COEP Technological University Pune

(A Unitary Public Univresity of Govt. of Maharashtra)

School of Electrical and Communication Engineering

Curriculum

Second Year B. Tech.

in

Electronics and Telecommunication Engineering

(F.Y. Structure Effective from: A.Y. 2024-25)

List of Abbreviations

Abbreviation	Title
BS	Basic Science Course
ESC	Engineering Science Course
PCC	Programme Core Course (PCC)
PEC	Programme Elective Course (PEC)
OE/SE	Open/School Elective (OE/SE) other than particular program
MD M	Multidisciplinary Minor (MD M)
VSEC	Vocational and Skill Enhancement Course (VSEC)
HSMC	Humanities Social Science and Management
IKS	Indian Knowledge System (IKS)
VEC	Value Education Course (VEC)
RM	Research Methodology (RM)
--	Internship
--	Project
CEA	Community Engagement Activity (CEA)/Field Project
CCA	Co-curricular & Extracurricular Activities (CCA)

S. Y. B. Tech
in
Electronics and Telecommunication Engineering
Semester - III

Sr. No.	Course Code	Course Title	L	T	P	S	Cr	Category
01	ET-24001	Signals and Systems	2	1	0	1	3	PCC
02	ET-24002	Electronic Devices and Circuits	3	0	2	1	4	PCC
03	ET-24003	Digital System Design	3	0	2	1	4	PCC
04	OEC-24001	Electrical Machines and Drives	2	0	0	1	2	OE
05	HS-24003	Indian Language	2	0	0	1	2	HSMC
06	AS-24001	Environmental Studies	1	0	0	2	1	VEC
07	AS-24004	Community Engagement Activity (CEA)/Field Project	--	--	--	--	2	CEA
08	HS-24001	Entrepreneurship	2	0	0	1	2	HSMC
09	HS-24002	Design Thinking	--	--	2	1	1	HSMC
		Total	**14**	**02**	**04**	**08**	**21**	

Semester -IV

Sr. No.	Course Code	Course Title	L	T	P	S	Cr	Category
01	ET-24004	Analog and Digital Communication	3	0	2	1	4	PCC
02	ET-24005	Analog Circuits	3	0	2	1	4	PCC
03	ET-24006	Microcontrollers and Applications	3	0	2	1	4	PCC
04	AS-24003	Constitution of India	1	0	0	2	1	VEC
05	OEC-	Principles of Electronic Communication	2	0	0	1	2	OE
06	ET-24007	Cornerstone project -I	0	0	4	2	2	VSEC
07	ET(MDM)-24001	Multidisciplinary Minor	3	0	0	1	3	MD M
		Total	**13**	**01**	**12**	**09**	**20**	

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **S**-Self Study, **Cr**-Credits
ISE-In-Semester-Evaluation, **ESE**-End-Semester-Evaluation, **MSE**-Mid-Semester-Evaluation, **TA**-Teachers' Assessment, **CIE**-Continuous-Internal-Evaluation

Exit option to qualify for UG Diploma:

- Advanced PCB Design (3 Credits)
- Electronic Product Design (3 Credits)

Semester -III

[ET-24001] Signals and Systems

Teaching Scheme	Examination Scheme
Lectures: 2 hrs./week	MSE - 30 Marks
Tutorial: 1 hr./week	TA - 20 Marks
Self-study: 1 hr./week	End Sem Exam - 50 marks

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

1. Classify signals based on their characteristics and perform basic operations on signals.
2. Interpret system characteristics and analyze LTI systems.
3. Analyze the spectral properties of signals using Fourier analysis.
4. Apply Z- transform to study discrete-time signals and systems.

Unit 1 **(5 hrs)**
Introduction to Signals: Definition of Signals, Classification of Signals, elementary signals, basic operations on signals.

Unit 2 **(6 hrs)**
System Classification and Properties: Introduction to Systems, Classification of Systems, Properties of Systems, Impulse response characterization and convolution for CT- LTI and DT-LTI systems, LTI systems characterized by Differential and difference equations.

Unit 3 **(6 hrs)**
Fourier analysis of Continuous Time Signals: Fourier analysis for Continuous time signals, Continuous time Fourier Transform, its properties, frequency response.

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Unit 4 **(5 hrs)**
Fourier Analysis of Discrete Time Signals: Discrete time Fourier series and its convergence, discrete time Fourier Transform, its properties, frequency response.

Unit 5 **(6 hrs)**
Z-Transform: Representation of Signals Using Discrete-Time Complex Exponentials: Z-Transform, Significance and Properties of Region of Convergence, Properties of Z-Transform, Inverse Z-Transform, relationship of z-transform with Fourier transform, applications of Z-transform to solutions of difference equations, Properties of Z transform.

Textbooks:

- Simon Haykins and Barry Van Veen, "Signals and Systems", John Wiley and sons.
- Michael J. Robert, "Introduction to Signals and Systems", TMH, Second ed., 2003.
- Tarun Kumar Rawat "Signals and Systems", Oxford University Press, first edition 2010.

