# GOVERMENT COLLEGE OF ENGINEERING, AMRAVATI

## DEPARTMENT OF ELECTRONICS ENGINEERING

# M. TECH. (Electronics Systems and Communication)

# 2019-2020

# Specialization: Electronics Systems and Communication

## PROGRAM OBJECTIVES

1. Students should have Core Competence in mathematical, scientific and engineering principles necessary to formulate, analyze and solve hardware/software engineering problems and also to pursue higher study or research.

2. Student should function effectively as an individual and in a team in industry and research activity.

3. Student should understand the social issues and should have ability to come up with remedial measures.

4. Students should have enough techno-scientific excellence to serve the rising demands in agricultural as well as industrial sectors and contribute to nation building.

5. Students should have enough analytical skills to visualize the applications of Electronics and Communication engineering concepts in real life situations.

6. Students should come up with entrepreneurship quality with ethical attitude.

## PROGRAM OUTCOMES (POs):

Students will be able to

1. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Identify, formulate and solve engineering problems in the broad areas like System Design using communication and Networking platform, Applications in Signal Processing, Machine Vision.

3. Use different software tools in the domain of Communication; Signal processing, VLSI and Embedded Systems Design. Analysis and Verification such as Design entry, Synthesis, Functional and Timing Simulation, Platform specific EDA sets.

4. Design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

5. Function as a member of a multidisciplinary team with sense of ethics, integrity and responsibility

## M. Tech. (Electronics Systems and Communication)

| SEM I | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Course Code | Name of the Course | Teaching Scheme | | | | Evaluation Scheme | | | | | | Credits |
| | | | | | | | Theory | | | Practical | | Total | |
| | | | Theory Hrs /week | Tutorial Hrs/week | Practical Hrs/week | Total | MSE | TA | ESE | ICA | ESE | | |
| EC | ETP121 | Advanced Digital Signal Processing | 3 | - | - | 3 | 30 | 10 | 60 | - | - | 100 | 3 |
| EC | ETP122 | Advanced Communication Networks | 3 | - | - | 3 | 30 | 10 | 60 | - | - | 100 | 3 |
| EC | ETP123 | Optoelectronics and Optical Communication Systems | 3 | - | - | 3 | 30 | 10 | 60 | - | - | 100 | 3 |
| ECEL | ETP124 | Program Elective I | 3 | - | - | 3 | 30 | 10 | 60 | - | - | 100 | 3 |
| EC | ETP125 | System Design and Communication Lab-I | - | - | 6 | 6 | - | - | - | 50 | 50 | 100 | 3 |
| ECP | ETP126 | Seminar-I | - | - | 4 | 4 | - | - | - | 50 | - | 50 | 2 |
| MC | SHP121 | Audit Course | - | - | - | - | - | - | 60 | - | - | 60 | - |
| | Total | | 12 | - | 10 | 22 | 120 | 40 | 300 | 100 | 50 | 610 | 17 |

**ETP125 System Design and Communication Lab-I will consist of practical / assignments based on theory of first semester subjects. ETP126 Seminar-I to be delivered by the students on general topic not covered in syllabi and to be evaluated by two members committee, appointed by HOD wherein guide should be one of the members**

**LIST OF PROGRAM ELECTIVES**

| PROGRAM ELECTIVE I(ETP124) |
|---|
| (A) RF & Microwave circuit design |
| (B) Embedded System Design |
| (C) Soft Computing |
| (D) Optical Network |

**LIST OF AUDIT COURSE**

| AUDIT COURSES(SHP121) | |
|---|---|
| (A) English for Research Paper Writing | (B) Disaster Management |
| (C) Sanskrit for Technical Knowledge | (D) Value Education |
| (E) Pedagogy Studies | (F) Stress Management by Yoga |
| (G) Personality Development through Life Enlightenment Skills. | |
| (H) Constitution of India | |

## M. Tech. (Electronics Systems and Communication)

| SEM II | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Course Code | Name of the Course | Teaching Scheme | | | | Evaluation Scheme | | | | | | | |
| | | | | | | | Theory | | | Practical | | | | |
| | | | Theory Hrs /week | Tutorial Hrs/week | Practical Hrs/week | Total | MSE | TA | ESE | ICA | ESE | Total | Credits |
| EC | ETP221 | Antennas and Radiating Systems | 3 | - | - | 3 | 30 | 10 | 60 | - | - | 100 | 3 |
| EC | ETP222 | Analog and Digital CMOS VLSI Design | 3 | - | - | 3 | 30 | 10 | 60 | - | - | 100 | 3 |
| EC | ETP223 | Image and Video Processing | 3 | - | - | 3 | 30 | 10 | 60 | - | - | 100 | 3 |
| ECEL | ETP224 | Program elective II | 3 | - | - | 3 | 30 | 10 | 60 | - | - | 100 | 3 |
| MC | SHP221 | Research Methodology | 2 | - | - | 2 | 30 | 10 | 60 | - | - | 100 | 2 |
| EC | ETP225 | Systems Design and Communication Lab-II | - | - | 6 | 6 | - | - | - | 50 | 50 | 100 | 3 |
| ECP | ETP226 | Seminar II | - | - | 4 | 4 | - | - | - | 50 | - | 50 | 2 |
| | Total | | 14 | 00 | 10 | 24 | 150 | 50 | 300 | 100 | 50 | 650 | 19 |

**ETP225 System Design and Communication Lab.-II will consist of practicals / assignments based on theory of second semester subjects**

**ETP226 Seminar-II to be delivered by the students on Literature survey based on dissertation topic and to be evaluated by two members committee, appointed by HOD wherein guide should be one of the members.**

### LIST OF PROGRAM ELECTIVES

| PROGRAM ELECTIVE II(ETP224) |
|---|
| (A) Satellite Communication |
| (B) Programming Language for Embedded Systems |
| (C) Pattern Recognition and Machine Learning |
| (D) Wireless Sensor Network |

## M. Tech. (Electronics Systems and Communication)

| SEM III* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Course Code | Name of the Course | Teaching Scheme | | | | Evaluation Scheme | | | | | | |
| | | | | | | | Theory | | | Practical | | Total | Credits |
| | | | Theory Hrs /week | Tutorial Hrs/week | Practical Hrs/week | Total | TA | MSE | ESE | ICA | ESE | | |
| ECEL | ETP321 | Program Elective III | 3 | - | - | 3 | 10 | 30 | 60 | - | - | 100 | 3 |
| OE | SHP321 | Open Elective | 3 | - | - | 3 | 10 | 30 | 60 | - | - | 100 | 3 |
| ECP1 | ETP322 | Dissertation Stage I | - | - | 20 | 20 | - | - | - | 100 | - | 100 | 10 |
| | Total | | 06 | 00 | 20 | 26 | 20 | 60 | 120 | 100 | - | 300 | 16 |

