# NOIDA INTERNATIONAL UNIVERSITY

# EVALUATION SCHEME & SYLLABUS

**For**

UNDERGRADUATE DEGREE COURSE

IN

## ELECTRONICS & COMMUNICATION ENGINEERING

**(Effective from the Session: 2020-21)**

# B. Tech in Electronics and Communication Engineering

## Program Educational Objectives (PEOs)

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The Department of Electronics and Communication Engineering has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of E&C Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

## Program outcomes (POs)

***Engineering Graduates will be able to:***

**PO**1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO**2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO**3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO**4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO**5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO**6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO**7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
**PO**8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
**PO**9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
**PO**10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
**PO**11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
**PO**12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAMME SPECIFIC OUTCOMES (PSOs)

***On completion of B.Tech. ECE program, graduates will be able to:***
**PSO1.**
To identify the engineering problems and develop solutions in the area of communication, signal processing, VLSI and embedded systems.
**PSO2.**
To demonstrate proficiency in utilization of software and hardware tools along with analytical skills to arrive at appropriate solutions
**PSO3.**
Incorporate the socio-responsible electronics and communication engineer with leadership, teamwork skills and exhibit a commitment to the lifelong learning.

# Credit Distribution

**Definition of Credit**:

| | |
|---|---|
| 1 Hr. Lecture (L) per week | 1 credit |
| 1 Hr. Tutorial (T) per week | 1 credit |
| 1 Hr. Practical (P) per week<br>1 Hours Practical(Lab)/week | 0.5 credits<br>1 credit |

**Range of credits:**

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honors, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

**Course code and definition**

| Course code | Definitions |
|---|---|
| BSC | Basic Science Courses |
| ESC | Engineering Science Courses |
| HSMC | Humanities and Social Sciences including Management courses |
| MC | Mandatory Course |
| OE | Open Elective |
| EC | Program Core |
| ECEL | Program Elective |

**Structure of Undergraduate Engineering program:**

| S.no | Category | Credits |
|---|---|---|
| 1 | Humanities and Social Sciences including Management courses | 12 |
| 2 | Basic Science courses | 26 |
| 3 | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc | 20 |
| 4 | Professional core courses | 51 |
| 5 | Professional Elective courses relevant to chosen specialization/branch | 21 |
| 6 | Open subjects – Electives from other technical and /or emerging subjects | 12 |
| 7 | Project work, seminar and internship in industry or elsewhere | 14 |
| 8 | Mandatory Courses<br>[Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge] | Non-credit |
| **Total** | | **156** |

| SEVENTH SEMESTER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **S. No** | **Course Code** | **Subject** | **Period** | | | **Evaluation Scheme** | | | | | **Total Credits** |
| | | | | | | **Sessional Exam** | | | **End Exams** | **Subject Total** | |
| | | | **L** | **T** | **P** | **CA** | **TA** | **Total** | | | |
| 1 | ECEL* | Program Elective – 4 | 3 | 0 | 0 | 20 | 20 | 40 | 60 | 100 | 3 |
| 2 | ECEL* | Program Elective – 5 | 3 | 0 | 0 | 20 | 20 | 40 | 60 | 100 | 3 |
| 3 | ECEL* | Program Elective – 6 | 3 | 0 | 0 | 20 | 20 | 40 | 60 | 100 | 3 |
| 4 | | Open Elective-2 | 3 | 0 | 0 | 20 | 20 | 40 | 60 | 100 | 3 |
| 5 | | Online Course, NPTEL for Honors degree | | | | | | | | | |
| **PRACTICALS** | | | | | | | | | | | |
| 1 | ECP1 | Project Stage-I | 0 | 0 | 10 | - | - | 40 | 60 | 100 | 5 |
| **Total** | | | | | | | | | | | **17** |

