber non-linear effects using cross phase modulation (XPM).

Note: This list is an indicative list of experiments, which can be expanded depending on the course requirement.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECD-730	Thesis – Part I	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Knowledge of research area
Course Objective: The objective is to enhance the research abilities of PG students. The aim is always kept into mind that any research that is done must be implemented to the day to day life. It must add up some ease in the life of a common man and benefit of the society. The students are asked to make a detailed literature survey of field of choice and formulate the problem to work on.
Course Outcomes:
CO-1 Ability to identify research issue/problem on complex engineering topics related to ECE.
CO-2 Gain knowledge on the research problem identified through extensive literature survey.
CO-3 Ability to work in group and mange and understand research papers/literature related to research topic through group-discussion.
CO-4 Understanding of professional & ethical research issues.
CO-5 Ability to present/communicate effectively the research topic though synopsis presentation.
CO-6 Understanding of simulator tools required to carry out research work.

The Thesis work should be of Research nature only and it should be started during the third semester and the candidate must do the following:

a) Literature Survey
b) Problem Formulation

Around 40% of the Thesis work should be completed in this semester. The remaining 60% work will be carried out in the fourth semester. Each student is required to submit a detailed report about the work done on topic of Thesis as per the guidelines decided by the department. The Thesis work is to be evaluated through Presentations and Viva-Voce during the semester and at the end of semester as per the guidelines decided by the department from time to time.

Fourth Semester

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course no.	Title of course	Core/Elective	Credit	L	P
ECD-740	Thesis – Part II	Core	4	4	0

Course Assessment Methods: Both Continuous & Semester End Assessment
Pre-requisites: Knowledge of Basic domain
Course Objective: Research is the back of scientific and social growth of any country and specially the research that is related to the day to day life. The PG students are motivated to use their accumulated knowledge for such research that adds up some ease in the life of a common man and beneficial for the society. The students get the knowledge of state of art technology in their field and start working.
Course Outcomes:
CO-1 Ability to bring ideas into practice through simulation of analysis of research topic.
CO-2 Ability to identify specific problems/issues in the form of research objectives.
CO-3 Ability to propose a novel idea/modified technique/new interpretation after analyzing the existing research work.
CO-4 Ability to contribute towards the knowledge up gradation of scientific community and society in general.
CO-5 Imposed communication skills (oral as well as writing) through seminars, group discussions, thesis writing and research paper writing.
CO-6 Understating of significance of ethical and research professional.
CO-7 Ability to stay updated through continuous learning.
CO-8 Understanding of research techniques and simulation tools for detected analysis of research issues.
CO-9 Interpretation and compilation of simulation result to issue at a meaningful conclusion.

Around 40% of the Thesis work should be completed in third semester. The remaining 60% work will be carried out in this semester. Each student is required to submit a detailed Thesis report about the work done (III Sem + IV Sem) on topic of Thesis as per the guidelines decided by the department. The Thesis work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time.
The candidate has to present/publish one paper in national/international conference/seminar/journal of repute is must before submission. Research work should be carried out at GJUS & T Hisar. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.