**Dissertation Stage I: Student has to submit the report and deliver the seminar based on 50% or more work on Dissertation topic. It is to be evaluated internally by three member's panel of examiners headed by HOD wherein guide should be one of the members of the panel. Last date of submission of report shall be two weeks before the end of semester.*Students going for Industrial Project/Thesis will complete these courses through MOOCs.**

### LIST OF PROGRAM ELECTIVES

| PROGRAM ELECTIVE III (ETP321) |
|---|
| A) Wireless communication |
| B) VLSI Design verification and testing |
| C) Computer Vision |
| D) Network security and Cryptography |

### LIST OF OPEN ELECTIVES

| OPEN ELECTIVE (SHP321) |
|---|
| (A) Business Analytics(ME) |
| (B) Industrial Safcty(ME) |
| (C) Operations Research(ME) |
| (D) Cost Management of Engineering Projects(CE) |
| (E) Composite Materials(ME) |
| (F) Waste to Energy(CE) |
| (G) Finance Management(EE) |
| (H) Project Management(EE) |
| (I) Data Structure and Algorithms(CS) |
| (J) Any other course approved by BOS |

M.Tech. (Electronics Systems and Communication)

| SEM IV | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Course Code | Name of the Course | Teaching Scheme | | | | Evaluation Scheme | | | | | Credits |
| | | | | | | | Theory | | Practical | | Total | |
| | | | Theory Hrs /week | Tutorial Hrs/week | Practical Hrs/week | Total | MSE | ESE | ICA | ESE | | |
| ECP2 | ETP421 | Dissertation Stage II | - | - | 32 | 32 | - | - | 200 | 200 | 400 | 16 |
| | Total | | - | - | **32** | **32** | - | - | **200** | **200** | **400** | **16** |

**Dissertation Phase-II: Internal assessment of dissertation (complete work) is to be carried out by the guide for 100 marks. External assessment of Dissertation (complete work) is to be carried out by panel of examiner consisting of internal (guide) and external examiner for 200 marks. Candidate shall present the entire work on Dissertation, followed by viva-voce. Last date of submission of dissertation will be the end of the semester. Please see Appendix-C of Rules & Regulation for further information.**

*** Note: ETP322Dissertation Stage I, SHP121 Audit course, ETP126 Seminar I and ETP226 Seminar II as prerequisite for ETP421Dissertation Stage II.**

**Department of Electronics Engineering**

**Equivalence Scheme**

**Programme Name: -Electronics Systems and Communication**

| Sr. No. | Course code with Name of course(old) with total 90 credits | | Credit | Remark | Course code with Name of course(new)with total 68 credits | | Credit | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | ETP108 | Electronic Design Technology with HDL | 4 | No equivalence | ETP121 | Advanced Digital Signal Processing | 3 | No equivalence |
| 2 | ETP109 | Digital Signal and Speech Processing | 4 | No equivalence | ETP122 | Advanced Communication Networks | 3 | No Equivalence |
| 3 | ETP110 | Wireless Digital Communications | 4 | No equivalence | ETP123 | Optoelectronics and Optical Communication Systems | 3 | Newly added |
| 4 | ETP104 | Optic communication Systems | 4 | No equivalence | ETP124 | Program Elective I | 3 | |
| 5 | ETP111(A) | Digital image processing | 4 | No equivalence | ETP124(B) | RF & Microwave circuit design | 3 | No equivalence |
| 6 | ETP111(B) | Digital Communication Systems | 4 | No equivalence | ETP124(B) | Embedded System Design | 3 | No equivalence |
| 7 | ETP111(C) | Artificial Intelligence | 4 | No equivalence | ETP124(C) | Soft Computing | 3 | Newly added |
| 8 | ETP111(D) | Biomedical Instrumentation Techniques | 4 | Omitted from syllabus | ETP124(D) | Optical Network | 3 | Newly added |
| 9 | ETP111(E) | Telecomm Network Planning and Management | 4 | Omitted from Syllabus | ETP125 | Systems and Communication Lab-I | 3 | No equivalence |
| 10 | ETP112 | System Design and Communication Lab- I | 4 | No equivalence | ETP126 | Seminar-I | 2 | EquivalenceWithETP107 Seminar-II |
| 11 | ETP107 | Seminar-I | 1 | Equivalence with ETP126Seminar-I | SHP221 | Audit Course | 0 | Newly added |
| 12 | ETP201 | Embedded System Design | 4 | No equivalence | ETP221 | Antennas and Radiating Systems | 3 | Newly added |
| 13 | ETP208 | Mixed Signal VLSI Design | 4 | No equivalence | ETP222 | Analog and Digital CMOSVLSI Design | 3 | Newly added |
| 14 | ETP203 | RF and Microwave Communications | 4 | No equivalence | ETP223 | Image and Video Processing | 3 | Newly added |
| 15 | ETP209 | Satellite Communications | 4 | No equivalence | ETP224 | Program elective II | 3 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 15 | ETP209 | Satellite Communications | 4 | No equivalence | ETP224 | Program elective II | 3 | |
| 16 | ETP210(A) | Mobile Communication Systems | 4 | Omitted from syllabus | ETP224(A) | Satellite Communication | 3 | No equivalence |
| 17 | ETP210(B) | Fuzzy Logic | 4 | Omitted from syllabus | ETP224(B) | Programming Language for Embedded Systems | 3 | Newly added |
| 18 | ETP210(C) | Neural Network | 4 | Omitted from syllabus | ETP224(C) | Pattern Recognition and Machine Learning | 3 | Newly added |
| 19 | ETP210(D) | Computer Network and Applications | 4 | No equivalence | ETP224(D) | Wireless Sensor Network | 3 | Newly added |
| 20 | ETP210(E) | Data Compression | 4 | Omitted from syllabus | SHP221 | Research Methodology | 2 | Newly added |
| 21 | ETP206 | System Design and Communication Lab – II | 4 | No equivalence | ETP225 | Systems and Communication Lab-II | 3 | No equivalence |
| 22 | ETP207 | Seminar – II | 1 | Equivalence with ETP226 Seminar-II | ETP226 | Seminar II | 2 | Equivalence with ETP207 Seminar-II |
| 23 | ETP301 | Dissertation Phase-I | 10 | Equivalence with ETP322 Dissertation Phase-I | ETP321 | Program Elective III | 3 | Newly added |
| 24 | ETP401 | Dissertation Phase-II | 30 | Equivalence with ETP421 Dissertation Phase-II | ETP321(A) | Wireless Communication | 3 | No equivalence |
| | | | | | ETP321(B) | VLSI Design Verification and testing | 3 | Newly added |
| | | | | | ETP321(C) | Computer Vision | 3 | Newly added |
| | | | | | ETP321(D) | Network Security and Cryptography | 3 | Newly added |
| | | | | | SHP321 | Open Elective | 3 | Newly added |
| | | | | | ETP322 | Dissertation Stage I | 10 | Equivalence with ETP301 Dissertation Phase-I |
| | | | | | ETP421 | Dissertation Stage II | 16 | Equivalence with ETP401 Dissertation Phase-II |

