# Electronics & Telecommunication Engineering Department

## Curriculum: T Y (E&TC)

# Government College of Engineering, Aurangabad

**(An Autonomous Institute)**

Teaching and Evaluation Scheme from year 2023-24

**Third Year - B. Tech. Program in Electronics & Telecommunication Engineering**

**Semester V**

| Course | | | | Teaching Scheme | | | Continuous Evaluation in terms of Marks | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sr No** | **Category** | **Course Code** | **Course Name** | **TH** | **T** | **PR** | **Credits** | **ISE I** | **ISEII** | **ISEIII** | **ESE** | **Total (100)** |
| 1 | PCC | ETPC3017 | Electromagnetic Engineering | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 2 | PCC | ETPC3018 | Digital Signal Processing | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 3 | PCC | ETPC3020 | Digital Communication | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 4 | PCC | ETPC3022 | Embedded Systems | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 5 | PCC | ETPC3019 | Lab-Digital Signal Processing | - | - | 2 | 1 | - | - | 25 | 25 | 50 |
| 6 | PCC | ETPC3021 | Lab-Digital Communication | - | - | 2 | 1 | - | - | 25 | 25 | 50 |
| 7 | PCC | ETPC3023 | Lab-Embedded Systems | - | - | 2 | 1 | - | - | 25 | 25 | 50 |
| 8 | PROJ | ETPR3001 | Mini-Project I | - | - | 2 | 1 | - | - | 25 | 25 | 50 |
| 9 | HSMC II | | | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 10 | OEC II | | | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 11 | PEC I* | | MOOC/NPTEL Course | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| | | | **Total** | **21** | **-** | **08** | **25** | **105** | **105** | **170** | **520** | **900** |

**Semester VI**

| **Sr No** | **Category** | **Course Code** | **Course Name** | **TH** | **T** | **PR** | **Credits** | **ISE I** | **ISEII** | **ISEIII** | **ESE** | **Total (100)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PCC | ETPC3024 | Computer Network | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 2 | PCC | ETPC3025 | A.I. and M.L. | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 3 | PEC II | | | 2 | - | - | 2 | 15 | - | 10 | 50 | 75 |
| 4 | PEC III | | | 2 | - | - | 2 | 15 | - | 10 | 50 | 75 |
| 5 | PCC | ETPC3026 | Lab-Computer Network & AI & ML | - | - | 2 | 1 | - | - | 25 | - | 25 |
| 7 | PEC II | | Lab – PEC II | - | - | 2 | 1 | - | - | 25 | - | 25 |
| 8 | PEC III | | Lab – PEC III | - | - | 2 | 1 | - | - | 25 | - | 25 |
| 9 | PROJ | ETPR3002 | Mini-Project II | - | - | 2 | 1 | - | - | 25 | 25 | 50 |
| 10 | OEC III | | | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 11 | HSMC III | | | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| 12 | HSMC IV | | | 3 | - | - | 3 | 15 | 15 | 10 | 60 | 100 |
| | | | **Total** | **19** | **-** | **08** | **23** | **105** | **75** | **170** | **425** | **775** |

Industrial training of a minimum of 4 weeks may be completed after the second/third year, Activities from Group I and Group II may be completed this year which needs to be registered in 8th semester.

***This is MOOC/NPTEL course. Students have to register and appear for the assignments and examination conducted by MOOC/NPTEL course only. After submitting the Passing certificate of such course, students will be awarded the 3 credits by virtue of 'Transfer of Credits'.**

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## List of Professional Elective Courses

| Professional Elective | Sr. No. | Course Code | Course Title |
|---|---|---|---|
| **I (MOOC/ NPTEL Courses) (3+0+0)** | 01 | ETPE3001 | Computer Architecture |
| | 02 | ETPE3002 | Operating System Fundamentals |
| | 03 | ETPE3003 | Quantum Computing |
| | 04 | ETPE3004 onwards | Any other MOOC/NPTEL course on current technology with the permission of BoS Chairman |
| | | | |
| **II (2+0+1)** | 01 | ETPE3011 | Information Theory and Coding |
| | 02 | ETPE3012 | Lab - Information Theory and Coding |
| | 03 | ETPE3013 | Optical Fiber Communication |
| | 04 | ETPE3014 | Lab - Optical Fiber Communication |
| | 05 | ETPE3015 | Microwave Engineering |
| | 06 | ETPE3016 | Lab - Microwave Engineering |
| | | | |
| **III (2+0+1)** | 01 | ETPE3021 | Digital Image Processing |
| | 02 | ETPE3022 | Lab - Digital Image Processing |
| | 03 | ETPE3023 | Power Electronics |
| | 04 | ETPE3024 | Lab - Power Electronics |
| | 05 | ETPE3025 | Digital System Design |
| | 06 | ETPE3026 | Lab - Digital System Design |
| | 07 | ETPE3027 | Industrial Automation |
| | 08 | ETPE3028 | Lab - Industrial Automation |
| | | | |

