

IV Year				I Semester			
S. No.	Course Type	Course Code	Course Title	Periods Per Week			Credits
				L	T	P	
1	PCC	EC701PC	Microwave and Optical Communications	3	0	0	3
2	PEC		Professional Elective - III	3	0	0	3
3	PEC		Professional Elective - IV	3	0	0	3
4	OEC		Open Elective - II	3	0	0	3
5	HSMC	SM701MS	Professional Practice, Law & Ethics	2	0	0	2
6	PROJ	EC703PC	Project Phase-1	0	0	6	3
7	PCC	EC704PC	Microwave and Optical Communications Lab	0	0	2	1
8	PROJ	EC705PC	Industry Oriented Mini Project	0	0	0	2
9	PROJ	EC706PC	Seminar	0	0	2	1
Total				14	0	10	21

NOTE: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

IV Year				II Semester			
S. No	Course Type	Course Code	Course Title	Periods Per We			Credits
				L	T	P	
1	OEC		Open Elective - III	3	0	0	3
2	PEC		Professional Elective - V	3	0	0	3
3	PEC		Professional Elective - VI	3	0	0	3
4	PROJ	EC801PC	Project Phase -2	0	0	14	7
Total				9	0	14	16

Professional Elective –I

EC511PE	Error Correcting Codes
EC512PE	Mobile Communications and Networks
EC513PE	Electronic Measurements and Instrumentation

Professional Elective–II

EC611PE	Speech Processing
EC612PE	EMI & EMC
EC613PE	Embedded System Design

Professional Elective –III

EC711PE	Digital Image Processing
EC712PE	Radar Systems
EC713PE	Artificial Neural Networks

Professional Elective–IV

EC721PE	Adaptive Signal Processing
EC722PE	Satellite Communications
EC723PE	Internet of Things

Professional Elective–V

EC811PE	Global Navigation Satellite Systems
EC812PE	Wireless Sensor Networks
EC813PE	Test and Testability

Professional Elective–VI

EC821PE	System on Chip Architecture
EC822PE	Television Engineering
EC823PE	Low Power VLSI Design

***Open Elective** – Students should take Open Electives from List of Open Electives Offered by Other Departments/Branches Only.

These are the list of open electives offered by our branch to other branches

Open Elective - 1
Fundamentals of Internet of Things

Open Elective - 2
Electronic Sensors

Open Elective - 3
Measuring Instruments

EC811PE: GLOBAL NAVIGATION SATELLITE SYSTEM

B. Tech. IV Year II Semester								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
EC811PE	PEC	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Prerequisite: Nil								
Course Objectives:								
<ol style="list-style-type: none"> 1. To explain the basic satellite communication operation. 2. To classify the various constellations under GNSS and make the students understand the GNSS segments and signal structure 3. To distinguish between the coordinates systems likely to be encountered by GPS users 4. To demonstrate an understanding of error sources in GPS observations, and explain the uses and critical factors of Differential GPS techniques. 5. To make the students interpret the GPS navigation and observation files and determine the position. 6. To demonstrate the necessity of augmentation systems and help the students understand their operation. 								
Course Outcomes: Upon completing his course, the student will be able to								
<ol style="list-style-type: none"> 1. Explain the operation of basic satellite communication. 2. Differentiate between various GNSS constellations and describe the three GNSS segments and explain the signal structure of GNSS. 3. Frame various coordinate systems for estimating position. 4. Estimate the various errors and their effect on position estimation. 5. Determine user position from Navigation and Observation data formats. 6. Apply DGPS principle and can also analyze various augmentation systems. 								
Unit: I	Satellite Communication Fundamentals & Satellite Subsystems							
Satellite Communication Fundamentals:								
Orbit and Description, Satellite Frequency Bands, Applications, Orbital Period and Velocity, Coverage angle and slant Range, Eclipse.								
Satellite Subsystems:								
Communication Subsystem, Telemetry Command and Ranging Subsystem, Attitude Control Subsystem, Electrical Power Subsystem, Placement of a Satellite in a Geo-Stationary orbit.								
Unit: II	GNSS Basics							
GNSS Basics:								
Overview of GNSS segments, Space Segment, Ground Segment and Control Segment. Overview of GNSS Constellations: GPS, GLONASS, GALILEO, IRNSS (NAVIC), Beidou, Concept of Ranging Using TOA Measurements, Orbital mechanics and Satellite position determination, Time references. Dilution of precision: HDOP, VDOP and GDOP, GNSS applications.								
Unit: III	Coordinate systems and Sources of Error:							
Coordinate systems and Sources of Error:								
Coordinate Systems: Geodetic reference systems:								
Earth-Centered Inertial Coordinate System, Earth-Centered Earth-Fixed Coordinate System, World Geodetic System, Indian Geodetic System (IGS),								
Sources of error in GNSS:								
Satellite and Receiver clock errors, ephemeris error, Multipath error, atmospheric errors, Hardware bias error, and Pseudorange error budget. Effects of Satellite Outages on GPS Availability								
Unit: IV	GNSS Segments and Signal Structure							
GNSS Segments and Signal Structure:								
Overview of Space Segment, Control Segment and User Segment, GPS Signal Structure, SPS and PPS services, GPS Receivers, Pseudorange Measurements, Carrier Phase Measurements, Cycle Slips, Signal Acquisition, GPS Observables, GPS navigation and observation data formats (RINEX).								