- All students promoted to second year with some backlog courses shall remain in old scheme (90 Credits) with old curriculum.
- All students who failed in second year (DC Students) shall be transferred to new same scheme (68 Credits) but with new curriculum.
- Important notes for * courses
  i) All courses of old curriculum shall be offered during the academic year (2019-2020) for back logger students.
  ii) In the academic year 2020-21and onward all students shall register for courses as revised curriculum.

## Department of Electronics Engineering

## Equivalence Scheme for *online courses*

## Programme Name:-Electronics Systems and Communication

| Sr. No. | Course code with Name of course(old/new) | | Credit | Course code with Name of course (online) | Name of Online platform | Credit |
|---|---|---|---|---|---|---|
| 1. | ETP121 | Advanced Digital Signal Processing | 3 | 1. NPTEL course on **Foundations og Wavelets and Multirate Digital Signal Processing**<br>2. NPTEL course on **Fundamentals of Wavelets, filter bsnks and Time Frequency Analysis and Wavelet Transform** | NPTEL | -- |

| Sr. No. | Course code with Name of course(old/new) | | Credit | Course code with Name of course (online) | Name of Online platform | Credit |
|---|---|---|---|---|---|---|
| | | | | 3. NPTEL course on **Adv. Digital Processing- Multirate and Wavelet**<br>4. NPTEL course on **Introduction to Time Frequency Analysis and Wavelet Transform** | | |
| 2. | ETP122 | Advanced Communication Networks | 3 | 1. NPTEL course on **Computer Network and IP protocol**<br>2. NPTEL course on **Wireless Adhoc and Sensor Network**<br>3*. NPTE--L course on **Communication Network and Switching(Web)** | NPTEL | -- |
| 3. | ETP123 | Optoelectronics and Optical Communication Systems | 3 | 1. NPTEL course on **Fiber Optic Communication Technology**<br>2. NPTEL course on **Optical Communication**<br>3. NPTEL course on **Non linear Optics(Web)** | NPTEL | -- |

| Sr. No. | Course code with Name of course(old/new) | | Credit | Course code with Name of course (online) | Name of Online platform | Credit |
|---|---|---|---|---|---|---|
| 4. | ETP124(A) | RF and Microwave Circuit Design | 3 | 1. NPTEL course on **Design Principles Of RF And Microwave Filters And Amplifiers** | NPTEL | -- |
| 5. | ETP124(B) | Embedded System Design | 3 | 1*. NPTEL course on **Embedded Systems**<br>2. NPTEL course on **Embedded Systems Design with ARM**<br>3. NPTEL course on **Embedded Systems Design** | NPTEL | -- |
| 6. | ETP124(C) | Soft Computing | 3 | 1. NPTEL course on **Introduction to soft computing** | NPTEL | -- |
| 7. | ETP124(D) | Optical Network | 3 | 1*. NPTEL course on **Advanced Optical Communication**<br>2. NPTEL course on **Optic Communication Technology** | NPTEL | -- |
| 8. | ETP321(A) | Wireless Communication Networks | 3 | 1. NPTEL course on **Wireless Adhoc and Sensor Networks** | NPTEL | -- |

| Sr. No. | Course code with Name of course(old/new) | | Credit | Course code with Name of course (online) | Name of Online platform | Credit |
|---|---|---|---|---|---|---|
| 9. | ETP321(B) | VLSI Design Verification and testing | 3 | 1. NPTEL course on **VLSI Design Verification and test** | NPTEL | -- |
| 10. | ETP321(C ) | Computer Vision | 3 | 1. NPTEL course on **Computer Vision** | NPTEL | -- |
| 11. | ETP321(D) | Network Security and Cryptography | 3 | 1. NPTEL course on **Cryptography and Network Security** | NPTEL | -- |

*Courses without online certification available on NPTEL

## ETP121 ADVANCED DIGITAL SIGNAL PROCESSING

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESEDuration:2.30 hrs.**

**Course Objectives:**

To make the student understand

I. The use of various transforms in digital signals and systems analysis.
II. Spectrum estimation of discrete random signals.
III. Optimum filters and adaptive filters.
IV. Multirate digital signal processing.

Transforms and their applications: Review of Z Transform, Discrete Fourier Transform, Discrete Time Fourier Transform, Discrete Fourier series. Introduction to Discrete Wavelet Transform, Haar wavelet. Application of transforms to discrete signals.

Discrete Time Random Processes and Spectrum Estimation: Deterministic process, Stochastic( random ) process, Auto correlation and auto covariance of random processes, Cross correlation of random variables, Ergodic random process, Gaussian random process, Stationary and WSS random process, Power spectrum, Parseval's theorem, Wiener-Khintchine theorem, Spectral factorization, Periodogram - Modified periodograms using Bartlett, Welch, Blackman and Tukey windows, AR, MA, ARMA model based spectral estimation, Yule-Walker Equations, Durbin's algorithm.

Adaptive Filters: FIR adaptive filters, Stepest descent method, Window-Hoff LMS algorithm, Normalized LMS method, Adaptive channel equalization, Adaptive noise cancellation, IIR adaptive filters, RLS filters.

Multirate Digital Signal Processing: Need for multirate sampling, Decimation, Interpolation, Poly-phase filters, Multistage implementation, Phase shifters, Sub-band coders Transmultiplexers, Quadrature mirror filters.