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| ETPC3017: Electromagnetic Engineering | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| **Lectures: 3 Hrs/Week** | **ISE I : 15 Marks** |
| | **ISE II : 15 Marks** |
| **Total Credits: 03** | **ISE III: 10 Marks** |
| | **End Semester Exam: 60 Marks** |

**Course Objectives:**

- To understand the three-dimensional representation of vector fields and vector calculus. To understand basic laws of electromagnetics
- To understand the Maxwell's equations as applied to static and time varying fields.
- To understand Transmission lines
- To understand complex electromagnetic phenomenon of wave propagation and electromagnetic radiation & Antenna Fundamentals

**Course Outcomes:** After completing the course, students will be able to:

| | |
|---|---|
| CO1 | Gain knowledge of coordinate systems & Understand Basic of Electromagnetics |
| CO2 | Understand the Maxwell's equations |
| CO3 | Carryout Impedance transformation Transmission lines (TL) & TL sections for realizing circuit element |
| CO4 | Characterize wave propagation, understanding Plane wave properties |
| CO5 | Understand the phenomenon of wave propagation and electromagnetic radiation. |
| CO6 | Understand Antenna fundamentals. |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | **Electrostatics &Magnetostatics**<br>Basic of vector calculus, Electric field intensity, Electric flux density and Divergence, Gauss's law, Application of Gauss's Law: Some symmetrical charge distributions, Differential volume element, Divergence. Steady magnetic field, Faraday's law, Ampere's Circuital law, Curl, Magnetic flux. |
| **Unit 2** | **Time Varying Fields and Maxwell's Equations**<br>Magnetic boundary conditions, Magnetic Circuit, Potential energy and forces on magnetic materials, Displacement current, Maxwell's equations in point form, Maxwell's equations in integral form. |
| **Unit 3** | **Transmission Lines**<br>Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements. |
| **Unit 4** | **Wave Propagation**<br>Wave equation, Poynting vector.Plane waves and properties: reflection and refraction,polarization, phase and group velocity, propagation through various media, Wave propagation in parallel plane waveguide, rectangular waveguide, skin depth. |

| | |
|---|---|
| **Unit 5** | **Antenna Fundamentals**<br>Antenna parameters, Isotropic radiators, Radiation power density, Radiation intensity, Directivity (D), Front to back ratio, Antenna bandwidth and Antenna beam width.Rectangular and circular waveguides, dipole and monopole antennas, linear antenna arrays. |

**Mapping of Course outcome with Program Outcomes and Program Specific Outcome**

| Course Outcome | PO 1 | PO2 | PO3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | 2 | | | | 3 | 2 |
| CO2 | 2 | 2 | 1 | | | | | | | 2 | | 3 | | 3 | 2 |
| CO3 | 2 | | | | | | | | | 2 | | 3 | | 3 | 2 |
| CO4 | 2 | 2 | | | | | | | | 2 | | | | 3 | 2 |
| CO5 | 2 | | 1 | 1 | | | | | 3 | 2 | | | | 3 | 2 |
| CO6 | 2 | | 1 | | | | | | | 2 | | 3 | | 3 | 2 |

**3 – High 2 – Medium 1 - Low**

**Assessment:**

| | |
|---|---|
| **ISE I:** | Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects |
| **ISE II:** | Shall be based on class test |
| **ISE III:** | Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects |

**Assessment Pattern**

| **Assessment Pattern Level No.** | **Knowledge Level** | **ISEI** | **ISE II** | **ISE III** | **End Semester Examination** |
|---|---|---|---|---|---|
| K1 | Remember | 10 | 00 | 00 | 15 |
| K2 | Understand | 05 | 10 | 10 | 35 |
| K3 | Apply | 00 | 05 | 00 | 10 |
| K4 | Analyze | 00 | 00 | 00 | 00 |
| K5 | Evaluate | 00 | 00 | 00 | 00 |
| K6 | Create | 00 | 00 | 00 | 00 |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**

| Assessment Tool | **K1** | **K2** | **K2** | **K3** | **K2** |
|---|---|---|---|---|---|
| | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| ISE I (15 Marks) | 05 | 10 | 00 | 00 | 00 |
| ISE II (15 Marks) | 00 | 00 | 10 | 05 | 00 |
| ISE III (10 Marks) | 00 | 00 | 00 | 00 | 10 |
| ESE Assessment(60 Marks) | 15 | 10 | 15 | 10 | 10 |

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| ETPC3018: Digital Signal Processing | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| **Lectures: 3 Hrs/Week** | **ISE I:15 Marks** |
| **Credits: 03** | **ISE II:15 Marks** |
| | **ISE III: 10 Marks** |
| | **End Semester Exam: 60 Marks** |

**Course description:**

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete time systems as signal processing devices.