## EIGTHTH SEMESTER

| S.No | Course Code | Subject | Period | | | Evaluation Scheme | | | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sessional Exam | | | External Exam | Subject Total | |
| | | | L | T | P | CA | TA | Total | | | |
| 1 | ECEL* | Program Elective –7 | 3 | 0 | 0 | 20 | 20 | 40 | 60 | 100 | 3 |
| 2 | | Open Elective-3 | 3 | 0 | 0 | 20 | 20 | 40 | 60 | 100 | 3 |
| 3 | | Open Elective-4 | 3 | 0 | 0 | 20 | 20 | 40 | 60 | 100 | 3 |
| 4 | | Online Course, NPTEL for Honors degree NPTEL | | | | | | | | | |
| **PROJECT** | | | | | | | | | | | |
| 1 | ECP2 | Project Stage-II | 0 | 0 | 18 | | | 200 | 400 | 600 | 9 |
| **Total** | | | | | | | | | | | **18** |

**Total Credits ---- 156**

**Program Elective Courses:**

| S.N | Course Code | Course Title | Preferred Semester |
|---|---|---|---|
| 1 | ECEL1 | Bio-Medical Electronics | V |
| 2 | ECEL2 | CMOS Design | V |
| 3 | ECEL3 | Information Theory and Coding | V |
| 4 | ECEL4 | Introduction to MEMS | VI |
| 5 | ECEL5 | Electro Magnetic Waves | VI |
| 6 | ECEL6 | Speech and Audio Processing | VI |
| 7 | ECEL7 | Power Electronics | VI |
| 8 | ECEL8 | Nano electronics | VI |
| 9 | ECEL9 | Scientific computing | VI |
| 10 | ECEL10 | Adaptive Signal Processing | VII |
| 11 | ECEL11 | Antennas and Propagation | VII |
| 12 | ECEL12 | Digital Image & Video Processing | VII |
| 13 | ECEL13 | Mobile Communication and Networks | VII |
| 14 | ECEL14 | Mixed Signal Design | VII |
| 15 | ECEL15 | Microwave Theory and Techniques | VII |
| 16 | ECEL16 | Fiber Optic Communications | VII |
| 17 | ECEL 17 | RADAR and Satellite Communication | VII |
| 18 | ECEL18 | High Speed Electronics | VII |
| 19 | ECEL19 | Wavelets | VII |
| 20 | ECEL20 | Wireless Sensor Networks | VIII |
| 21 | ECEL21 | Embedded systems | VIII |
| 22 | ECEL22 | Error correcting codes | VIII |

**OPEN ELECTIVES**

1. Non-Conventional Energy Resources($7^{th}$)
2. Quality Management ($6^{th}$)
3. Operations Research
4. Introduction to Biotechnology
5. Nonlinear Dynamic Systems
6. Product Development
7. Automation & Robotics
8. Soft Computing (Neural Networks, Fuzzy Logic and Genetic Algorithm)
9. Nano Sciences
10. Laser Systems and Applications
11. Space Sciences
12. Polymer Science & Technology
13. Nuclear Science
14. Material Science
15. Finance & Accounting
16. Human Resource Development ($7^{th}$)
17. Cyber Law & Ethics ($8^{th}$)
18. Introduction to Philosophical Thoughts
19. Comparative Study of Literature
20. Indian Music System
21. History of Science & Engineering
22. Introduction to Art and Aesthetics
23. Economic Policies in India
24. Entrepreneurship Development($8^{th}$)

# DETAILED CURRICULUM CONTENTS

**Undergraduate Degree**

**In**

**Engineering & Technology**

**BRANCH: Electronics & Communication Engineering**

# SEMESTER -7

**Course Code: ECEL10** **Course Name: Adaptive Signal Processing**
**Course Credit:** 3 **Total Contact Hour:** 40hr

**Course Objective:**

- To understand multirate DSP and design efficient digital filters.
- To construct multi-channel filter banks.
- To select linear filtering techniques to engineering problems.
- To describe the most important adaptive filter generic problems and various adaptive filter algorithms.

**Course Description:**

This **course** develops the concepts, key issues and motivating examples for adaptive filters; Discrete time linear systems and filters; Random variables and random processes, covariance matrices; Z transforms of stationary random processes. Optimum Linear Systems - Error surfaces and minimum mean square error; Optimum discrete time Wiener filter; Principle of orthogonality and canonical forms; Constrained optimisation; Method of steepest descent - convergence issues; Stochastic gradient descent LMS - convergence in the mean and misadjustment Case study. Least squares and recursive least squares. Linear Prediction - Forward and backward linear prediction; Levinson Durbin; Lattice filters.