**References:**


1. Monson H. Hayes, Statistical digital signal processing and modeling, John Wiley and Sons, 2005.
2. John G.Proakis& Dimitris G. Maolakis, DSP principles, algorithms andApplications, 4th edition, Pearson Education, 2007.


**Course Outcomes:**

After Completion of Course students shall be able to

ETP121.1 Implement various transforms in digital signals & systems analysis.
ETP121.2 Estimate Spectrum of discrete random signals.
ETP121.3 Design Optimum filters & adaptive filters.
ETP121.4 Understand multirate digital signal processing.

## ETP 122 ADVANCE COMMUNICATION NETWORKS

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

**Course Objectives:**

To make the student able

I. To study the concept of Layered Architectures.
II. To study the principles of wired and wireless networks, Mobile Ad-hoc Networks.
III. To study the different TCP/IP based networks.
IV. To study High Performance networks based WiMax and UWB.

Introduction: Overview of Communication Networks: Telephone networks, Computer networks, Cable television networks, Wireless networks, Networking principles, Digitalization, Network externalities, Service integration; Network Services and Layered Architecture: Traffic characterization and QoS, Network services, Network elements, Network mechanisms, Layered architecture, Network bottlenecks.

Broadband Networks Introduction: Multihop wireless broadband networks, Mesh networks, MANET importance of routing protocols, Classification of routing protocols in MANET, Routing metrics, Packet scheduling algorithms, Admission control mechanism

Internet and TCP / IP Networks Internet: Internet protocol, Technology trends in IP networks, IP packet communications in mobile communication networks; TCP and UDP, Internet success and limitation, Performance of TCP/ IP networks; Circuits Switched Networks: SONET, DWDM, Fiber to home, DSL, Intelligent Network (IN) scheme, Comparison with conventional systems, Merits of the IN scheme, CATV and layered network, Services over CATV.

ATM Networks Introduction: ATM reference model, Addressing, Signaling, Routing, ATM Adaptation Layer (AAL), Traffic classes, Traffic management and quality of service, Traffic descriptor, Traffic shaping, Management and control, Traffic and congestion control, Network status monitoring and control, User/ network signaling, Internetworking with ATM, IP over ATM, Multiprotocol over ATM.

High Performance Networks Introduction: WiMAX overview, Competing technologies, Overview of the physical layer, PMP mode, Mesh mode, Multihop relay mode; Introduction: UWB overview, Time hopping UWB, Direct sequence UWB, Multiband UWB; Introduction: LTE and LTE, A overview, System model, Specifications, Frame structure, Comparison with broadband technologies.

**References:**


1. Amitabha Ghosh and Rapeepat Ratasuk, "Essentials ofLTE and LTE-A", Cambridge University, 2011.
2. David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, Kee Chaing Chua and Jon W. Mark, "Wireless Broadband Networks", John Wiley and Sons.
3. Jean Warland and Pravin Varaiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008.
4. Leon Gracia and Widjaja, "Communication Networks", Tata McGraw Hill, 2008.
5. Lumit Kasera and Pankaj Sethi, "ATM Networks: Concepts and Protocols", Tata McGraw Hill, 2007.
6. Jeffrey G. Andrews, Arunabha Ghosh and Rias Muhamed, "Fundamentals of WiMAX understanding Broadband Wireless Networking", Prentice Hall of India, 2008.


**Course Outcome:**

By the end of course, the students shall be able to

ETP122.1 Understand the requirement of theoretical and practical aspect of computer network.

ETP122.2 Describe various protocols used in High Performance based network.

ETP122.3 Design the network

ETP122.4 Design MANET based applications.

## ETP123 OPTOELECTRONICS AND OPTICAL COMMUNICATION SYSTEMS

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration:2 .30hrs**

**Course Objectives:**

To make the student able

I. To study the concept of designing parameters for optical transmitter and receiver.
II. To study the implementation of digital system.
III. To study the principles of direct and coherent detection systems.
IV. To study the nonlinear properties of light propagation through optical.

Integrated optics and photonics technologies, Planar waveguides, Some integrated optical devices, Beam splitters, directional couplers and switches, Modulators, Periodic structures for filters and injection lasers, Polarization transformers and wavelength converters, Optoelectronic integration, Photonic integrated circuits, Optical bistability and digital optics, Optical computation.

The optical transmitter circuit, Source limitations, LED drive circuits, Laser drive circuits; The optical receiver circuit, The preamplifier, Automatic gain control, Equalization; System design considerations, Component choice, Multiplexing; Digital systems; Digital system planning considerations, The optoelectronic regenerative repeater, The optical transmitter and modulation formats, The optical receiver, Channel losses, Temporal response Optical power budgeting, Line coding and forward error correction.

Analog systems, Direct intensity modulation (D–IM), System planning, Subcarrier intensity modulation, Subcarrier double-sideband modulation (DSB–IM),Subcarrier frequency modulation (FM–IM), Subcarrier phase modulation (PM–IM), Pulse analog techniques; Distribution systems; Multiplexing strategies; Optical time division multiplexing, Subcarrier multiplexing, Orthogonal frequency division multiplexing, Wavelength division multiplexing, Optical code division multiplexing, Hybrid multiplexing, Application of optical amplifier.

Basic coherent system, Coherent detection principles, Practical constraints of coherent transmission, Injection laser line width, State of polarization, Local oscillator power, Transmission medium limitations; Modulation formats, Amplitude shift keying, Frequency shift keying, Phase shift keying, Polarization shift keying; Demodulation schemes, Heterodyne synchronous detection, Heterodyne asynchronous detection, Homodyne detection, Intradyne detection, Phase diversity reception, Polarization diversity reception and polarization scrambling ,Differential phase shift keying, Receiver sensitivities, ASK heterodyne detection, FSK heterodyne detection, PSK heterodyne detection, ASK and PSK homodyne detection, Dual-filter direct detection FSK, Interferometric direct detection DPSK, Comparison of sensitivities; Multicarrier systems, Polarization multiplexing, High-capacity transmission.

Fiber Soliton, Nonlinear Schrodinger Equation, Bright Solitons, Dark Solitons; Soliton-Based Communications, Information Transmission with Solitons, Soliton Interaction3, Frequency Chirp, Soliton Transmitters; Loss-Managed Solitons, Loss-Induced Soliton Broadening ,Lumped Amplification, Distributed Amplification, Experimental Progress.