Unit: V**GPS Augmentation systems**

Differential GPS (DGPS), Local Area DGPS (LADGPS), Wide Area DGPS (WADGPS).

GPS Augmentation systems:

Need for augmentation, Types of augmentation systems: Space Based Augmentation system (SBAS), GPS Aided GEO Augmented Navigation (GAGAN). Ground Based Augmentation System (GBAS).

Text Books:

1. Tri T. Ha, Digital Satellite Communications, 2nd Edition, Tata McGrawHill, 2009.
2. Ahmed El-Rabbany, Introduction to GPS, 2nd Edition, Artech House Publishers, Boston, 2006.
3. Elliot D Kaplan and Christopher J Hegarty, Understanding GPS Principles and Applications, 2nd Edition, Artech House Publishers, Boston & London, 2005.

Reference Books:

1. B. Hofmann-Wellenhof, H. Lichtenegger, and J. Collins, GPS Theory and Practice, 5th Edition, Springer Verlag, 2008.
2. Bradford W. Parkinson and James J. Spilker, Global Positioning system: Theory and Application, Vol. II, American Institution of Aeronautics and Astronautics Inc., Washington, 1996

Web References:

1. https://nptel.ac.in/courses/105104100/lectureB_8/B_8_10Indiandatum.htm
2. <https://deepradhan.heliohost.org/gis/indian-grid/>
3. <https://www.sac.gov.in/SACSITE/GAGAN%20&%20IRNSS.pdf>
4. <https://www.insidegnss.com/auto/julyaug17-IRNSS.pdf> 5. <http://insidegnss.com/wp-content/uploads/2018/01/janfeb16-GAGAN.pdf>

EC812PE: WIRELESS SENSOR NETWORKS

B. Tech. IV Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P		CIA	SEE	Total
EC812PE	PEC	3	-	-	3	30	70	100

Prerequisite: Analog and Digital Communications

Course Objectives:

- To acquire the knowledge about various architectures and applications of Sensor Networks
- To understand issues, challenges and emerging technologies for wireless sensor networks
- To learn about various routing protocols and MAC Protocols
- To understand various data gathering and data dissemination methods
- To study about design principals, node architectures, hardware and software required for implementation of wireless sensor networks.

Course Outcomes: Up on completing this course, the student will be able to

- Analyze and compare various architectures of Wireless Sensor Networks
- Understand Design issues and challenges in wireless sensor networks
- Analyze and compare various data gathering and data dissemination methods.
- Design, Simulate and Compare the performance of various routing and MAC protocol

Unit: I

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

Unit: II

Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Unit: III

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee

Unit: IV

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols

Unit: V

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC

Text Books:

1. Ad-Hoc Wireless Sensor Networks- C.Siva Ram Murthy, B.S.Manoj, Pearson
2. Principles of Wireless Networks– Kaveh Pah Laven and P. Krishna Murthy, 2002, PE

Reference Books:

1. Wireless Digital Communications– Kamilo Feher, 1999, PHI.
2. Wireless Communications- Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication– Gottapu Sasibhushana Rao, Pearson Education, 2012.
4. Wireless Communication and Networking– William Stallings, 2003, PHI.

EC813PE: TEST AND TESTABILITY

B. Tech. IV Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P		CIA	SEE	Total
EC813PE	PEC	3	-	-	3	30	70	100

Prerequisite: Switching Theory and Logic Design, Digital System Design with PLDS

Course Objectives:

- To provide or broad understanding of fault diagnosis.
- To illustrate the framework of test pattern generation.
- To understand design for testability in Digital Design

Course Outcomes: Up on completing this course, the student will be able to

- To acquire the knowledge of fundamental concepts in fault and fault diagnosis
- Test pattern generation using LFSR and CA
- Design for testability rules and techniques for combinational circuits
- Introducing scan architectures

Unit: I

Need for testing, the problems in digital Design testing, the problems in Analog Design testing, the problems in mixed analog/digital design testing, design for test, printed-circuit board (PCB) testing, software testing, Fault in Digital Circuits:
General Introduction, Controllability and Observability, Fault Models, stuck at faults, bridging faults, CMOS technology considerations, intermittent faults.