**Course Contents:**

Unit1

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complexvalued The LMS algorithm (real, complex), convergence analysis, weight errorcorrelation matrix, excess mean square error and mis-adjustment

Unit 2

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Unit 3

Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank andnullity, innerp roduce space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

Unit 4

Vector space of random variables, correlation as inner product, forward andbackward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit 5

Introduction to recursive least squares (RLS), vector space formulation of RLSestimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

**Course Learning Outcomes(CLOs) :**

At the end of this course students will demonstrate the ability to

- Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.
- Mathematically represent the _adaptability requirement'.
- Understand the mathematical treatment for the modeling and design of the signal processing systems.

**Text books:**

- S. Haykin, Adaptive filter theory, Prentice Hall, 1986.

**Reference books:**

- C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

**Online links for study & reference materials:**

https://nptel.ac.in/courses/117/105/117105075/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code:** ECEL11 **Course Name:** Antenna & Propagation
**Course Credit Hour:** 3hr **Total Contact Hour:** 40hr

**Course Objective:**

- To introduce the student to antennas, covering their principles of radiation, their basic parameters, (radiation resistance, radiation pattern, polarization, reciprocity, effective radiated power), their general types, and those commonly used in wireless systems.
- Concept of radiation mechanism of various antennas.
- Mechanism and models for radio-wave propagation.

**Course Description:**

Antenna and Wave Propagation is to introduce to the students the basics of radiating elements and effect of propagation of radio waves in actual environment. This course provides students with comprehensive coverage of a wide variety of antennas and propagation topics related to numerous communication systems with a particular emphasis on military applications.

**Course Contents:**

**UNIT-1**

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

**UNIT-2**

Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

**UNIT-3**

Aperture and Reflector Antennas- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

**UNIT-4**

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, and synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

**UNIT-5**

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. Different modes of Radio Wave propagation used in current practice.

**Course Learning Outcomes (CLOs):**

- Understand the properties and various types of antennas.
- Analyze the properties of different types of antennas and their design.
- Operate antenna design software tools and come up with the design of the antenna of required specifications.

**Text books:**


- J.D. Kraus, Antennas, McGraw Hill, 1988.
- C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.

**Reference books :**

- R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.

**Online links for study & reference materials :**

https://nptel.ac.in/courses/108/101/108101092/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Mid exam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code ECEL12** **Course Name: Digital Image & Video Processing**
**Course Credit:** 3 **Total Contact Hour:** 40hr

**Course Objective:**

- To understand the need for image transforms different types of image transforms and their properties.
- To develop any image processing application.
- To understand the rapid advances in Machine vision.
- To learn different techniques employed for the enhancement of images.

**Course Description:**

This course will cover the fundamentals of image and video processing. We will provide a mathematical framework to describe and analyze images and videos as two- and three-dimensional signals in the spatial, spatio-temporal, and frequency domains. In this class not only will you learn the theory behind fundamental processing tasks including image/video enhancement, recovery, and compression – but you will also learn how to perform these key processing tasks in practice using state-of-the-art techniques and tools. We will introduce and use a wide variety of such tools – from optimization toolboxes to statistical techniques.

**Course Contents:**

UNIT 1

Digital Image Fundamentals-Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

UNIT 2

Image Enhancements and Filtering-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

UNIT 3

Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

UNIY 4

Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000.

UNIT 5

Fundamentals of Video Coding-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices,

macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

**Course Learning Outcomes(CLOs) :**

At the end of this course students will demonstrate the ability to

- Mathematically represent the various types of images and analyze them.
- Process these images for the enhancement of certain properties or for optimized use of the resources.
- Develop algorithms for image compression and coding

**Text books:**

- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
- Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004

**Reference books:**

- Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

**Online links for study & reference materials:**

https://nptel.ac.in/courses/117/105/117105079/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code: ECEL13** **Course Name: Mobile Communication and Networks**
**Course Credit:** 3 **Total Contact Hour:** 40hr

**Course Objective:**

- To study the concept of Mobile radio propagation, cellular system design
- To understand mobile technologies like GSM and CDMA.
- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.
- To have overview of immerging technologies for 4 G standards.