Dispersion-Managed Solitons, Dispersion-Decreasing Fibers, Periodic Dispersion Maps, Design Issues; Impact of Amplifier Noise, Moment Method, Energy and Frequency Fluctuations, Timing Jitter, Control of Timing Jitter; High-Speed Soliton Systems, System Design Issues, Soliton Interaction, Impact of Higher-Order Effects, Timing Jitter; WDM Soliton Systems, Interchannel Collisions, Effect of Lumped Amplification,Timing Jitter, Dispersion Management.

**References:**


1. Senior J.M, "Optical Fiber Communications Principles and Practice", 3rd edition, Pearson Education, 2009.
2. Govind P. Agrawal, "Fiber- Optic Communication Systems", 3rd edition John Wiley and Sons, 2002.

**Course Outcomes:**

At the end of this course, students shall be able to

ETP123.1 Design different parameters for optical transmitter and optical receiver.

ETP123.2 Implement digital system using digital planning considerations.

ETP123.3 Comprehend, understand and analyze direct detection and coherent detection system.

ETP123.4 Understand how to use nonlinear property of light propagation in optical fiber in the form of Soliton.

## ETP124(A) RF AND MICROWAVE CIRCUIT DESIGN

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

**Course Objectives:**

To make the student understand

I. Different passive and active components.
II. Various parameters of transmission line and use of Smith chart.
III. Choosing Optimum components.
IV. Application of RF circuit design.

Transmission Line Theory: Lumped element circuit model for transmission line, Field analysis, Smith chart, Quarter wave transformer, Generator and load mismatch, Impedance matching and tuning.

Microwave Network Analysis: Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, Transmission matrix, Signal flow graph.

Microwave Components: Microwave resonators, Microwave filters, Power dividers and directional couplers, Ferromagnetic devices and components.

Nonlinearity and Time Variance Inter-symbol interference, Random process & noise, Definition of sensitivity and Dynamic range, Conversion gain and distortion.

Microwave Semiconductor Devices and Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, and HEMT.

Amplifiers Design: Power gain equations, Stability, Impedance matching, Constant gain and noise figure circles, Small signal, Low noise, High power and Broadband amplifier, Oscillators, Mixers design.

**References:**


1. Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", Author House, 2009.
2. D.M.Pozar, "Microwave engineering", Wiley, 4th edition, 2011.
3. R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.
4. G.D. Vendelin, A.M. Pavoi, U. L. Rohde, "Microwave Circuit Design Using Linear and Non Linear Techniques", John Wiley 1990.
5. S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987.
6. Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education, 2004.


**Course Outcomes**:

At the end of this course, students shall be able

| | |
|---|---|
| ETP124 (A).1 | To understand the behavior of RF passive components and model active components. |
| ETP124 (A).2 | Perform transmission line analysis and demonstrate use of Smith Chart for high frequency circuit design. |
| ETP124 (A).3 | Justify the choice/selection of components from the design aspects. |
| ETP124 (A).4 | Contribute in the areas of RF circuit design. |

## ETP 124 (B) EMBEDDED SYSTEM DESIGN

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

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**Course Objectives:**

To make the student able

I. To understand basics of embedded systems.
II. To study the architecture of Microcontroller.
III. To understand need and application of Microcontroller in embedded system.
IV. To learn external interfacing of real world input and output devices with Microcontroller.

Introduction to Embedded System, Applications and Scope

32 bit Microcontroller architecture, Assembly Language and C language programming, Microcontroller based development boards

Introduction to Arduino boards, Sketching in code

Working with variables, Making decisions and repetitive operations

Digital Ins and Outs, Analog Ins and Outs, Interfacing switches, buzzer, seven segment displays

Timings functions, Random Functions, Writing new functions, Hardware Interrupts

Arrays and Memory, Hardware Libraries Using Serial and I2C bus
Case studies of a few projects using Arduino boards and Shields

**References:**


1. Joseph Yiu, "The definitive guide to ARM Cortex-M3", Elsevier, 2nd Edition
2. Brian Evans, "Beginning Arduino Programming", Springer, 2011
3. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008
4. Raj Kamal, "Embedded Systems – Architecture: Programming and Design", TMH
5. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley


**Course Outcomes:**

At the end of this course, students shall be able to

| | |
|---|---|
| ETP124(B).1 | Deploy low end applications using low and high level languages on microcontroller platform. |
| ETP124(B).2 | Implement simple sketches on the Arduino boards involving several Peripherals. |
| ETP124(B).3 | Identify, design and implement applications on the Arduino boards producing custom shields. |

## ETP 124 (C) SOFT COMPUTING

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

**Course Objectives:**

To make the student able

I. To understand the fundamentals of soft computing.
II. To understand the concepts of Fuzzy logic and Artificial Neural Networks and optimization techniques using Genetic algorithm.
III. To solve single and multi-objective optimization problems.
IV. To solve real time applications based on soft computing techniques.

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques

Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc, Solving single-objective optimization problems using GAs.

Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA),Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs

Artificial Neural Networks: Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real life problems.

**References:**


1. Soft Computing and Its Applications: R.A. Aliev, R.R. Aliev
2. Neuro-Fuzzy and Soft Computing: A computational Approach to Learning & Machine Intelligence; Roger Jang, Tsai Sun, Eiji Mizutani, PHI.
3. Neural Network: A Comprehensive Foundation; Simon Haykin, PHI.
4. Elements of artificial Neural Networks; Kishan Mehtrotra, S. Ranka, Penram International Publishing (India).
5. Fuzzy Logic with Engineering Applications; Timothy Ross, McGraw-Hill.


**Course Outcomes:**

After completing this course, Students shall be able to learn:

ETP124(C).1 Fuzzy logic and its applications

ETP124(C).2 Artificial neural network and its applications

ETP124(C).3 Solve single and multi-objective optimization problems

ETP124(C).4 Applications of soft computing to solve any real life problem.

## ETP 124(D) OPTICAL NETWORKS

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

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**Course Objectives:**

I. To make the student able
II. To understand various issues in designing an optical network.
III. To study WDM network design.
IV. To study optical network

SONET/SDH: Optical transport network, IP, Routing and forwarding, Multiprotocol label switching.

WDM network elements: Optical line terminals and amplifiers, Optical add/drop multiplexers, OADM architectures, Reconfigurable OADM, Optical cross connects.

Control and management: Network management functions, Optical layer services and interfacing, Performance and fault management, Configuration management, Optical safety.

