Optical Communication

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-1-0, (4)	CORE	EC107101EC

[Pre-requisites: EC105101EC- Digital Communication]

Course Objectives

1. To understand mechanism of propagation of light through optical medium.
2. To understand mechanism of generation of light using semiconductor devices and methods of utilization of optical measuring instruments.
3. To understand, analyze and evaluate various techniques of optical modulation.
4. To understand, analyze and evaluate techniques of demodulation of digitally modulated signals received through optical medium.
5. To understand and analyze the techniques of coherent optical transmission and reception.

Course Content

UNIT-I

OPTICAL MEDIUM AND SOURCES: Optical fibers, Step and graded index fibers, Wave propagation, Dispersion in single mode fibers, Fiber losses, Nonlinear optical effects. Semiconductor laser, Laser characteristics, Direct modulation, and external modulation. Optical measuring instruments.

UNIT- II

PHOTONIC TRANSMITTERS: Optical modulators, Phase modulators, Intensity modulators, Return-to-zero optical pulses, CSRZ, RZ33 pulses and their phasor representation, Optical DPSK transmitter, OOK-RZ modulation, Discrete phase modulation NRZ formats, Continuous phase modulation (PM-NRZ) formats.

UNIT- III

OPTICAL RECEIVERS: Photonic and electronic noise at the receiver, Receiver sensitivity, Optical SNR, Performance of OOK receiver, Quantum limit of optical receivers under different modulation, Binary coherent optical receiver, Non-coherent detection of optical DPSK and MSK.

UNIT- IV

COHERENT OPTICAL TRANSMISSION: Optical heterodyne detection, PSK coherent system, Homodyne detection, Coherent and non-coherent transmission, Optical source and modulation, Filters and phase comparators, Coherent phase and differential phase shift keying, Optical multi-level modulation, Coherent OFDM. Introduction to WDM, SONET.

Course Materials

Required Text: Text books

1. Digital Optical Communications, Le Nguyen Binh, CRC Press, Chennai, 2009.
2. Fiber-Optic Communication Systems, 4ed, G. P. Agrawal, John Wiley & Sons, NY, 2010.

Optional Materials: Reference Books

1. Advanced Optical and Wireless Communication Systems, Ivan B. Djordjevic, Springer, 2018.
2. Optical Wireless Communications: System and Channel Modeling with Matlab, Z. Ghassemlooy, W. Popoola, S. Rajbhandari, CRC Press, 2013.

5G Communication and Beyond

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-1-0, (4)	CORE	EC107102EC

[Pre-requisites: EC105101EC- Digital Communication,]

Course Objectives

1. To understand evolution of mobile communication upto 5G standards.
2. To perform computations and solve numerical problems on different multiple access schemes.
3. To assess how softwarization of network function helps in scalability and ease of operations.
4. To evaluate the use of advanced 5G techniques in cellular communications.

Course Content

UNIT-I

Mobile Communications Overview: Evolution from 1G to 5G, Analog voice systems in 1G, digital radio systems in 2G, voice and messaging services, TDMA based GSM, CDMA, 2.5G (GPRS), 2.75G (EDGE); IMT2000, 3G UMTS, W-CDMA, HSPA, HSPA+, 3G services and data rates, IMT Advanced, 4G, LTE, VOLTE, OFDM, MIMO, LTE Advanced Pro (3GPP Release 13+), IMT2020, enhancements in comparison to IMT Advanced,

UNIT-II

Introduction to 5G Communication: 5G potential and applications, Usage scenarios, enhanced mobile broadband (eMBB), ultra reliable low latency communications (URLLC), massive machine type communications (MMTC), D2D communications, V2X communications, Spectrum for 5G, spectrum access/sharing, millimeter Wave communication, channels and signals/waveforms in 5G, carrier aggregation, small cells, dual connectivity.

UNIT-III

5G Network: New Radio (NR), Standalone and non-standalone mode, non-orthogonal multiple access (NOMA), massive MIMO, beam formation, PHY API Specification, flexible frame structure, Service Dala Adaptation Protocol (SDAP), centralized RAN, open RAN, multi-access edge computing (MEC), Introduction to software defined networking (SDN), network function virtualization (NFV), network slicing; restful API for service-based interface, private networks.