**Course Description:**

This Course is to expose the students to the most recent technological developments in Mobile communication systems.. The Course considers the basic concepts of cellular system. Following this, various propagation effects and propagation models used in mobile communication are included in the course.This course deals with various methodologies to improve the received signal quality in mobile communication.The Course provides various multiple access techniques and Standards in Cellular mobile Communication.

**Course Contents:**

Unit 1

Cellular concepts-Cell structure, frequency reuse, cell splitting, channelassignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Unit 2

Signal propagation-Propagation mechanism- reflection, refraction, diffraction andscattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Unit 3

Capacity of flat and frequency selective channels. Antennas-Antennas for mobileterminal-monopole antennas, PIFA, base station antennas and arrays.

Unit 4

Multiple access schemes- FDMA, TDMA, CDMA and SDMA. Modulationschemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Receiver structure- Diversity receivers- selection and MRC receivers, RAKEreceiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

Unit 5

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff.Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

**Course Learning Outcomes(CLOs) :**

At the end of this course students will demonstrate the ability to

- Understand the working principles of the mobile communication systems.
- Understand the relation between the user features and underlying technology.
- Analyze mobile communication systems for improved performance

**Text books:**


- WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
- WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.

**Reference books:**


- Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
- AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
- VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.


**Online links for study & reference materials:**

http://www.nptelvideos.in/2012/12/wireless-communication.html

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code:** ECEL14 **Course Name:** Mixed Signal Design

**Course Credit Hour:** 3hr **Total Contact Hour:** 40hr

**Course Objective:**

- Study the mixed signal of submicron CMOS circuits
- Understand the various integrated based filters and topologies
- Learn the data converters architecture, modeling and signal to noise ratio
- Study the integrated circuit of oscillators and PLLs

**Course Description:**

This course provides the understanding of the practical situations where mixed signal analysis is required and analyze to handle the inter-conversions between signals. It includes the concepts of design systems involving mixed signals.

**Course Contents:**

**UNIT-1**

Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.

**UNIT-2**

Switched-capacitor filters- Non idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

**UNIT-3**

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

**UNIT-4**

Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission.

**UNIT-5**

Introduction to frequency synthesizers and synchronization; Basics of PLL, Analog PLLs; Digital PLLs; DLLs.

**Course Learning Outcomes (CLOs):**

- Apply the concepts for mixed signal MOS circuit.
- Analyze the characteristics of IC based CMOS filters.
- Design of various data converter architecture circuits.
- Design of oscillators and phase lock loop circuit.

**Text books:**

- CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.

**Reference books :**

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Reprint, 2016.

**Online links for study & reference materials :**

https://nptel.ac.in/content/storage2/courses/117101105/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Mid exam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code:** ECEL15 **Course Name:** Microwave Theory & Techniques
**Course Credit Hour:** 3hr **Total Contact Hour:** 40hr

**Course Objective:**

- To understand the microwave waveguides, passive & active devices, tubes and network analysis.
- To design microwave matching networks.
- To perform microwave measurements.

**Course Description:**

Microwaves are everywhere in current technology, especially in the most popular television industries. Microwaves is very much applicable between local and national security channels. For instance, microwaves are used missile guidance infrastructures to control the speed of their missiles as well as parameters.

**Course Contents:**

**UNIT-1**

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

**UNIT-2**

Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line. Microwave Network Analysis- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

**UNIT-3**

Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes,

Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

**UNIT-4**

Microwave Design Principles- Impedance transformation, Impedance Matching, Microwave

Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave

**UNIT-5**

General measurement setup, Microwave bench, Power measurement – low, Medium & high, Attenuation measurement, Measurement of VSWR, Measurement of dielectric constant, Measurement of Impedance: using Smith Chart, Measurement with spectrum analyzer, Scalar & vector network analyzer operation.