Unit: II

General Introduction, to test pattern generation, Test Pattern generation for combinational logic circuits, Manual test pattern generation, automatic test pattern generation, boolean difference method, Roth's D-algorithm, Developments following Roth's D-algorithm, Pseudorandom test pattern generation.

Unit: III

Pseudorandom test pattern generators, Design of test pattern generator using Linear feedback shift registers (LFSRs) and cellular automata (CAs).

Unit: IV

Design for Testability for combinational circuits: Basic Concept of testability, control ability and observability, the Reed Muller's expansion techniques, use of control logic and syndrome testable designs.

Unit: V

Making sequential circuits testable, testability insertion, full scan DFT technique-Full scan insertion, flip-flop structures, Full scan design and test, scan architectures-full scan design, shadow register DFT, partial scan methods, multiple scan design, other designs.

Text Books:

1. Fault Tolerant and Fault Testable Hardware Design-Parag K. Lala, 1984, PHI.
2. VLSI Testing digital and Mixed analogue/digital techniques-Stanley L. Hurst, IEE Circuits, Devices and Systems series 9, 1998.

Reference Books:

1. Digital Systems Testing and Testable Design - Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, Jaico Books
2. Essentials of Electronic Testing - Bushnell and Vishwani D. Agarwal, Springer.
3. Design for test for Digital IC's and Embedded Core Systems - Alfred L. Crouch, 2008, Pearson Education.

EC821PE: SYSTEM ON CHIP ARCHITECTURE

B. Tech. IV Year II Semester

Course Code	Category	Hours/Week			Credits	Maximum Marks		
		L	T	P		CIA	SEE	Total
EC821PE	PEC	3	-	-	3	30	70	100

Prerequisite: Embedded System Design

Course Objectives:

- To introduce the architectural features of system on chip.
- To imbibe the knowledge of customization using case studies.
-

Course Outcomes: Up on completing this course, the student will be able to

- Expected to understand SOC Architectural features.
- To acquire the knowledge on processor selection criteria and limitations
- To acquire the knowledge of memory architectures on SOC.
- To understand the interconnection strategies and their customization on SOC.

Unit: I	Introduction to the System Approach
----------------	--

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing, System level interconnection, An approach for SOC Design, System Architecture and Complexity.

Unit: II	Processors
-----------------	-------------------

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

Unit: III	Memory Design for SOC
------------------	------------------------------

Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split-I, and D-Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor-memory interaction.

Unit: IV	Interconnect Customization
-----------------	-----------------------------------

Interconnect Customization: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization:

Unit: V	Configuration
----------------	----------------------

Configuration: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance-Specific design, Customizable Soft Processor, Reconfiguration-overhead analysis and trade-off analysis on reconfigurable Parallelism.

Text Books:

1. Computer System Design System-on-Chip by Michael J. Flynn and Wayne Luk, Wiley India Pvt. Ltd.
2. ARMS System on Chip Architecture – Steve Furber – 2nd Eed., 2000, Addison Wesley Professional

Reference Books:

1. Design of System on a Chip: Devices and Components–Ricardo Reis, 1stEd.,2004, Springer
2. Co-Verification of Hardware and Software for ARM System on Chip Design(Embedded Technology) – Jason Andrews– Newnes, B Kand CDROM
3. SystemonChipVerification–MethodologiesandTechniques–PrakashRashinkar,Peter Paterson and Leena Singh L,2001,KluwerAcademicPublishers.