UNIT-IV

Current state and Challenges ahead: 5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements, large cell usage, LMLC, possible solutions for connectivity in rural areas (Bharat Net, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul/backhaul solutions: LEOS, HAP/UAV, Limitations of 5G and road towards 6G.

Course Materials

Required Text: Text books

1. Mobile Communications by Jochen Schiller Pub: Financial Times / Imprint of Pearson.
2. Afifosseiran, Jose F Monserrat, Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.

Optional Materials: Reference Books

1. Mobile Cellular Telecommunications: Analog and Digital Systems by William Lee, Pub: McGraw Hill Education
2. Mobile Communications Design Fundamentals by William Lee, Pub: Wiley India Pvt. Ltd.
3. Wireless Communications: Principles and Practice by Theodore S. Rappaport, Pub: Pearson
4. Saad Z. Asif, “5G Mobile Communications Concepts and Technologies”, CRC Press, Taylor & Francis Group, First Edition, 2018.
5. HarriHolma, Antti Toskala, Takehiro Nakamura, “5G Technology 3GPP NEW RADIO”, John Wiley & Sons First Edition,2020.
6. Martin Sauter “From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband”, Wiley-Blackwell.

7. Athanasios G. Kanatos, Konstantina S. Nikita, Panagiotis Mathiopoulos, “New Directions in Wireless Communication Systems from Mobile to 5G”, CRC Press.
8. R. Vannithamby and S. Talwar, Towards 5G: Applications, Requirements and Candidate Technologies., John Willey & Sons, West Sussex, 2017.
9. Manish, M., Devendra, G., Pattanayak, P., Ha, N., 5G and Beyond Wireless Systems PHY Layer Perspective, Springer Series in Wireless Technology.

Introduction to Deep Learning

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC107201EC

[Pre-requisites: NA]

Course Objectives

1. To identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
2. To understand the concepts of feed forward networks, convolutional networks, recurrent neural networks etc.
3. To understand various optimization algorithms such as gradient descent, adam, adagrad, RMSprop etc.
4. To implement deep learning algorithms and solve real-world problems.

Course Content

UNIT-I

Deep Feedforward Networks: Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms.

Unit- II

Regularization for Deep Learning: Parameter Norm Penalties, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Early Stopping, Parameter Tying and Parameter Sharing, DropoutOptimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates.

Unit- III

Convolutional Networks: The Convolution Operation, Pooling, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Convolutional Networks, and the History of Deep Learning: LeNet, AlexNet, VGGNet.

Unit- IV

Sequence Modeling: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Deep Recurrent Networks, The Challenge of Long-Term Dependencies, The Long Short-Term Memory and Other Gated RNNs.

Course Materials

Required Text: Text books

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

Optional Materials: Reference Books

1. Neural Networks: A Systematic Introduction, Raul Rojas, 1996
2. Pattern Recognition and Machine Learning, C.M. Bishop, Springer, 2006.

Satellite and Space Systems

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC107202EC

[Pre-requisites: EC104101EC-Electromagnetic field theory]

Course Objectives

1. To understand orbital mechanics and satellite coordinate systems.
2. To identify different components and their functioning in a satellite system.
3. To understand basic principles of radio astronomy, deep space radio sources and their characteristics.
4. To understand methods of observing deep space radio sources using single dish and interferometer methods.

Course Content

UNIT-I:

Orbital Mechanics: Kepler's laws, orbital elements, apogee and perigee heights, Coordinate transformations, Time, orbit perturbations, effects of a non-spherical earth, atmospheric drag. Geostationary orbit: introduction, antenna look angles, the polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage, launching orbits.

Unit- II:

Satellite systems: Space Segment, Power Supply, Attitude Control, Spinning satellite stabilization, Momentum wheel stabilization, Station Keeping, Thermal Control, TT&C Subsystem, Transponders, The wideband receiver, power amplifier, Antenna Subsystem. Earth Segment: Receive-Only Systems, Transmit-Receive Earth Stations. Case study: Decoding of NOAA APT or Meteor M2 data from the received signal.

Unit- III:

Satellite based navigation systems: Introduction to GPS or NavIC; GPS observables: pseudo ranges, carrier phase, SA/AS, format of data; Estimation procedures: Stochastic and mathematical models, sequential estimation, Kalman filtering.