Reference Book:

- Alan V Oppenhein, Alan S Wiilsky, "Signals and systems" PHI, Second ed. 2009.
- Shaila Dinkar Apte "Signals and Systems: Principles and Applications", Cambridge University

Press.

e-Learning Resources:

- https://www.youtube.com/watch?v=TrgfP7QD3Nk Linear and Circular Convolution in DSP/Signal and Systems - (linear using circular, zero padding)
- https://onlinecourses.nptel.ac.in/noc21_ee28/preview,Signals and Systems, By Prof. Kushal K. Shah,IISER Bhopal

[ET-24002] Electronic Devices and Circuits

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs./week Self-study: 1 hr./week	MSE - 30 Marks TA - 20 Marks End Sem Exam - 50 marks

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

1. Understand the physics of BJT and MOS devices, their operation and characteristics, and large signal and small signal model.
2. Analyze bipolar and CMOS sub circuits like single stage amplifier and evaluate voltage gain, input output impedance and its biasing configurations.
3. Analyze Frequency response of circuits and determine pole and zeros through inspection.
4. Apply feedback to stabilize the circuits and evaluate gain and input output impedances.
5. Analyze various type of oscillators and evaluate its criteria for oscillation.
6. Analyze power amplifiers and determine power dissipation and heat sink criteria.

Unit 1 **(10L + 2S)**

Physics of Bipolar Junction Transistors: Energy-Band Diagram, Ebers-Moll Model, Operation of BJT in Cutoff, saturation and Active mode, I/V characteristics, Large Signal model, Small signal model, Concept of transconductance, Early Effect.

Physics of MOS Transistors: Structure of N and P MOSFET, Energy-Band Diagram, Operation of MOSFET, Channel Length Modulation, Back Gate Effect and some second order effects, MOS Device Models – Large Signal model and small signal model, CMOS Technology.

S: Diode p-n junction, Charge carriers, Carrier transport-drift and diffusion current, band gap energy.

Unit 2 **(10L + 2S)**

Analog Sub-Circuits:

Bipolar Amplifiers: Operating Point Analysis and Design, Input and Output Impedances, Biasing, DC and Small signal Analysis, Bipolar amplifier Topologies – Common Emitter with and without emitter degeneration, Common Base, Emitter Follower.

CMOS Amplifiers: MOS Amplifier Topologies, Biasing, Realization of Current Sources, Common Source stage with and without source degeneration, Common Gate stage, Source Follower, Cascaded stages, concept of cascode stages and current mirrors.

S: Independent and dependent sources, Nodal and mesh analysis, KVL, KCL, Thevenin and Norton theorems.

Unit 3 **(6L + 2S)**

Frequency Response: Fundamental Concepts, square wave testing, effect of coupling, bypass, junction and stray capacitances, Relationship between Transfer function and Frequency Response, Determination of Pole-Zero through inspection at nodes, Miller's Theorem, Bode's Rules, Concepts of stability, Concept of Frequency Response, High frequency Model of Transistor.

S: Laplace transform.

Unit 4 **(6L + 2S)**

Feedback Amplifiers: Loop gain, properties of Negative feedback – Gain Desensitization, Bandwidth Extension, Modification of I/O impedances, Linearity improvement, Sense and Return Techniques, Feedback Topologies – Voltage Voltage Feedback, Voltage Current Feedback, Current Voltage Feedback, Current Current Feedback.

S: Stability Concepts.

Unit 5 **(4L + 2S)**

Oscillators: Criterion for oscillation, Barkhausen's criteria, Crystal oscillator, RC oscillators, LC Oscillators, Ring Oscillators, Voltage Controlled Oscillators.

S: General oscillator criteria.

Unit 6 **(4L + 2S)**

Output Stages and Power Amplifiers: Emitter follower as Power Amplifier, Push pull stage, Large signal considerations, Short circuit protection, Heat Dissipation, heat sink requirement, Power dissipation, Efficiency, Class-A, B, AB.

S: Single Stage amplifiers.

Textbooks:

- Behzad Razavi, "Fundamentals of Microelectronics", Second Edition; Wiley.
- Adel Sedra, Kenneth Smith, "Microelectronics Circuits" Seventh Edition, Oxford University Press.

Reference Book:

- Ben G Streetman, Sanjay Kumar Banerjee, "Solid State Electronic Devices", Sixth Edition, PHI.
- Donald A. Neamen, "Microelectronics Circuit Analysis and Design", Fourth Edition, Mc-Graw Hill.
- Thomas L Floyd, "Electronic Devices", Tenth edition, Pearson.

Electronic Devices and Circuits Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs./week	In-Sem Evaluation - 50 Marks End Sem Exam - 50 marks

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

1. Identify and characterize basic devices such as BJT and FET from their package information by referring to manufacturers' data sheets.
2. Design and Analyze small signal parameters and gain of BJT and MOS amplifiers using Spice tools.
3. Design and Analyze performance of feedback amplifiers, oscillators and power amplifiers

using spice tools.