- The primary objective of this course is to provide a thorough understanding and working knowledge of design, implementation, and analysis DSP systems.
- This course in digital signal processing develops essential analysis and design techniques required for a broad range of disciplines.
- Student familiar with most important methods in DSP, including digital filter design, transform domain processing and importance of signal processor.
- After completion of the subject, the student should be able to understand the design principles and the implementation of digital filters and DFT/FFT, and be able to make use of signal processing concepts and wavelets to perform some simple applications.

**Course Outcomes**
After completing the course, students will be able to:

| | |
|---|---|
| COl | Interpret, represent and process discrete/digital signals and systems |
| CO2 | Implement frequency domain analysis of discrete time signals of DSP system |
| CO3 | Understand transforms of signals and systems. |
| CO4 | Design and implement digital filters for processing discrete time signals. |
| CO5 | Develop creative and innovative design that achieves desirable performance criteria within specified objectives and constraints for lifelong learning and continuing professional education. |
| CO6 | Understand the theory of DSP processors with programming skills. |

## Detailed Syllabus

| | |
|---|---|
| **Unit 1** | **Discrete-time Systems and General Realization Techniques**<br>Concept of discrete-time signal. Sampling and reconstruction of signal. Time invariance, causality, linearity, periodic, energy, power convolution and LTI systems |
| **Unit 2** | **Discrete Time Fourier Transform (DTFT):**<br>Concept of frequency in discrete and continuous domain, frequency response in the discrete domain.<br>**Z- Transforms:**<br>Definition, unit circle, convergence and ROC, properties of Z-transform, characteristic of signals, initial value theorem, Parseval's relation, inverse Ztransform.<br>**Discrete Fourier Transform:**<br>Relation between DTFT & DFT. Twiddle factors and their properties, computation by different methods, filtering of long data sequences |

| | |
|---|---|
| | **Fast Fourier Transforms:**<br>Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal<br>**Introduction to Wavelet Transforms** |
| **Unit 3** | **Design of Infinite Impulse Response Filters**<br>Revision of analog systems, Butterworth filters and Chebyshev filters. Types of digital filters: IIR and FIR. IIR filter design, bilinear transformation, frequency scaling, transformation from prototype low-pass filter to high-pass filter and band-pass filter. Impulse-invariant and/or step-invariant approaches |
| **Unit 4** | **Design of Finite Impulse Response Filters**<br>FIR filter analysis, Fourier series approach, windowing, Gibbs phenomenon, commonly used windows, concept of linear phase, frequency transformation, low-pass, band-pass, high-pass filters and filter band design. |
| **Unit 5** | **Digital Signal Processors and Applications**<br>1. Architectures and important instruction sets of TMS320c 5416/6713<br>2. FPGA: Architecture, different subsystem, design flow of DSP system design, mapping into DSP algorithm into FPGA. |

**TEXT AND REFERENCE BOOKS**


1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
3. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
4. D. J. DeFatta, J. G. Lucas and W. S. Hodgkis, Digital Signal Processing Wiley and Sons, Singapore, 1988.
5. G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2003 / PHI.
6. 6. K. Mitra, 'Digital Signal Processing – A Computer Based Approach, Tata McGraw Hill, New Delhi, 2001


**Mapping of Course outcome with Program Outcomes**

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | 1 | 2 | 2 | - | - | 2 | 2 | 2 | - | - | | - | 3 |
| CO2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | - | - | | 1 | 3 |
| CO3 | 2 | 1 | 1 | 1 | - | - | 1 | 2 | 2 | 1 | - | - | | 1 | 3 |
| CO4 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | | 1 | 3 |
| CO5 | 1 | 2 | 3 | 2 | 1 | 2 | 2 | 1 | | 1 | 1 | 1 | 1 | 1 | 3 |
| CO6 | 2 | 2 | 2 | 1 | - | 2 | 1 | 1 | | 1 | 1 | 3 | 1 | 1 | 3 |

**3 – High2 – Medium1 – Low**

**Assessment:**

| | |
|---|---|
| **ISE I:** | Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects |
| **ISE II:** | Shall be based on class test |


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| | |
|---|---|
| **ISE III:** | Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects |

**Assessment Pattern**

| **Assessment Pattern Level No.** | **Knowledge Level** | **ISE I** | **ISE II** | **ISE III** | **End Semester Examination** |
|---|---|---|---|---|---|
| K1 | Remember | 05 | 00 | 00 | 06 |
| K2 | Understand | 10 | 10 | 05 | 42 |
| K3 | Apply | 00 | 05 | 05 | 12 |
| K4 | Analyze | 00 | 00 | 00 | 00 |
| K5 | Evaluate | 00 | 00 | 00 | 00 |
| K6 | Create | 00 | 00 | 00 | 00 |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**

| Assessment Tool | K1 | K2 | K3 | K2 | K2 | K2 |
|---|---|---|---|---|---|---|
| | C01 | C02 | C03 | CO4 | CO5 | CO6 |
| ISE I (15 Marks) | 05 | 10 | 00 | 00 | 00 | 00 |
| ISE II (15 Marks) | 00 | 00 | 05 | 10 | 00 | 00 |
| ISE III (10 Marks) | 00 | 00 | 05 | 05 | 00 | 00 |
| ESE Assessment (60 Marks) | 06 | 12 | 10 | 12 | 12 | 08 |

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| ETPC3019: Lab-Digital Signal Processing | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| **Practical: 2 Hrs/Week** | **ISE III: 25 Marks** |
| **Credits: 01** | **End Semester Examination: 25 Marks** |

**Purpose:**

The Digital Signal Processing Lab (DSPLAB) provides all the required equipment to implement real-time digital signal processing solutions supporting experimental research, applied research, and industrial projects.
Students simulate the number of experiments in MATLAB. Students also use TMS 320C5416 fixed-point DSP processors. Programing of the DSP chip is done in C(and some assembly) language using the Code Composer Studio integrated development environment.
Equipment: DSP prototype board or FPGA development tools and platforms, Texas Instruments C6727 Floating Point DSP developer kit.

**Laboratory Course Outcomes**

As an outcome of completing the Laboratory course using MATLAB/CCS/IDE, students will be able to:

| | |
|---|---|
| CO1 | The student will be able to carry out simulation of DSP systems. |
| CO2 | Develop and Implement DSP algorithms in software using a computer language such as C/MATLAB /TMS320C6713 floating point Processor. |
| CO3 | Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital FIR filters. |
| CO4 | Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital IIR filters. |

**List of Experiments**

The practical part of the work consists of a minimum of eight tasks that should be performed on the RPi /DSP starter board /or MATLAB simulations.

| Sr. No. | Details |
|---|---|
| 1 | Program for Discrete-time signals and systems, linear coefficients difference equations and realization structures, convolution, and correlation using MATLAB |
| 2 | Program for DTFT and DFT Spectral Analysis |
| 3 | Program for FFT and Bit reversal |
| 4 | Design and implement of FIR filter, FIR filtering interfacing MATLAB and Code Composer Studio |
| 5 | Design discrete-time digital filters and implement them in real time. |
| 6 | Design and implement of IIR filter |
| 7 | Program for Multi-rate Signal Processing<br>Basic Sampling Rate Alteration Devices<br>• Decimator and Interpolator Design and Implementation<br>• Design of Filter Banks<br>• Design of Nyquist Filters |
| 8 | Program for STFT Implementation |

| | |
|---|---|
| 9 | Introduction to Hardware and Software Tools for the TMS320C6748 Board<br>1. C6000 instruction set architecture or<br>2. Developer Kit (LCDK)<br>3. Or FPGA /Raspberry Pi 3<br>4. TI Code Composer Studio software tools<br>5. TI DSP BIOS (operating system)<br>6. LabVIEW and Matlab |
| 10 | Generating a Sine Wave Using the Hardware and Software Tools for the TI TMS320C6711 DSP Processor |

**Mapping of Course outcome with Program Outcomes**

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | | 3 | | | | | | | | | | | 3 |
| CO2 | | 3 | | 2 | | | | | | | | | | 1 | 3 |
| CO3 | 2 | 2 | | 1 | | | | | | | | | | 1 | 3 |
| CO4 | | | | 1 | | 1 | | | | | 1 | | | 1 | 3 |
| CO5 | 2 | 1 | | | 1 | | | | | | | | 1 | 1 | 3 |
| CO6 | | | 1 | | | 2 | 2 | | | | | | 1 | 1 | 3 |

**3 – High2 – Medium1 – Low**

**Assessment Table**

| Assessment Tool | S2 | S1 | S4 | S3 | S2 | S3 |
|---|---|---|---|---|---|---|
| | CO1 | CO2 | CO3 | C04 | CO5 | CO6 |
| ISE III (25 Marks) | 05 | 04 | 02 | 05 | 05 | 04 |
| Practical Examination & Viva Voce (25 Marks) | 05 | 02 | 02 | 10 | 03 | 03 |

**Assessment Pattern**

| **Assessment Pattern Level No.** | **Skill Level** | **Term Work** | **Practical Examination & viva voce** |
|---|---|---|---|
| S1 | Imitation | 08 | 08 |
| S2 | Manipulation | 05 | 05 |
| S3 | Precision | 10 | 10 |
| S4 | Articulation | 02 | 02 |
| S5 | Naturalization | 00 | 00 |
| **Total** | | 25 | 25 |

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| ETPC3020: Digital Communication | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| **Lectures:3 Hrs/Week** | **ISE I: 15 Marks** |
| **Total Credits: 03** | **ISE II: 15 Marks** |
| | **ISE III: 10 Marks** |
| | **End Semester Exam: 60 Marks** |

**Course description**: This course covers the fundamentals of digital communication. It deals with pulse modulation and digital modulation techniques. It also covers interference in transmission and probability of error in received signal. Spread Spectrum Modulation is dealt withappropriately.