EC822PE: TELEVISION ENGINEERING

B. Tech. IV Year II Semester								
Course Code	Category	Hours/Week			Credits	Maximum Marks		
EC822PE	PEC	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
Prerequisite: Embedded System Design								
Course Objectives:								
<ol style="list-style-type: none"> 1. Study the different camera and picture tubes. 2. Know about various standard TV channels. 3. Study about TV receiver, sync separation, detector etc., 4. Study about color signal encoding, decoding and receiver. 								
Course Outcomes: Up on completing this course, the student will be able to								
<ol style="list-style-type: none"> 1. Known working principle and construction of various camera tubes. 2. Understand the concept of TV transmission and reception. 3. Understand the working of color TV. 4. Learn the basics of various digital TV systems. 								
Unit: I	Introduction & TV Signal Transmission and Propagation							
Introduction								
TV transmitter and receivers, synchronization. Geometric form and aspect ratio, image continuity, interlaced scanning, picture resolution, Composite video signal, TV standards. Camera tubes : Image Orthicon, Plumbicon, Vidicon, Silicon Diode Array Vidicon, Comparison of camera tubes, Monochrome TV camera,								
TV Signal Transmission and Propagation								
Picture Signal transmission, positive and negative modulation, VSB transmission, sound signal transmission, standard channel BW, TV transmitter, TV signal propagation, interference, TV broadcast channels, TV transmission Antennas.								
Unit: II	Monochrome TV Receiver							
Monochrome TV Receiver								
RF tuner, IF subsystem, video amplifier, sound section, sync separation and processing, deflection circuits, scanning circuits, AGC, noise cancellation, video and inter carrier sound signal detection, vision IF subsystem of Black and White receivers, Receiver sound system: FM detection, FM Sound detectors, and typical applications.								
Unit: III	Sync Separation and Detection							
Sync Separation and Detection								
TV Receiver Tuners, Tuner operation, VHF and UHF tuners, digital tuning techniques, remote control of receiver functions. Sync Separation, AFC and Deflection Oscillators: Synchronous separation, k noise in sync pulses, separation of frame and line sync pulses. AFC, single ended AFC circuit, Deflection Oscillators, deflection drive ICs, Receiver Antennas, Picture Tubes.								
Unit: IV	Color Television & Color Signal Encoding and Decoding							
Color Television								
Color signal generation, additive color mixing, video signals for colors, color difference signals, encoding, Perception of brightness and colors luminance signal, Encoding of color difference signals, formation of chrominance signals, color cameras, Color picture tubes.								
Color Signal Encoding and Decoding								
NTSC color system, PAL color system, PAL encoder, PAL-D Decoder, chrome signal amplifiers, separation of U and V signals, color burst separation, Burst phase discriminator, ACC amplifier, Reference oscillator, Indent and color killer circuits, U& V demodulators.								
Unit: V	Color Receiver & Digital TV							
Color Receiver								
Introduction to color receiver, Electron tuners, IF subsystem, Y-signal channel, Chroma decoder, Separation of U & V Color, Phasors, synchronous demodulators, Sub carrier generation, raster circuits.								

Digital TV

Introduction to Digital TV, Digital Satellite TV, Direct to Home Satellite TV, Digital TV Transmitter, Digital TV Receiver, Digital Terrestrial TV, LCD TV, LED TV, CCD Image Sensors, HDTV.

Text Books:

1. Monochrome and Color TV- R.R. Gulati, New Age International Publication, 2002.
2. Television and Video Engineering- A.M.Dhake, 2nd Ed., McGraw Hill, 2017

Reference Books:

1. Color Television Theory and Practice-S.P.Bali, TMH, 1994.
2. Basic Television and Video Systems-B.Grob and C.E.Herndon, McGraw Hill, 1999.
3. Modern Television Practice – Principles, Technology and Service- R.R.Gallatin, New Age International Publication, 2002.

EC823PE: LOWPOWER VLSIDESIGN

B. Tech. IV Year II Semester									
Course Code	Category	Hours/Week			Credits	Maximum Marks			
EC823PE	PEC	L	T	P	C	CIA	SEE	Total	
		3	-	-	3	30	70	100	
Prerequisite: VLSI Design									
Course Objectives:									
<ul style="list-style-type: none"> Known the low power low voltage VLSI design Understand the impact of power on system performances. Known about different Design approaches. Identify suitable techniques to reduce power dissipation in combinational and sequential circuits. 									
Course Outcomes: Upon completing this course, the student will be able to									
<ul style="list-style-type: none"> Understand the need of Low power circuit design. Attain the knowledge of architectural approaches. Analyze and design Low-Voltage Low-Power combinational circuits. Known the design of Low-Voltage Low-Power Memories 									
Unit: I	Fundamentals								
Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects – Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.									
Unit: II	Low-Power Design Approaches, Switched Capacitance Minimization Approaches								
Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach–Pipelining and Parallel Processing Approaches.									
Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, and Mask level Measures.									
Unit: III	Low-Voltage Low-Power Adders								
Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures									
Ripple Carry Adders, Carry Look- Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques – Trends of Technology and Power Supply Voltage, Low-Voltage Low- Power Logic Styles									
Unit: IV	Low-Voltage Low-Power Multipliers								
Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.									
Unit: V	Low-Voltage Low-Power Memories								
Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM									
Text Books:									
<ol style="list-style-type: none"> 1. CMOS Digital Integrated Circuits–Analysis and Design–Sung-Mo Kang, Yusuf Leblebici, TMH, 2011. 2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering. 									

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective—Ming-BOLin, CRC Press, 2011
2. Low Power CMOS VLSI Circuit Design—Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
3. Practical Low Power Digital VLSI Design—Gary K. Yeap, Kluwer Academic Press, 2002.
Leakage in Nanometer CMOS Technologies—Siva G. Narendran, Anatha Chandrakasan, Springer, 2005