Unit- IV:

Processing of GPS data: Mathematical model of GPS observables, Use of differencing, differential position, Wide-lanes and use in kinematic positioning, Cycle slip fixing/Bias resolution, Kinematic (moving receiver) GPS processing, Introduction to programming for processing GPS data and relevant software.

Course Materials

Required Text: Text books

1. Satellite Communications, Dennis Roddy (Fourth edition), McGraw Hill.
2. GPS Theory and Practice, Hofmann-Wellenh , B. H. Lichtenegger, and J. Collins, Springer, 1994.

Optional Materials: Reference Books

1. Satellite Communication Systems Engineering, Wilbur L. Pritchard, Henri G. Suyderhoud, Robert A. Nelson (SecondEdition), Pearson
2. Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt (Second Edition), John Wiley & Sons.
3. MIT Open courseware. Link: https://ocw.mit.edu/courses/earth-atmospheric-and-planetary-sciences/12-540-principles-of-the-global-positioning-system-spring-2012

Digital Image Processing

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC107203EC

[Pre-requisites: EC104102EC- Digital Signal Processing]

Course Objectives

1. To understand the fundamental concepts of a digital image processing system.
2. To choose appropriate technique for image enhancement both in spatial and frequency domains.
3. To interpret image segmentation and representation techniques.
4. To compare the image compression techniques in spatial and frequency domains.

Course Content

UNIT-I:

Introduction to image processing: Types of image processing, Applications and fields of image processing, Fundamental steps in Digital image processing, Elements of visual perception, Image sensing and acquisition, Basic Concepts in Sampling and Quantization, representing digital images, Some Basic Relationships Between Pixels.

Unit- II:

Image Enhancement in the Spatial Domain: Some basic gray level transformations, Histogram Processing, Histogram modification, Contrast Stretching, Log Transformation, Image subtraction, spatial filtering, Sharpening Spatial filters, use of first and second derivatives for enhancement.

Image Enhancement in the Frequency Domain, Gaussian filters, Homomorphic filtering Pseudo coloring: intensity slicing.

Unit- III:

Image Segmentation: - Some Basic Relationships between pixels, Point, Line and edge detection, Gradient operators, Canny edge detection, pyramid edge detection. Edge linking and boundary detection, Hough transform, Chain codes, boundary segments, skeletons, Boundary descriptors, Fourier descriptors.

Thresholding: The role of illumination, Global thresholding, Adaptive thresholding, Use of boundary characteristics for histogram improvement and local thresholding, Region based segmentation, Region growing, region splitting and merging.

Unit- IV:

Morphological Image Processing: Introductions, Dilation, Erosion, Opening, closing.

Image Compression: Data redundancies Elements of information, variable-length coding, predictive coding, Transform coding, Image compression standards; Color image processing: Color models, Pseudocolor image processing, Color transformations.

Course Materials

Required Text: Text books

1. Digital Image Processing, Gonzalez and Woods, 3rd Edition (DIP/3e), Prentice Hall, 2008
2. Fundamentals of Digital Image Processing, A.K. Jain, PHI, New Delhi, 2001

Optional Materials: Reference Books

1. Image Processing, Analysis and Machine Vision, Milan Sonka, Thomson Learning, 2001
2. Digital Image Processing, Pratt W.K, John Wiley & Sons, 2001

Low Power Circuit Design

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC107204EC

[Pre-requisites: EC103102EC- Microelectronic Devices and Circuits, EC103104EC- Digital logic design, EC106103EC-VLSI Design]

Course Objectives

1. To design Low power CMOS circuits for digital applications.
2. To gain knowledge on low power circuit design styles.
3. To learn power estimation and optimization methods for VLSI circuits.

Course Content

UNIT-I

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation,
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, Mask level Measures.

Unit- II

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures, Low Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles.

Unit- III

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier.

Unit- IV

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Low Power SRAM, DRAM Technologies.

Course Materials

Required Text: Text books

1.Low-Voltage, Low-Power VLSI Subsystems, Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

Optional Materials: Reference Books

1. CMOS Digital Integrated Circuits – Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
2. Introduction to VLSI Systems: A Logic, Circuit and System Perspective, Ming-BO Lin, CRC Press.
3. Low Power CMOS Design, Anantha Chandrakasan, IEEE Press, /Wiley International, 1998.
4. Low Power CMOS VLSI Circuit Design, Kaushik Roy, Sharat C. Prasad, John Wiley, & Sons, 2000.