Network Survivability: Protection in SONET/SDH & client layer, Optical layer protection schemes.

WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

**References**:


1. Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3 rd edition, 2010.
2. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.


**Course Outcomes**:

At the end of this course, students shall be able to

ETP124(D).1 Contribute in the areas of optical network
ETP124(D).2 Work in WDM network design.
ETP124(D).3 Implement simple optical network
ETP124(D).4 Understand further technology developments for future enhanced network

## ETP 125 SYSTEM DESIGN AND COMMUNICATION LAB.- I

**Teaching Scheme: 06P** **Total: 06** **Credits: 06**

**Evaluation Scheme: 50 Internal + 50 External** **Total Marks: 100**

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**The instructor may choose experiments as per his/her requirements, so as to cover entire course contents of ETP121, ETP122, ETP123 and/or ETP124. Minimum 10 experiments should be performed.**

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## ETP 221 ANTENNAS AND RADIATING SYSTEMS

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30Hrs.**

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**Course Objective:**

The students shall

I. Be acquainted with various types of antennas and different methods of their analysis.
II. Develop the concepts of antenna arrays and their applications.
III. Be able to appreciate the role of aperture antennas in communication systems
IV. Be able to understand radiation pattern, how to design antenna and antenna arrays.

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna.

Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture.
Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Reflector Antennas: Plane reflector, parabolic reflector, Cass grain reflectors, Introduction to MIMO.

**References:**

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.

2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3. R. C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Grew Hill,1984.
R. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

**Course Outcomes:**

At the end of this course, students shall be able to

| | |
|---|---|
| ETP221.1 | Compute the far field distance, radiation pattern and gain of an antenna for given current distribution. |
| ETP221.2 | Estimate the input impedance, efficiency and ease of match for antennas. |
| ETP221.3 | Compute the array factor for an array of identical antennas. |
| ETP221.4 | Design antennas and antenna arrays for various desired radiation pattern Characteristics |

## ETP222 ANALOG AND DIGITAL CMOS VLSI DESIGN

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

**Course Objective:**

I. To understand the operation of MOS devices.
II. To analyze MOS devices in small and large signal conditions.
III. To understand back-end design tools.
IV. To impart in-depth knowledge about switched capacitors and Op-AMP using MOS devices.

Review: Basic MOS structure and its static behavior, Quality metrics of a digital design: Cost, Functionality, Robustness, Power, and Delay, Stick diagram and Layout, Wire delay models. Inverter: Static CMOS inverter, Switching threshold and noise margin concepts and their evaluation, Dynamic behavior, Power consumption.

Physical design flow: Floor planning, Placement, Routing, CTS, Power analysis and IR drop estimation-static and dynamic, ESD protection-human body model, Machine model. Combinational logic: Static CMOS design, Logic effort, Ratioed logic, Pass transistor logic, Dynamic logic, Speed and power dissipation in dynamic logic, Cascading dynamic gates, CMOS transmission gate logic.

Sequential logic: Static latches and registers, Bi-stability principle, MUX based latches, Static SR flip-flops, Master-slave edge-triggered register, Dynamic latches and registers, Concept of pipelining, Pulse registers, Non-bistable sequential circuit. Advanced technologies: Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology, FinFET, TFET etc. Analog CMOS Design:

Single Stage Amplifier: CS stage with resistance load, Divide connected load, Current source load, Triode load, CS stage with source degeneration, Source follower, Common gate stage, Cascade stage, Choice of device models. Differential Amplifiers: Basic difference pair, Common mode response,
Differential pair with MOS loads, Gilbert cell.

Passive and active current mirrors: Basic current mirrors, Cascade mirrors, Active current mirrors. Frequency response of CS stage: Source follower, Common gate stage, Cascade stage
and difference pair, Noise

Operational amplifiers: One stage OPAMP, Two stage OPAMP, Gain boosting, Common mode feedback, Slew rate, PSRR, Compensation of 2 stage OPAMP, Other compensation techniques.

**References:**


1. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", Prentice Hall electronics and VLSI series, 2nd Edition.
2. Baker, Li, Boyce, "CMOS Circuit Design, Layout, and Simulation", Wiley, 2nd Edition.
3. Behzad Razavi , "Design of Analog CMOS Integrated Circuits", TMH, 2007.
4. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford, 3rd Edition. R J Baker, "CMOS circuit Design, Layout and Simulation", IEEE Inc., 2008.
5. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design", TMH, 3rdEdition. Pucknell, D.A. and Eshraghian, K., "Basic VLSI Design", PHI, 3rd Edition.


**Course Outcomes:**

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

ETP222.1 Analyze, design, optimize and simulate analog and digital circuits using CMOS constrained by the design metrics.

ETP222.2 Connect the individual gates to form the building blocks of a system.
ETP222.III Use EDA tools like Cadence, Mentor Graphics and other open source software
tools like Ngspice.

ETP222.3 Analyze switched capacitors and Op-AMP using MOS devices.

## ETP223 IMAGE AND VIDEO PROCESSING

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks:100**
**ESC Duration: 2.30hrs**

**Course Objectives:**
Students will be able to understand,

I. Basic concepts of image processing, fundamentals and mathematical models in digital image and video processing.
II. Different types of image transforms for image processing
III. Image enhancement and develop time and frequency domain techniques for it.
IV. Image segmentation, restoration, and morphological signal processing with applications.

Introduction to Digital Image Processing & Applications: elements of visual perception, Mach band effect, sampling, quantization, basic relationship between pixels, color image fundamentals-RGB-HSI models, image transforms - two dimensional orthogonal and unitary transforms, separable unitary transforms, basis images, DFT, WHT, KLT, DCT and SVD

Image compression: lossy and lossless compression, image compression standards, Application in various fields

Image Enhancement: filters in spatial and frequency domains, histogram-based processing, homomorphic filtering, image restoration: degradation models, PSF, circulant and block-circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy based methods, image segmentation: pixel classification, bi-level thresholding, multilevel thresholding, adaptive thresholding, spectral & spatial classification, edge detection, Hough transform, region growing.

Boundary Representation: chain codes, polygonal approximation, boundary segments, boundary descriptors, regional descriptors, relational descriptors, object recognition, pattern and pattern classes, recognition based on decision theoretic methods, matching, optimum statistical classifiers, structural methods, matching shape numbers, string methods, morphological image processing, erosion and dilation, opening or closing, HIT or MISS transformation, basic morphological algorithms, grey scale morphology.