**Course Objectives:**

- Understand the fundamentals of digital communication.
- To explain about the pulse modulation and digital modulation techniques
- To make students aware of interference in digital modulated signal
- To give exposure to Spread Spectrum Modulation

**Course Outcomes:**

After completing the course, students will be able to:

| | | |
|---|---|---|
| CO1 | Define basic concepts of pulse modulation, digital modulation, spread spectrum modulation | K1 |
| CO2 | Explain various types of pulse and digital modulation and demodulation techniques | K2 |
| CO3 | Formulate mathematical representation of pulse ,digital modulation -demodulation | K3 |
| CO4 | Describe the significance of noise in digital communication systems | K2 |
| CO5 | Understand the spread spectrum of modulated signal | K2 |
| CO6 | Interpret the performance of pulse and digital modulation techniques | K3 |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | Pulse modulation: Sampling, Quantization, Pulse code modulation, line coding, T1 Digital System, DPCM, DM, ADM, Voice coder (Vocoders) |
| **Unit 2** | Digital Modulation Techniques: Phase shift keying, Quadrature Amplitude shift keying, Frequency shift keying, Pulse shaping, reduction of inter channel and inter symbol interference, regenerative repeaters. |
| **Unit 3** | Optimal Reception of Digital Signal: Baseband signal receiver, probability of error, optimum receiver for both baseband and pass band, optimal coherent reception: PSK, FSK, QPSK. Signal space representation and Comparison of modulation system. |
| **Unit 4** | Noise in PCM and DM, PCM Transmission, Delta Modulation Transmission, Comparison of PCM and DM , The space shuttle ADM |
| **Unit 5** | Spread Spectrum Modulation: Spread Spectrum, Pseudo noise Sequences, DSSS, FHSS and Code Division Multiple Access Ranging |

**Text books and Reference books**


1. H. Taub and D. L. Schilling, "Principles of Communication Systems", 3rd Ed, McGraw-Hill 2012
2. Simon Haykin , "Digital Communications", John-Wiley, 4th Ed , 2006



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3. B. Carlson, “Communication Systems: An Introduction to Signals and Noise in Electrical Communication”, 5th Ed, McGraw-Hill,2010
4. K S Shanmugam, “Digital and Analog Communication Systems”, John-Wiley & Son,2006
5. R P Singh and S D Sapre, " Communication Systems ",2nd Ed, McGraw-Hill,2007

| Course Outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 1 | | | | | | | | | | | 3 | |
| CO2 | 2 | 2 | 1 | | 1 | | | | | 2 | | | | 3 | |
| CO3 | 3 | 3 | 2 | | 2 | | | | | | | | | 3 | 1 |
| CO4 | 2 | 2 | 2 | | 1 | | | | | 2 | | | | 3 | |
| CO5 | 2 | 2 | 2 | | | 1 | 1 | 2 | | 2 | | | | 3 | |
| CO6 | 3 | 2 | 2 | | 2 | | | | | | | | | 3 | 1 |

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

**3 –High 2 –Medium 1 – Low**

**Assessment:**

| | |
|---|---|
| **ISE I:** | Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects |
| **ISE II:** | Shall be based on class test |
| **ISE III:** | Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects |

**Assessment Pattern:**

| Level No. | Knowledge Level | ISE I | ISE II | ISE III | End Semester Examination |
|---|---|---|---|---|---|
| K1 | Remember | 05 | 00 | 00 | 06 |
| K2 | Understand | 10 | 05 | 05 | 42 |
| K3 | Apply | 00 | 10 | 05 | 12 |
| K4 | Analyze | 00 | 00 | 00 | 00 |
| K5 | Evaluate | 00 | 00 | 00 | 00 |
| K6 | Create | 00 | 00 | 00 | 00 |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment table**

| Assessment Tool | K1 | K2 | K3 | K2 | K2 | K3 |
|---|---|---|---|---|---|---|
| | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
| ISE I (15) Marks) | 05 | 10 | 00 | 00 | 00 | 00 |
| ISE II (15 Marks) | 00 | 05 | 10 | 00 | 00 | 00 |
| ISE III (10 Marks) | 00 | 00 | 05 | 00 | 05 | 00 |
| ESE Assessment (60 Marks) | 06 | 24 | 06 | 12 | 06 | 06 |

| ETPC3021: Lab Digital Communication | |
|---|---|
| **Teaching Scheme** | **Examination Scheme:** |
| **Practical: 2 Hrs/Week** | **ISE III: 25 Marks** |
| | **Practical Examination & Viva Voce: 25 Marks** |