Wireless Sensor Networks

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC107205EC

[Pre-requisites: EC106203EC- Computer Communication and Networks,EC106101EC- Wireless Communication]

Course Objectives

1. To understand the WSN node Architecture and Network Architecture
2.To identify the Wireless Sensor Network Platforms
3.To program WSN using embedded C
4.To design and develop wireless sensor node

Course Content

UNIT-I

Introduction to Adhoc/sensor networks: Key definitions of Adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering. Issues and Challenges in WSN.

Unit- II

MAC Protocols : Issues in designing MAC protocols for Adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4. Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols

Unit- III

Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

Unit- IV

QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes. Case study of any deployed WSN.

Course Materials

Required Text: Text books

1. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig, John Wiley & Sons, 2005.
2. Wireless Sensor Networks,Zhao and L. Guibas, Morgan Kaufmann, San Francisco, 2004
3. Wireless Sensor Networks, C. S. Raghavendra, K. M. Shivalingam and T. Znati, Springer, New York,2004.

Optional Materials: Reference Books

1. Wireless Sensor Networks Architecture and Protocols, E. H. Callaway, Jr. E. H. Callaway, CRC Press, 2009.
2.Wireless Sensor Network Designs, Anna Hac, John Wiley & Sons, 2004.
3.Wireless Sensor Networks: Technology, Protocols, and Applications, Kazem Sohraby, Daniel Minoli and Taieb Znati, Wiley Inter Science, 2007.

RADAR Engineering

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC107206EC

[Pre-requisites: EC106102EC-Microwave Engineering, EC104105EC-Analog Communication, EC105101EC- Digital Communication]

Course Objectives

1. To understand working principles of RADAR.
2. To explore the different types and applications of RADAR

Course Content

UNIT-I

Introduction to Radar: Basic radar, the simple form of radar equation, Radar block diagram, Radar frequencies, Applications to radar.

Unit- II

Radar Equation: Introduction, Detection of signal in noise, Receiver noise and the signal to noise ratio, Probability density functions, Probabilities of detection and false alarm, Integration of Radar pluses, Radar cross section of targets, Radar cross section fluctuations, Transmitter power, Pulse repetition frequency, antenna parameters, system losses, Other Radar equation considerations.

Unit- III

MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay-Line cancelers, Staggered pulse repetition frequencies, Doppler filter banks, Digital MTI processing, Moving target detector, Limitation of MTI performance, MTI from a moving platform, Pulse Doppler Radar, CW Radar.

Unit- IV

Tracking Radar: Tracking with Radar, Mono-pulse tracking, Conical scan and sequential lobbing, Limitation to tracking accuracy, Low-angle tracking, Tracking in range, Comparison of trackers, Automatic tracking with Surveillance Radar (ADT), Basic Radar Measurements.

Course Materials

Required Text: Text books

1. Introduction to RADAR systems, M. I. Skolnik, 3rd Ed., McGraw Hill, 2017.
2. Principles of modern RADAR systems, M. H. Carpentier, Artech house publishers, 1988.

Optional Materials: Reference Books

1. Fundamentals of RADAR signal processing, Richards M.A.,Indian Ed., McGraw Hill, 2005.
2. Principles of Radar, J.C. Toomay, Paul J. Hannen, Third Edition.

Design, verification, and testing of VLSI circuits

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	Elective	EC107207EC

[Pre-requisites: EC106103EC – VLSI Design]

Course Objectives

1. To understand basic concepts of testing and verification of VLSI design process.
2. To understand the fundamentals of VLSI testing
3. To understand various approaches for system testing and verification.

Course Content

UNIT-I

Scope of testing and verification in VLSI design process. Issues in test and verification of complex chips, embedded cores and SOCs.

Unit- II

Fundamentals of VLSJ testing. Fault models. Automatic test pattern/generation. Design for testability. Scan design. Test interface and boundary scan.

Unit- III

System testing and test for SOCs. Iddq testing. Delay fault testing. BIST for testing of logic and memories.