**Course Learning Outcomes (CLOs):**

- Understand about different modes of wave propagation (TE, TM and TEM) and waveguide structure.
- Knowledge about different microwave components
- Understanding about devices used in microwave generation
- Microwave measurement theory and technology

**Text books:**

- R.E. Collins, Microwave Circuits, McGraw Hill
- K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

**Reference books:**

- Liao, S.Y., Microwave Devices & Circuits, Tata McGraw Hill (2006) 2nd edition.

**Online links for study & reference materials:**

https://nptel.ac.in/courses/108/101/108101112/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Mid exam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code: ECEL16** **Course Name: Fiber Optic Communication**
**Course Credit:** 3 **Total Contact Hour:** 40hr

**Course Objective:**

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion, SM fibers
- To learn the various optical sources, materials and fiber splicing
- To learn the fiber optical receivers and noise performance in photo detector.

**Course Description:**

The course is aimed at equipping the undergraduate Engineering and Physics students with the basic understanding of optical fibers and optical fiber communication. The course provides knowledge of optical fiber waveguide at fundamental level, essentials of an optical fiber communication system and understanding of various components of an optical fiber telecommunication system.

**Course Contents:**

Unit 1

Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model.Different types of optical fibers, Modal analysis of a step index fiber.

Unit 2

Signaldegradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detectorresponsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Unit 3

Optical switches - coupled mode analysis of directional couplers, electro-opticswitches.

Unit 4

Optical amplifiers - EDFA, Raman amplifier.WDM and DWDM systems. Principles of WDM networks.

Unit 5

Nonlinear effects in fiber optic links. Concept of self-phase modulation, groupvelocity dispersion and solition based communication.

**Course Learning Outcomes(CLOs) :**

- Understand the principles fiber-optic communication, the components and the bandwidth advantages.
- Understand the properties of the optical fibers and optical components.
- Understand operation of lasers, LEDs, and detectors
- Analyze system performance of optical communication systems
- Design optical networks and understand non-linear effects in optical fibers

**Text books:**

- J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).

- T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.

**Reference books:**

- J. Gowar, Optical communication systems, Prentice Hall India, 1987.
- S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.

**Online links for study & reference materials:**

https://nptel.ac.in/courses/108/106/108106167/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code:** ECEL17 **Course Name:** Radar & Satellite Communication
**Course Credit:** 3 T**otal Contact Hour:** 40hr

**Course Objective:**

- To become familiar with satellites and satellite services.
- Study of satellite orbits and launching.
- Study of earth segment and space segment components
- Study of satellite access by various users.

**Course Description:**

The course introduces the students to the basic concept in the field of satellite communication. This will enable the students to know how to place a satellite in an orbit and about the earth & space segment. The satellite services like broadcasting are also studied thoroughly.

**Course Contents:**

**Unit-1**

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

**Unit-2**

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

**Unit-3**

Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

**Unit-4**

Typical Phenomena in Satellite Communication:Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

**Unit-5**

Satellite link budget, flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Modulation and Multiple Access Schemes:Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA**.**

**Course Learning Outcomes(CLOs) :**

At the end of this course students will demonstrate the ability to

- Visualize the architecture of satellite systems as a means of high speed, high range communication system.
- State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

**Text books:**

- Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002

**Reference books:**

- Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
- Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

**Online links for study & reference materials:**

https://nptel.ac.in/courses/117/105/117105131/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40** |

**Course Code : ECEL18** **Course Name : High Speed Electronics**
**Course Credit:** 3 **Total Contact Hour:** 40hr

**Course Objective :**

Aim of this subject is to understand significance and the areas of application of high-speed electronics circuits

**Course Description :**

Important parameters governing the high speed performance of devices and circuits are described, mainly emphases on transmission line, Noise analysis, RF amplifier design, mixer circuit,oscillators and understanding of PCB Designing is given.

**Course Contents :**

Unit 1

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency powerdelivery, methodologies for design of high speed buses, radiated emissions and minimizing system noise.