Video Processing: display enhancement, video mixing, video scaling, scan rate conversion, representation of digital video, Spatio-temporal sampling, video compression-motion estimation, intra and interframe prediction, perceptual coding, standards - MPEG, H.264.

**References:**


1. Fundamentals of Digital Image processing, A. K. Jain, Pearson Education, 1989
2. Digital Image Processing using MATLAB, R. C. Gonzalez , R. E. Woods and S. L. Eddins: Pearson Education, 2004
3. Digital Image Processing; G. A. Baxes: John Wiley, 1994

4. Digital Image Processing and Computer Vision; R.J. Schalkoff: John Wiley, 1989.
5. Image Processing; Sid Ahmed: McGraw - Hill, 1994.
6. Digital Video and Audio Compression; S.J. Solari: McGraw - Hill, 1996.
7. Video Processing and Communications" by Yao Wang, Joern Ostermann, and Ya - Qin Zhang, Prentice Hall, 2002, ISBN 0 - 13 - 017547 - 1
8. Digital Video Processing , M. Tekalp Prentice Hall, 1995, ISBN 0 - 13 - 190075 - 7
9. The Art of Digital Video, J. Watkinson, 3rd edition, Focal Press, 2000. 11. "Video Demystified", K. Jack, 3rd edition, Llh Technology Publishing, 2001.
10. Motion Analysis and Image Sequence Processing, edited by M.I. Sezan and R.L. Lagendijk, Kluwer Academic Publishers, 1993.
11. Image and Video Compression Standards: Algorithms and Architectures, V. Bhaskaran and K. Konstantinides, Kluwer Academic Publishers, 2nd edition, 1997.

**Course Outcomes:**

At the end of the course student will be able to:

| | |
|---|---|
| ETP223.1 | Understand theory and models in Image and Video Processing. |
| ETP223.2 | Interpret and analyze 2D signals in frequency domain through image transforms. |
| ETP223.3 | Apply quantitative models of image and video processing for various engineering applications |
| ETP223.4 | Develop innovative design for practical applications in various fields. |

## ETP224(A) SATELLITE COMMUNICATION

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**
**ESE duration: 2.30hrs**

**Course Objectives:**

To make the student understand

I. The architecture of satellite systems.
II. Various aspects like orbital equations, different sub systems of satellite, parameter to be considered while designing link budget, modulation and multiple access schemes.
III. How to design link budget and solve numerical of orbital motions.

Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, 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.

Satellite sub-systems: 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, antenna sub-system.

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.

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, Case study of Personal Communication system (satellite telephony) using LEO.

Modulation and Multiple Access Schemes: Modulation and Multiple Access Schemes used in satellite communication. Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS system.

**References:**


1 Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition, 2010.

2 S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.

3 Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.

4 Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.


**Course Outcomes**:

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

| | |
|---|---|
| ETP224(A).1 | Visualize the architecture of satellite systems as a means of high speed, high range communication system. |
| ETP224(A).2 | State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes. |
| ETP224(A).3 | Solve numerical problems related to orbital motion. |
| ETP224(A).4 | Design of link budget for the given parameters and conditions. |

## ETP224(B) PROGRAMMING LANGUAGE FOR EMBEDDED SYSTEMS

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

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**Course Objective:**

To make the student able

I. To understand fundamental of embedded C programming
II. To learn how to develop and analyze algorithms in C++
III. To comprehend Object oriented programming
IV. To study various scripting languages

Embedded 'C' Programming - Bitwise operations, Dynamic memory allocation, OS services - Linked stack and queue, Sparse matrices, Binary tree - Interrupt handling in C, Code optimization issues - Writing LCD drives, LED drivers, Drivers for serial port communication - Embedded Software Development Cycle and Methods (Waterfall, Agile)

Object Oriented Programming - Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data encapsulation, data abstraction and information hiding, inheritance, polymorphism

CPP Programming: 'cin', 'cout', formatting and I/O manipulators, new and delete operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend function, dynamic memory allocation

Overloading and Inheritance: Need of operator overloading, overloading the assignment, overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, multiple inheritance, virtual base class, polymorphism, virtual functions.

Templates: Function template and class template, member function templates and template arguments, Exception Handling: syntax for exception handling code: try-catch- throw, Multiple Exceptions.

Scripting Languages Overview of Scripting Languages – PERL, CGI, VB Script, Java Script. PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables, Inter process Communication Threads, Compilation & Line Interfacing.

**References**:


1. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008 .
2. Randal L. Schwartz, "Learning Perl", O'Reilly Publications, 6th Edition 2011
3. A. Michael Berman, "Data structures via C++", Oxford University Press, 2002
4. Robert Sedgewick, "Algorithms in C++", Addison Wesley Publishing Company,1995
5. Abraham Silberschatz, Peter B, Greg Gagne, "Operating System Concepts", John,Willey &Sons, 2005


**Course Outcomes:**

At the end of this course, students shall be able to

| | |
|---|---|
| ETP224(B).1 | Write an embedded C application of moderate complexity. |
| ETP224(B).2 | Develop and analyze algorithms in C++. |
| ETP224(B).3 | Differentiate interpreted languages from compiled languages. |
| ETP224(B).4 | Able to apply scripting language for different applications. |

## ETP 224(C) PATTERN RECOGNITION AND MACHINE LEARNING

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

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**Course Objectives:**

To make the student able

I. To Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms.
II. To Understand the basic methods of Neural Network along with new training Methods.
III. To understand deep learning and apply unsupervised classification methods to detect and characterize patterns in real-world data.
IV. To Develop prototype pattern recognition algorithms that can be used to study algorithm behavior and performance against real-world multivariate data.

Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification

Neural Network: Perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Linear discriminant functions-Decision surfaces, two-category, multi-category, minimum- squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Algorithm independent machine learning-lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers
Unsupervised learning and clustering-k-means clustering, fuzzy k-means clustering, hierarchical clustering

**References:**


1. RichardO.Duda,DavidG.Stork,"PatternClassification",2ndEditionJohn Wiley & Sons,2001.
2. Trevor Hasti, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.


**Course Outcomes**

At the end of this course, students shall be able

ETP224(C).1 To study the parametric and linear models for classification.
ETP224(C).2 To design neural network and SVM for classification.
ETP224(C).3 To develop machine independent and unsupervised learning techniques.
ETP224(C).4 To study algorithm independent machine learning.

