4th Year 7th Semester

National Institute of Technology Raipur												
Course of Study and Scheme of Examination							B. Tech. 7th Semester				Branch:	
S. No.	Subject Code	Subject Name	Periods per Week			TA	Examination Scheme				Total Marks	Credits
							MSE/MTR		ESE/ESVE			
			L	T	P		Theory	Prac.	Theory	Prac.		
1	EC107101EC	Optical Communication	3	1	0	20	30		50		100	4
2		Program Elective	3	0	0	20	30		50		100	3
3		Program Elective	3	0	0	20	30		50		100	3
4		Open Elective	3	0	0	20	30		50		100	3
5	EC107401EC	Optical Comm Lab	0	0	2	40		20		40	100	1
6	EC107501EC	Project Work	0	0	8	40		20		40	100	4
7	EC107701EC	Summer Internship II	-	-	-	40		20		40	100	2
												20

Program Electives	
Subject Code	Name of Subject
EC107201EC	Low Power Circuit Design
EC107202EC	Industrial Automation
EC107203EC	Wireless Sensor Network
EC107204EC	Satellite and Space Systems
EC107205EC	RF IC Design
EC107206EC	RADAR Engineering

Open Electives	
Subject Code	Name of Subject
EC107301EC	Computer Vision
EC107302EC	Real Time Embedded Systems

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.

Low Power Circuit Design

[7th Semester, Fourth Year]

Course Description

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

[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.

Industrial Automation

[7th Semester, Fourth Year]

Course Description

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

[Pre-requisites: EC105102EC-Microprocessors & Microcontrollers, EC103102EC- Microelectronic Devices and Circuits, EC103104EC- Digital Logic Design]

Course Objectives

1. To explain various power electronic devices analyze and develop different application circuits based on thyristors.
2. To understand regulated / controlled power supply principles
3. To understand the components of data acquisition system

Course Content

UNIT-I

Introduction of Power Electronics, Thyristors : definition and basic introduction of the members of thyristor family: Thyristor Basics: Silicon controlled rectifier, SCR Construction, SCR terminology and two transistor model, Static and dynamic characteristics of SCR, Turn-on methods of a Thyristor, Different triggering circuits for SCRs, Turn-off methods of Thyristor, Different methods of forced commutation, Thyristor ratings, Comparison of SCRs & transistors, The SCR crowbar: Power Semiconductors Devices: Power semiconductor devices – Diac, Triac, Power transistor, Power MOSFET, IGBT, MCT, Comparison between Power transistor, Power MOSFET and Power IGBT. : Series and Parallel Operation of SCRs: Series Operation, Need for equalizing network, Triggering of series connected thyristors, Parallel operation, Methods for ensuring proper current sharing, Triggering of parallel connected thyristors, String efficiency.

Unit- II

Application of regulated power supply inverters and Phase Controlled Converters: Performance measures of single and three-phase converters with discontinuous load current for R, RL and RLE loads. Stabilized Power Supplies: Uninterrupted power supplies, online UPS, offline UPS, high frequency online UPS, Inverters: Performance parameters, voltage control of three phase inverters-Sinusoidal PWM, Third Harmonic PWM, 60 and Space Vector Modulation. Harmonic reduction.

Unit- III

Data acquisition: Data acquisition system and its uses in intelligent Instrumentation system. Detail study of each block involved in making of DAS, Signal conditioners as DA, IA, signal converters (ADC), Sample and hold. Designing application for Pressure, Temperature measurement system using DAS, Data logger.

Unit- IV

Evolution and Role of PLC in Automation Block Diagram & Principle of Working PLC Characteristics and hardware configuration – CPU, Racks, Power Supply, Memory, Input & Output Modules, Application Specific Modules, Speed of Execution, Communication, Redundancy. Introduction to PLC Programming Languages –Ladder, Instruction List.

Required Text: Text books

1. Programmable logic controller, Frank D. Petrusella, Tata McGraw-Hill publication.
2. Power Electronics, M. D. Singh & K. B. Khanchandani, Tata McGraw Hill., 2007.
3. Computer Based Industrial Control, Krishna Kant, PHI.