Unit 2

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Intermodulation,Cross-modulation, Dynamic range.

Devices: Passive and active, Lumped passive devices (models), Active (models,low vs highfrequency)

Unit 3

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages

Unit 4

Mixers –Upconversion Downconversion, Conversion gain and spurious response.Oscillators Principles.PLL Transceiver architectures

Unit 5

Printed Circuit BoardAnatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

**Course Learning Outcomes(CLOs) :**

At the end of the course, students will demonstrate the ability to:

- CLO1 : Understand significance and the areas of application of high-speed electronics circuits.
- CLO2& CLO3: Understand the properties of various components used in high speed electronics
- CLO4 : Design High-speed electronic system using appropriate components.
- CLO5: Understand about CAD tools for PCB Design

**Text books :**

- Stephen H. Hall, Garrett W. Hall, James A. McCall –High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices‖, August 2000, Wiley-IEEE Press
- Thomas H. Lee, –The Design of CMOS Radio-Frequency Integrated Circuits‖, CambridgeUniversity Press, 2004, ISBN 0521835399.

**Reference books :**

- Behzad Razavi, ―RF Microelectronics‖, Prentice-Hall 1998, ISBN 0-13-887571-5.
- Guillermo Gonzalez, –Microwave Transistor Amplifiers‖, 2nd Edition, Prentice Hall.
- Kai Chang, –RF and Microwave Wireless systems‖, Wiley.
- R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

**Online links for study & reference materials :**

https://nptel.ac.in/courses/117/106/117106089/
https://nptel.ac.in/courses/117/104/117104071/

**Assessment method :** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

Open Elective-2 for 7th SEM

**Course Code:** ECP1 **Course Name:** Project Stage-I
**Course Credit:** 5

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

2. Survey and study of published literature on the assigned topic;
3. Working out a preliminary Approach to the Problem relating to the assigned topic;
4. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
5. Preparing a Written Report on the Study conducted for presentation to the Department;
6. Final Seminar, as oral Presentation before a departmental committee.

# SEMESTER -8

**Course Code:** ECEL19 **Course Name:** Wavelets
**Course Credit:** 3 **Total Contact Hour:** 40hr

**Course Objective:**

- To expose to the basics of wavelet theory
- To illustrate the use of wavelet processing for data compression
- To understand denoising and noise suppression.

**Course Description:**

This course focus on the concepts, methodologies and tools of signal processing using wavelets. We will discuss the basics of wavelets, and aim at the appropriate balance of theory and applications. Topics of interest include multiresolution analysis, wavelet packets, and selected applications to data compression, denoising and signal and image processing.

**Course Contents:**

**Unit 1**

Introduction to time frequency analysis; the how, what and why about wavelets, Short-time Fourier transform,

**Unit 2**

Wigner-Ville transform.;Continuous time wavelet transform, Discrete wavelet transform, tiling of the time-frequency plane and wave packet analysis,

**Unit 3**

Construction of wavelets. Multiresolution analysis. Introduction to frames and biorthogonal wavelets, Multirate signal processing and filter bank theory,

**Unit 4**

Application of wavelet theory to signal denoising, image and video compression, multi-tone digital communication, transient detection.

**Course Learning Outcomes(CLOs) :**

At the end of the course, students will demonstrate the ability to:

- Understand time-frequency nature of the signals.
- Apply the concept of wavelets to practical problems.
- Mathematically analyze the systems or process the signals using appropriate wavelet functions.

**Text books:**

- Stephen H. Hall, Garrett W. Hall, James A. McCall ‒High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices‖, August 2000, Wiley-IEEE Press
- Thomas H. Lee, ‒The Design of CMOS Radio-Frequency Integrated Circuits‖, CambridgeUniversity Press, 2004, ISBN 0521835399.