## ETP 224(D) WIRELESS SENSOR NETWORKS

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

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**Course Objectives:** To make the student understand

I. Various parameters for designing wireless sensor network.
II. How to select optimum sensors depending on application.
III. Different standards and protocols of wireless sensor network.
IV. What are different energy and security challenges involved in wireless

sensors

Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Data Management: Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

**References:**


1. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.
3. F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
4. Yingshu Li, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.


**Course Outcomes**:

At the end of this course, students shall be able to

ETP224(D).1 Design wireless sensor network system for different applications under consideration.

ETP224(D).2 Understand the hardware details of different types of sensors and select right type of sensor for various applications.

| | |
|---|---|
| ETP224(D).3 | Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms. |
| ETP224(D).4 | Handle special issues related to sensors like energy conservation and security challenges. |

## ETP 225 SYSTEM DESIGN AND COMMUNICATION LAB- II

**Teaching Scheme: 06P** **Total: 06** **Credits: 06**

**Evaluation Scheme: 50 Internal + 50 External** **Total Marks: 100**

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**The instructor may choose experiments as per his requirements, so as to cover entire contents of the courses ETP221, ETP222, ETP223 and/or ETP224. Minimum 10 experiments should be performed**

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## ETP 321(A) WIRELESS COMMUNICATION

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

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**Course Objectives:**

To make the student understand

I. Various parameters for designing wireless communication system.
II. How to make use of frequency reuse and its analysis.
III. Different multiple access techniques and design procedure.
IV. About path loss, interference occurs and different contemporary wireless system and protocols.

Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channelassignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS),2.75 G Standards: EDGE.

Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations).

Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading. Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing,

soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, Introduction to 5G.

**References**:


1. H. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5thedition, 2008.
2. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
3. T.S.Rappaport, "Wireless Communications Principles and Practice", 2ndedition, PHI,2002.
4. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2ndedition, TMH, 1995.
5. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London, 1997.


**Course Outcomes:**

At the end of this course, students shall be able to

| | |
|---|---|
| EPT321 (A). 1 | Design appropriate wireless communication systems. |
| ETP321 (A).2 | Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques. |
| ETP 321(A).3 | Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology |
| ETP 321(A). 4 | Understanding upcoming technologies. |

## ETP 321(D) NETWORK SECURITY AND CRYPTOGRAPHY

**Teaching Scheme: 03L+00T** **Total: 03** **Credits: 03**

**Evaluation Scheme: 30 MSE + 10 TA + 60 ESE** **Total Marks: 100**

**ESE duration: 2.30hrs**

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**Course Objectives:**

To make the student able

I. To understand the fundamentals of Cryptography and acquire knowledge on standard algorithms.

II. To understand the various key distribution and management schemes.

III. To understand how to deploy encryption techniques to secure data in transit

across data networks

IV. To design security applications in the field of Information technology

Security- Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

Number Theory- Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

Private-Key (Symmetric) Cryptography- Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

Public-Key (Asymmetric) Cryptography- RSA, Key Distribution and Management Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms:MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

Authentication- IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

System Security- Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Counter measures, Firewalls, Firewall Design Principles, Trusted Systems.

**References:**


1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2nd Edition.
3. Christopher M. King, Ertem Osmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,
4. Stephen Northcutt, Leny Zeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey,"Inside Network Perimeter Security", Pearson Education, 2nd Edition
5. Richard Bejtlich, "The Practice of Network Security Monitoring:Understanding Incident Detection and Response", William Pollock Publisher, 2013.


**Course Outcomes:**

At the end of the course students shall be able to:

ETP321(D).1 Analyze the vulnerabilities in any computing system and hence be able to design a security solution.

| | |
|---|---|
| ETP321(D).2 | Identify the security issues in the network and resolve it. |
| ETP321(D).3 | Evaluate security mechanisms using rigorous approaches, including theoretical |
| ETP321(D).4 | Compare and Contrast different IEEE standards and electronic mail Security |

## ETP 322 DISSERTATION (PHASE- I)

**Teaching Scheme: 20P** **Total: 20** **Credits: 100**

**Evaluation Scheme: 100 Internal** **Total Marks: 100**

**Course Outcomes**:

At the end of this course, students shall be able to

| | |
|---|---|
| ETP322.1 | Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem. |
| ETP322.2 | Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design. |
| ETP322.3 | Ability to present the findings of their technical solution in a written report. |
| ETP322.4 | Presenting the work in International/ National conference or reputed journals. |

Syllabus Dissertation (Phase I):

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
2. Relevance to value addition to existing facilities in the institute
3. Relevance to industry need
4. Problems of national importance
5. Research and development in various domain

Student shall complete dissertation work in III, & IV semesters individually. In III semester, student shall complete Literature survey and decide the dissertation topic. He/She shall complete conceptual study and design part of dissertation topic and submit the progress report in proper format. Student has to deliver a seminar on the selected topic (covering 25% or more work). It is to be evaluated internally by three member's panel of examiners headed by HoD wherein guide should be one of the members of the panel. Last date of submission of report shall be two weeks before the end of semester.

## ETP 421 DISSERTATION (PHASE- II)

**Teaching Scheme: 32P** **Total: 32** **Credits: 100**

**Evaluation Scheme: 100 Internal+100 External** **Total Marks: 200**

**Course Outcomes**:

At the end of this course, students shall be able to

| | |
|---|---|
| ETP421.1 | Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem. |
| ETP421.2 | Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design. |
| ETP421.3 | Ability to present the findings of their technical solution in a written report. |
| ETP421.4 | Presenting the work in International/ National conference or reputed journals. |

Syllabus Dissertation (Phase II):

1. Student shall complete dissertation work in IV semester, and submit a progress report in proper format.
2. Dissertation (Phase-II): Internal assessment of dissertation (complete work) is to be carried out by three members panel of examiners headed by HOD wherein guide should be one of the members of the panel, for 100 marks. The external assessment of dissertation work is to be carried out by panel of examiners consisting of internal (guide) and external examiner for 200 marks.

Candidate shall present the entire work on Dissertation, followed by viva-voce. Last date of submission of dissertation will be the end of the semester. Please see Appendix-C of Rules & Regulation for Further information.

* Note: (ETP301) Dissertation Phase I & Seminar as prerequisite for (ETP401) Dissertation
In case of unsatisfactory performance, committee may recommend for extension or repeating the work