**Course Outcomes:**

After completing the course, students will be able to:

| | | |
|---|---|---|
| CO1 | Perform various pulse modulation and demodulation techniques | S1 |
| CO2 | Perform various digital modulation and demodulation techniques | S2 |
| CO3 | Interpret the performance of modulation techniques in presence of noise | S2 |
| CO4 | Use modern tools for simulation for modulation | S2 |

**List of Experiments**

| | |
|---|---|
| 1. | Study various Line coding techniques |
| 2. | Perform PAM,PWM,PPM |
| 3. | Perform Time DivisionModulation and demonstrate interlacing of at least three waveforms |
| 4. | Perform Pulse Code Modulation and Demodulation and recover original signal |
| 5. | Perform Delta and Adaptive Modulation and Demodulation. Observe change of step size in ADM |
| 6. | Perform Amplitude Shift Keying transmission and reception |
| 7. | Perform Frequency Shift Keying transmission and reception. Find out bandwidth of modulated signal |
| 8. | Perform Phase Shift Keying transmission and reception. Find out bandwidth of modulated signal |
| 9. | Compare performance of digital modulation techniques by EYE diagram |
| 10 | Simulate Spread Spectrum modulation technique |

**Mapping of Course outcome with Program Outcomes**

| Course Outcome | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | | 3 | 2 | | | | | 1 | | | | 3 | |
| CO2 | 1 | 1 | | 2 | 2 | | | | | 1 | | | | 3 | |
| CO3 | 2 | 2 | | 2 | 2 | | | | | 1 | | | | 3 | |
| CO4 | | | | 2 | 3 | | | | | 1 | | | | 3 | |

**3 –High 2 – Medium 1 -Low**

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**Assessment Table**

| Assessment Tool | S1 | S2 | S2 | S2 |
|---|---|---|---|---|
| | CO1 | CO2 | CO3 | CO4 |
| ISE III (25 Marks) | 03 | 12 | 05 | 05 |
| Practical Examination & Viva Voce (25 Marks) | 05 | 12 | 04 | 04 |

**Assessment Pattern**

| **Level No.** | **SkillLevel** | **ISE III** | **Practical Exam and Viva-Voce** |
|---|---|---|---|
| S1 | Imitation | 03 | 05 |
| S2 | Manipulation | 22 | 20 |
| S3 | Precision | 00 | 00 |
| S4 | Articulation | 00 | 00 |
| S5 | Naturalization | 00 | 00 |
| **Total** | | 25 | 25 |

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| ETPC3022: Embedded Systems | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| **Lectures: 3Hrs/week** | **ISE I: 15 Marks** |
| **Total credits: 03** | **ISE II: 15 Marks** |
| | **ISE III: 10 Marks** |
| | **End Semester Examination: 60 Marks** |

**Course description**:
This course introduces the concept of Embedded System, Embedded Microprocessor and its peripherals, interrupts and exceptions, C/ Assembly Programming, Tool Chains, Emulation and Debugging. The course focuses on ARM RISC processors for embedded applications.

**Course Objectives:**

- To develop understanding about requirements and general design methodology of Embedded Systems.
- To apply hardware and software knowledge for developing Embedded Systems as per requirements, specifications, and constraints.
- To impart knowledge of serial communication protocols, ARM architecture and Real Time Operating Systems.
- To expose the students to recent trends of Embedded System.

**Course Outcomes:** After completing the course, the students will be able to:

| | | |
|---|---|---|
| CO1 | Understand classification, design issues & metrics of embedded systems | K2 |
| CO2 | Comprehend ARM Basics, ARM architecture, instruction set, assembly language programmingand on-board devices | K2 |
| CO3 | Know serial communication protocols | K2 |
| CO4 | Interface different peripherals to ARM processor for engineering solutions | K3 |
| CO5 | Understand real time systems and System-on chip concepts | K2 |
| CO6 | Design Embedded systems for various applications | K3 |