Unit- IV

Test automation. Design verification techniques based on simulation, analytical and formal approaches. Functional verification. Timing verification, Formal verification.

Unit- V

Basics of equivalence checking arid model checking. Hardware emulation. Parametric testing, Reliability modeling, Yield models.

Course Materials

Required Text: Text books

1. Jan M. Rabaey, "Digital Integrated Circuits", Prentice Hall, 2003.
2. M.J.S. Smith, "Application Specific Integrated Circuits", Pearson Education India, 1997
3. Viswani D. Agraval Michael L. Bushnell, "Essentials of Electronic Testing for digital memory and mixed signal VLSI circuit", Kluwer Academic Publications, 1999.
4. Alfred L. Crouch "Design for test for digital ICs and embedded core systems", PHI, 1999.

Analog IC Design

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC107208EC

[Pre-requisites: EC103102EC-Microelectronic Devices and Circuits, EC104104EC-Linear Integrated Circuits and Applications]

Course Objectives

1. To learn Spice Modeling for circuit.
2. To study the basics of analog IC designing.
3. To understand the Frequency response, stability and noise issues in amplifiers.

Course Content

UNIT I:

Introduction to SPICE Simulation, Analysis of complex electronic circuits, simulation and analysis using SPICE, AC/DC operation, DC sweep transfer function, frequency response, feedback control analysis, transient response, device models, simulation and analysis of electronic circuits and systems.

UNIT II

Basic Analog Building Blocks, Switches, Active Resistors, Current and Voltage sources, Current and voltage references, Voltage regulators.

UNIT III

Amplifiers: Basic Amplifiers: CS, CG and source follower, Cascode Amplifiers, High Gain Amplifier Structure.

UNIT IV

Differential Amplifier, Current Mirrors, Operational Amplifiers: Operational Amplifier characteristics, Frequency response, stability and noise issues in amplifiers.

Required Text: Text books

1. CMOS: circuit design, layout, and simulation, R. J. Baker, Wiley, 2008
2. Design of Analog CMOS Integrated Circuits, B Razavi, Tata McGraw-Hill.

Optional Materials: Reference Books

1. Analysis and design of analog integrated circuits, Meyer, Paul R Gray, Hurst, Lewis, Wiley, 2009.
2. CMOS Analog Circuit Design, P. E Allen., D. R Holberg, Oxford University Press, 2012.
3. Introduction to Device Modeling and Circuit Simulation, T. A Fjeldly, T Ytterdal., M. S. Shur, Wiley, 1998.

Real Time Embedded Systems

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	OPEN ELECTIVE	EC107302EC

[Pre-requisites: EC105102EC-Microprocessors & Microcontrollers]

Course Objectives

1. To understand the concepts of embedded system design and analysis.
2. To learn Real-Time Operating Systems (RTOS) based embedded system.
3. To expose to the basic concepts of program modeling.
4. To learn the design examples and case studies of program modeling and programming with RTOS.

Course Content

UNIT I

Hardware Software Co-design and program Modelling: Characteristics of an Embedded System, Quality Attributes of Embedded Systems, Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modelling Language (UML), Hardware Software Tradeoffs.

UNIT II

REAL-TIME OPERATING SYSTEMS (RTOS) BASED EMBEDDED SYSTEM DESIGN Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling :Putting them Altogether, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS.

UNIT III

PROGRAM MODELING CONCEPTS: Program Models, DFG Models, state Machine Programming Models for Event controlled Program Flow, Modeling of Multiprocessor Systems, UML Modeling.

UNIT IV

DESIGN EXAMPLES AND CASE STUDIES OF PROGRAM MODELING AND PROGRAMMING WITH RTOS: Case study of Communication between Orchestra Robots, Embedded Systems in Automobile, Case study of an Embedded System for an Adaptive Cruise Control(ACC) System in a Car, Case study of an Embedded System for a Smart Card, Case study of a Mobile Phone Software for Key Inputs.

Course Materials

Required Text: Text books

1. Introduction to Embedded System, Shibu K V, McGraw Hill Higher Edition.
2. Embedded Systems Architecture, Programming and Design, Raj Kamal, Second Edition, McGraw Hill.
3. Embedded System Design, Peter Marwedel, Springer.