**Reference books:**

- Behzad Razavi, ―RF Microelectronics‖, Prentice-Hall 1998, ISBN 0-13-887571-5.
- Guillermo Gonzalez, ‒Microwave Transistor Amplifiers‖, 2nd Edition, Prentice Hall.
- Kai Chang, ‒RF and Microwave Wireless systems‖, Wiley.
- R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

**Online links for study & reference materials:**

https://nptel.ac.in/courses/117/101/117101001/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code:** ECEL20 **Course Name:** Wireless Sensor Network

**Course Credit:** 3 **Total Contact Hour:** 40hr

**Course Objective:**

- To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology
- Understand the medium access control protocols and address physical layer issues
- Learn key routing protocols for sensor networks and main design issues
- Learn transport layer protocols for sensor networks, and design requirements
- Understand the Sensor management ,sensor network middleware, operating systems.

**Course Description:**

This course will cover the latest research in the area of Wireless Sensor Networks. We will cover all aspects of these unique and important systems, from the hardware and radio architecture through protocols and software to applications. Topics will include sensor network architectures, hardware platforms, physical layer techniques, medium access control, routing, topology control, quality of service (QoS) management, localization, time synchronization, security, storage, and other advanced topics. Each student must complete a semester-long course project related to wireless sensor networks.

**Course Contents:**

**Unit 1**

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

**Unit 2**

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

**Unit 3**

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

**Unit 4**

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 5**

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.

**Course Learning Outcomes(CLOs) :**

At the end of the course the students will be able to

- Design wireless sensor networks for a given application
- Understand emerging research areas in the field of sensor networks

- Understand MAC protocols used for different communication standards used in WSN
- Explore new protocols for WSN

**Text books:**

- Waltenegus Dargie , Christian Poellabauer, –Fundamentals Of Wireless Sensor Networks Theory And Practice‖, By John Wiley & Sons Publications ,2011
- Sabrie Soloman, –Sensors Handbook" by McGraw Hill publication. 2009

**Reference books:**

- Feng Zhao, Leonidas Guibas, ―Wireless Sensor Networks‖, Elsevier Publications,2004
- Kazem Sohrby, Daniel Minoli, –Wireless Sensor Networks‖: Technology, Protocols and Applications, Wiley-Inter science
- Philip Levis, And David Gay "TinyOS Programming‖ by Cambridge University Press 2009

**Online links for study & reference materials:**

https://nptel.ac.in/courses/106/105/106105160/

**Assessment method:** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

**Course Code : ECEL21** **Course Name : Embedded Systems**
**Course Credit:**3 **Total Contact Hour:** 40hr

**Course Objective :**

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware , operating systems in correlation with hardware systems.

**Course Description :**

In this course you will learn the basics of designing, interfacing, configuring, and programming embedded systems. By the end of the course you will have mastered the basics of embedded system design and programming. This course will help to prepare you for cutting edge careers in industry and research.

**Course Contents :**

Unit 1

Introduction to Embedded Systems Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit 2

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit 3

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Unit 4

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Unit 5

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

**Course Learning Outcomes(CLOs) :**

- CLO1 : Expected to understand the selection procedure of Processors in the Embedded domain.
- CLO2: Design Procedure for Embedded Firmware.
- CLO 3: Expected to visualize the role of Real time Operating Systems in Embedded Systems
- CLO 4. Expected to evaluate the Correlation between task synchronization and latency issues

**Text books :**

- Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

**Reference books :**

- Embedded Systems - Raj Kamal, TMH.
- Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
- Embedded Systems – Lyla, Pearson, 2013
- An Embedded Software Primer - David E. Simon, Pearson Education.

**Online links for study & reference materials:**

https://nptel.ac.in/courses/108/102/108102045/
https://nptel.ac.in/courses/106/105/106105193/

**Assessment method :** (Continuous Internal Assessment = 40% , Final Examination = 60%)

| | |
|---|---|
| Assessment -1 | - 05% |
| Assessment-2 | - 05% |
| Assessment-3(Midexam) | - 20% |
| Assessment-3 | - 05% |
| Assessment-4 | - 05% |
| **Total Internal Assessment** | **- 40%** |

Open Elective-3 for 8th sem

Open Elective-4 for 8th sem

**Course Code: ECP2** **Course Name:** Project Stage -II

**Course Credit:** 9

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EC P1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.