**Detailed Syllabus:**

| | |
|---|---|
| **Unit 1** | **Introduction to Embedded Systems**<br>Definition of Embedded System, Components of a typical Embedded System, classification, Characteristics, Design Metrics, Overview of Embedded. Processor technology, IC Technology, Design Technology, Hardware components like Microcontroller, GPP, ASSP, ASIP, SoC, Introduction to Real Time non-OS and RTOS systems |
| **Unit 2** | **ARM as Embedded Processor**<br>ARM/RISC Design Philosophy, Introduction to ARM processors and its versions, ARM7/ARM9/ ARM11 features, advantages & suitability in embedded application, ARM7 Architecture, differentiation in Cortex Series (A, M, R), data flow model, programmers model, ARM Basics- Register, Stack, Processor modes, System Control Block, Interrupts and Exception Handling, Memory map, GPIO and ARM and Thumb instruction Set |

| | |
|---|---|
| **Unit 3** | **Communication Interfaces and on-chip devices**<br>Introduction to Serial / Parallel Communication, SPI, I2C, RS232 Serial Port, CAN, USB.<br>**LPC 2148:**Timer/Counter, Watchdog Timer, PWM, ADC, DAC |
| **Unit 4** | **Embedded System Development**<br>ARM Assembly Language Programming using Keil, Interfacing of peripherals and programming, Embedded system applications: Home Automation, vending machine or any other |
| **Unit 5** | **System on Chip**<br>Introduction to Zynq SoC, Anatomy of Embedded SoC, IP block design, High Level Synthesis, Case Study- Video Processing and Computer Vision on Zynq |

**Text and Reference Books**


1. ARM System Developer's Guide, Andrew N. Sloss, Dominic Symes, Chris Wright, ELSEVIER, 2005, ISBN 8181476468, 9788181476463
2. ARM System-On-Chip Architecture, 2ND ED, Steve Furber, Pearson Education, 2007, ISBN 8131708403
3. Embedded Systems Design, 2ND ED, Steve Heath, Newnes, 2003, ISBN 0750655461
4. Professional Embedded ARM Development, James A. Langbridge, John Wiley & Sons, Inc., 2014, ISBN 9781118788943
5. The Zynq Book, 1ST ED, Louise H. Crockett, Ross A. Elliot, Martin A. Enderwitz, RobertW. Stewart, Strathclyde Academic Media, 2014
6. ARM Assembly Language Fundamentals and Techniques, 2ND ED, William Hohl, Christopher Hinds, CRC Press, 2015, ISBN 9781482229868
7. ARM Assembly Language with Hardware Experiments, Ata Elahi, Trevor Arjeski, Springer, 2014, ISBN 9783319117034
8. PCI System Architecture, 4TH ED, Tom Shanley, Don Anderson, MindShare Inc. PEARSON Education, 2006, ISBN 813170100X


**Mapping of Course Outcome with Program Outcomes and Program Specific Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | | | | | | | 1 | 1 | 1 | | 1 | | |
| CO2 | 2 | 2 | 1 | | | | | | 1 | 1 | 1 | 1 | | 2 | |
| CO3 | 3 | 2 | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 2 | | |
| CO4 | 2 | 2 | 2 | 2 | 2 | | | | 1 | 1 | 1 | 2 | | | 2 |
| CO5 | 2 | 2 | 1 | 1 | 1 | | | | 1 | 1 | 2 | 1 | 2 | | |
| CO6 | 2 | 2 | 2 | 2 | 2 | | | | 2 | 2 | 3 | 2 | 2 | | 2 |

**3- High 2-Medium 1-Low**

**Assessment:**

| | |
|---|---|
| **ISE I:** | Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects |
| **ISE II:** | Shall be based on class test |
| **ISE III:** | Shall be based on Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects |

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**Assessment Pattern**

| Level No. | Knowledge Level | ISE I | ISE II | ISE III | End Semester Examination |
|---|---|---|---|---|---|
| K1 | Remember | 03 | 03 | 00 | 06 |
| K2 | Understand | 12 | 12 | 00 | 36 |
| K3 | Apply | 00 | 00 | 10 | 18 |
| K4 | Analyze | 00 | 00 | 00 | 00 |
| K5 | Evaluate | 00 | 00 | 00 | 00 |
| K6 | Create | 00 | 00 | 00 | 00 |
| **Total Marks 100** | | 15 | 15 | 10 | 60 |

**Assessment Table**

| Assessment Tool | K2 | K2 | K2 | K3 | K2 | K3 |
|---|---|---|---|---|---|---|
| | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
| ISE I (15 Marks) | 10 | 05 | 00 | 00 | 00 | 00 |
| ISE II (15 Marks) | 00 | 10 | 05 | 00 | 00 | 00 |
| ISE III (10 Marks) | 00 | 00 | 00 | 05 | 00 | 05 |
| ESE Assessment (60 Marks) | 12 | 18 | 06 | 12 | 06 | 06 |

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| ETPC3023: Lab Embedded Systems | | |
|---|---|---|
| **Teaching Scheme** | **Examination Scheme** | |
| **Practical: 2 Hrs/Week** | **ISE III:** | **25 Marks** |
| | **End Semester Examination:** | **25 Marks** |