Optional Materials: Reference Books

1. Embedded System Design – A Unified Hardware/Software Introduction, Frank Vahid, Tony D. Givargis, John Wiley, 2002.
2. Embedded/ Real Time Systems, KVKK Prasad, Dream tech Press, 2005.
3. An Embedded Software Primer, David E. Simon, Pearson Ed. 2005.

Industrial Internet of Things

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	OPEN ELECTIVE	EC107302EC

[Pre-requisites: EC105102EC - Microprocessor and Microcontrollers]

Course Objectives

1. To have knowledge of theory and practice related to Industrial IoT Systems.
2. Able to identify, formulate and solve engineering problems by using Industrial IoT.
3. Abile to implement real field problem by gained knowledge of Industrial applications with IoT capability.

Course Content

UNIT-I

Introduction to Industrial IoT (IIoT) Systems:
The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.
Implementation systems for IIoT:
Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.

UNIT-II
IIoT Data Monitoring & Control:
IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring.

UNIT-III
Cyber Physical Systems:
Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Security in IIoT.

UNIT-IV
Industrial IoT- Applications:
Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.
Case Studies of IIoT Systems:
IIoT application development with Embedded PC based development boards, Development of mini Project on new version of Operating systems and Edge development board. That project should also address to the current societal needs

Course Materials
Required Text: Text books

1. Industry 4.0: The Industrial Internet of Things Alasdair GilchristPublications: Apress
2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

Optional Materials: Reference Books

1. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.
2. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystem by Dr. OvidiuVermesan, Dr. Peter Friess,River Publishers.
3. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication).
4. Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
5. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)

Nanoelectronics

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	Open Elective	EC107303EC

Course Objectives

1. To study various emerging nano-electronics devices.
2. To understand different sensing mechanism of nano-sensor.
3. To explore emerging devices and sensors such as carbon nano-tube, grapheme, nanowire etc.

Course Content

UNIT-I

Shrink-down approaches: Introduction, CMOS Scaling.

Unit- II

The nanoscale MOSFET, FinFETs, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.), and spintronics devices.

Unit- III

Quantum dot, well and wire, Resonant Tunneling Diode & Transistors, Single electron transistors.

Unit- IV

Nanoelectronic based sensors: Bio-sensor, Gas sensor, Temperature sensor, pH Sensor.

Unit- V

Carbon nanotube electronics, band structure & transport, devices, applications, Graphene based Electronics, Band gap Modulation and Graphene devices and its applications.

Course Materials

Required Text: Text books

1. Introduction to Nanotechnology, C.P. Poole Jr., F.J. Owens,Wileyÿ (2003), C.P. Poole Jr.,F.J. Owens,Wiley (2003).
2. Nanoelectronics and Information Technology (Advanced Electronic Materials and Novel Devices), Waser Ranier ,Wiley-VCH,2003.
3. Nanosystems, K.E. Drexler,Wiley (1992),1992.
4. The Physics of Low-Dimensional Semiconductors,John H. Davies,"Cambridge University Press, "1998.

Optical Communication Lab

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	0-0-2, (1)	CORE	EC107401EC

Course Objectives

To expose the students to the basics of signal propagation through optical fibers,fiber impairments, test & measurement of Optical Fiber parameters, components anddevices and system design.

List of Experiments

1. Demonstration and study of different types of Optical Fibers, Connectors and Optical Power Meter.
2. Setting up a Fiber Optic Analog and Digital Link.
3. Study of Pulse Amplitude Modulation (PAM) over analog optical fiber link.
4. Study of Pulse Width Modulation (PWM) over digital optical fiber link for different frequencies of carrier pulses.
5. Study of Pulse Position Modulation (PPM) over digital optical fiber link.
6. Characteristics of LASER diode.
7. Characteristics of PHOTO DETECTOR.
8. Characteristics of AVALANCHE PHOTODIODE (APD).
9. Measurement of NUMERICAL APERTURE.
10. Measurement of ATTENUATION AND BENDING LOSS.
11. Fiber Dispersion Measurement.
12. Characteristics of WDM LINK.

Course Materials

Required Text: Text books

1. Digital Optical Communications, Le Nguyen Binh, CRC Press, Chennai, 2009.
2. Fiber-Optic Communication Systems, 4ed, G. P. Agrawal, John Wiley & Sons, NY, 2010.