Optional Materials: Reference Books

1. Process Control Instrumentation – By Curtis D. Johnson, Pearson Education.
2. Industrial Electronics, C. D. Simpson, Prentice-Hall Inc. Publication.
3. Power Electronics, Sachin S. Sharma.

Wireless Sensor Networks

[7th Semester, Fourth Year]

Course Description

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

[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.

Satellite and Space Systems

[7th Semester, Fourth Year]

Course Description

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

[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 (Second Edition), 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

RF IC Design

[7th Semester, Fourth Year]

Course Description

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

[Pre-requisites: EC104105EC- Analog Communication, EC106103EC- VLSI Design]

Course Objectives

1. To understand the issues involved in design for GHz frequencies.
2. To explore theoretical background relevant for design of active and passive circuits for RF front end in wireless digital communication systems.

Course Content

UNIT-I

Characteristics of passive components for RF circuits, Passive RLC networks, Transmission lines, Two-port network modelling, S-parameter model, The Smith Chart and its applications.

Unit- II

Active devices for RF circuits: SiGe MOSFET, GaAs pHEMT, HBT and MESFET, PIN diode, Device parameters and their impact on circuit performance, RF Amplifier design: single and multi-stage amplifier.

Unit- III

Review of analog filter design: Low-pass, high-pass, band-pass and band-reject fiter. Bandwidth estimation methods, Voltage references and biasing, Low noise amplifier design: noise types and their characterization, LNA topologies, power match vs noise match

Unit- IV

Linearity and large-signal performance, RF Power amplifiers: General properties, Class A, AB and C Power amplifiers, Class D, E and F amplifiers, Modulation of power amplifiers.

Course Materials

Required Text: Text books

1. RF Microelectronics. B. Razavi, United Kingdom: Prentice Hall, 2012.
2. The Design of CMOS Radio Frequency Integrated Circuits, Lee Thomas H, Cambridge University Press.

Optional Materials: Reference Books

1. Design of Analog CMOS integrated circuits, B. Razavi, McGraw Hill.
2. VLSI for wireless communication, Bosco Leung, Pearson Education.

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.

Computer Vision

[7th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC107301EC

[Pre-requisites: EC105301EC- Digital Image Processing]

Course Objectives

1. To provide an overview of basic approaches and current techniques in computer vision.
2. To understand various mechanisms responsible for motion estimation, computational imaging and multiple view geometry.
3. To study various applications of computer vision systems.

Course Content

UNIT-I:

Image Formation:

Geometric primitives and transformations: Orthogonal, euclidean, affine, projective, etc. photometric image formation.

Feature Extraction:

Edges canny, LOG, DOG; line detectors (Hough transform), Corners Harris, Hessian Affine, orientation histogram, SIFT, SURF, HOG, GLOH.

UNIT-II:

Camera Geometry:

Camera parameters and perspective projection, affine camera, least-squares parameter estimation, linear approach to camera calibration, homography, rectification, auto calibration.

Color Space:

Linear color spaces: CIE XYZ, RGB, CMY, non-linear colour spaces: HSV, spatial and temporal effects.

UNIT-III:

Motion Analysis:

Translational alignment, parametric motion, spline-based motion, optical flow, KLT.

Stereo correspondence:

Epipolar geometry, sparse correspondence, dense correspondence, multi-view stereo.

UNIT-IV:

Basics of object detection, face recognition, instance recognition, category recognition, context and scene understanding, activity recognition, computational photography, shape from X.

Course Materials

Required Text: Text books

1. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, 2010.
2. Computer Vision, Shapiro and Stockman, Prentice Hall, 2001.

Optional Materials: Reference Books

1. Image Processing, Analysis, and Machine Vision, Sonka, Hlavac, and Boyle, Cengage Learning, 2009.
2. Fundamentals of Machine Vision, Harley R. Myler, PHI Learning, 2003.
3. Computer Vision: A Modern Approach, Forsyth, David A., Ponce, Jean, PHI Learning, 2009.
4. Digital image processing, Rafael C. Gonzalez and Richard E. Woods, Pearson Education 3rd Edition.

Real Time Embedded Systems

[7th Semester, Fourth Year]

Course Description

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

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 and devices 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.