**Laboratory Course Outcomes**

As an outcome of completing the Laboratory course, students will be able to:

| | |
|---|---|
| CO1 | Use modern engineering tools necessary for integrating software and hardware components in Embedded system designs. |
| CO2 | Write programs in assembly language programming for ARM processor |
| CO3 | Program the basic interfacing of ARM processor with peripherals using Embedded C |
| CO4 | Demonstrate the data communication using SPI/ I2C and exception handling with ARM processor |

**List of Experiments (Any 8)**

| Sr. No. | List of Experiments |
|---|---|
| 1 | Practice IDE software and universal programmer to program microcontrollers. |
| 2 | ARM Instruction set and Assembly language programming 1 |
| 3 | Program to Interface LEDs to LPC2148 for generating patterns |
| 4 | Program to Interface Seven Segment display |
| 5 | Program to Interface keys/ key matrix |
| 6 | Program to Interface LCD/Graphics LCD |
| 7 | Program to Interface Buzzer, relay |
| 8 | Program to Interface ADC/DAC |
| 9 | Program to Interface Stepper motor/ temperature sensor |
| 10 | Use external interrupt to carry out ISR |
| 11 | Data communication using SPI/I2C |
| 12 | Understand free RTOS tutorial |

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 | PO 12 | PSO1 | PSO2 | PS03 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 2 | | 1 | 1 | | | | | 1 | | | 2 | | |
| CO2 | 1 | 2 | | 1 | 2 | | | | 2 | 1 | | | 3 | | |
| CO3 | 1 | 2 | | 2 | 2 | | | | 2 | 1 | | | 3 | 2 | 2 |
| CO4 | 2 | 2 | | 2 | 2 | | | | | 2 | | | 3 | 2 | 2 |

**3 – High2 – Medium 1 - Low**

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Dated: 18$^{th}$ April 2023

**Assessment Table**

| Assessment Tool | S1 | S2 | S2 | S2 |
|---|---|---|---|---|
| | CO1 | CO2 | CO3 | CO4 |
| ISE III (25 Marks) | 03 | 14 | 04 | 04 |
| ESE (25 Marks) | 05 | 12 | 04 | 04 |

**Assessment Pattern**

| **Level No.** | **Skill Level** | **ISE III** | **ESE** |
|---|---|---|---|
| S1 | Imitation | 03 | 05 |
| S2 | Manipulation | 22 | 20 |
| S3 | Precision | 00 | 00 |
| S4 | Articulation | 00 | 00 |
| S5 | Naturalization | 00 | 00 |
| **Total** | | 25 | 25 |

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| ETPR3001: Mini-Project I | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| **Lectures: 2 Hrs/Week** | **ISE III:25 marks** |
| **Credits: 01** | **Practical /Viva-voce:25 marks** |

**Course description**: The aim of this course is to enable the student to comprehend the principles of modern manufacturing processes / software and to acquire competency in the design, construction, and documentation of electronic equipment/ algorithms.

**Course Objectives:**

- Elaborate the design processes and production methods.
- Explain the use of software techniques and thermal analysis techniques.

**Course Outcomes**

After completing the course, students will be able to:

| | |
|---|---|
| CO1 | Identify task and required circuit diagram / system for it. |
| CO2 | Build a project model, simulate, and test it through software. |
| CO3 | Demonstrate working of the project. |

**Detailed Syllabus:**

A group of three or four students shall select a topic from the field of Electronics and Telecommunication Engineering. They have to build a system / mini project / algorithm and test it.

Term Work: It will consist of a report based on the study and actual work done on the selected topic, which will cover theoretical and analytical study of the system, specifications, applications, results etc.

Students are expected to design an IC based project of analogue / digital circuit / software system (This can be used as experimental set-up in the laboratory). PCB design, fabrication, testing and implementation / flow charting, modular design etc. should be done. Students may use the software simulation for verification of hardware implementation. Documentation of the project is to be in standard IEEE format. Project report should include abstract in 100 words (max), key words, introduction, design, simulation, implementation, results/ results comparison, conclusion and references.

**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 2 | 3 | | | | | | | | | | |
| CO2 | 3 | 1 | | | | | | | | | | | | | |
| CO3 | 1 | | 2 | 3 | | | | | | | | | | | |

**3 – High 2 – Medium 1 - Low**

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**Assessment Pattern**

| Level | Knowledge Level | ISE III | Practical Viva – Voce |
|---|---|---|---|
| S1 | Imitation | 05 | 05 |
| S2 | Manipulation | 15 | 15 |
| S3 | Precision | 05 | 05 |
| S4 | Articulation | 00 | 00 |
| S5 | Naturalization | 00 | 00 |
| S1 | Imitation | 25 | 25 |

**Assessment table:**

| Assessment Tool | **S1** | **S2** | **S3** |
|---|---|---|---|
| | **CO1** | **CO2** | **CO3** |
| ISE III | 05 | 05 | 15 |
| Practical / Viva-voce | 05 | 05 | 15 |

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