4. Simulate frequency response of single stage amplifiers and study effects of coupling and bypass capacitors.

List of Experiments:

1. Input and Output Characteristics of BJT in CE configuration. (Find small signal parameters and gain from characteristics).
2. Transfer and Drain Characteristics of MOSFET. (Find gm, rd and μ from characteristics).
3. Single stage MOSFET CS amplifier. (Find performance parameters - Av, Ri, Ro &Bandwidth for MOSFET CS amplifier).
4. Single stage BJT CE amplifier. (Find performance parameters - Av, Ri, Ro & Bandwidth for BJT CE amplifier).
5. Comparison of CE, CC, CB configurations for Av, Ri, Ro.
6. Simulate frequency response of single stage BJT CE / FET CS amplifier. (Analyze the effect of coupling and bypass capacitors).
7. Design and simulate Voltage Shunt Feedback Amplifiers. (Compare performance of voltage shunt circuit under with and without feedback conditions).
8. Design and simulate current series Feedback Amplifiers. (Compare performance of current series circuit under with and without feedback conditions).
9. Design and simulate LC and RC oscillators. (Compare practical and theoretical oscillation frequency).
10. Build and test LC or RC oscillator.
11. Design and simulate Power Amplifiers - Class A, Class AB complementary symmetry. (Efficiency calculations and comparison).

[ET-24003] Digital System Design

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs./week Self-study: 1 hr./week	MSE - 30 Marks TA - 20 Marks End Sem Exam - 50 marks

Course Outcomes:

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

1. Select logic gates and implement logic functions using gates
2. Conversion and representation of numbers in various forms for arithmetic operations.
3. Synthesize combinational and sequential circuits using MSI devices
4. Compare TTL and CMOS technology in terms of voltage levels, power dissipation, noise margin.

Unit 1 **(6L + 2S)**

Introduction to logic circuits: Analysis and Synthesis of logic circuits using basic and universal gates. Design examples, Optimized implementation of logic functions, Static and dynamic hazards.

S: Boolean algebra, SOP, POS, up to 6 variable K map.

Unit 2 **(10L + 2S)**

Number Representation and arithmetic circuits : Number representation, Number systems and its arithmetic, unsigned and signed numbers, arithmetic overflow, fixed point and floating point arithmetic, Design of arithmetic Circuits like Full adder, Ripple carry adder, Fast adder, Asymptotic time complexity, design of carry look-ahead adder, weighted and non weighted Codes, Multiplier (32 by 32) – Shift and Add, Booth’s algorithm. (Two 32 bit numbers producing

64 bit result), Division – Iterative divider (time complexity), rounding, truncation.
S: Binary representation and arithmetic, Iterative multiplier, Wallace tree multiplier

Unit 3 **(6L + 2S)**
Combinational circuit building blocks: Multiplexer synthesis using Shannon's expansion, decoder, Priority encoder, Synthesis and analysis of logic functions using Multiplexer and decoder
S: Octal to binary encoder, Design of 4:16 decoder using 3:8 decoder, Basic and Universal gates using MUX.

Unit 4 **(10L + 2S)**
Synchronous sequential design: Basic latch, Gated SR and D latch, Master slave and edge triggered Flip flops(D, JK and T), Shift Registers , Counters, Design of ripple and synchronous counters, Design and implementation of counters using JK FF and D FF, Introduction to FSM and its synthesis, Data Converters.
S: MOD counters, Random sequence counter, Vending machine: water bottle dispenser.

Unit 5 **(4L + 2S)**
Implementation technology: TTL and CMOS technology, voltage levels, Noise margin, power dissipation, Fan in and Fan out, Source and sink current.
S: Different logic families: I2L, ECL, MOS , Interfacing of TTL and CMOS ICs.

Unit 6 **(4L + 2S)**
Quantum computing: roadmap, quantum mission of India, applications of quantum, quantum basics, building block: single qubit gates, quantum circuits with single qubit gates.

Textbooks:

- M. Morris Mano, Michael D. Ciletti, "Digital Design" Pearson, Fourth edition.
- R. P. Jain, "Modern digital Electronics", Tata McGraw Hill, fourth edition.

Reference Book:

- Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL Design" Mc Craw Hill, Third edition.
- A. Anand Kumar, "Fundamentals of Digital circuits", PHI, Fourth edition.
- Rajiv Kumar, Quantum Computing, Pearson, 2022

Digital System Design Laboratory

Teaching Scheme	Examination Scheme
Practical: 2 hrs./week	In-Sem Evaluation - 50 Marks End Sem Exam - 50 marks

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

1. Design, simulate, built and debug complex combinational circuits based on an abstract functional specification
2. Design, simulate, built and debug complex sequential circuits based on an abstract functional specification

List of Experiments:

1. implementation of logic using basic and universal gates
2. Use of Multiplexers and decoders for implementing logic
3. Binary and BCD adders and subtractor using IC 7483 and additional gates
4. Design and implementation of ripple and synchronous counters using JK and D FF and additional gates
5. Design of counter using ICs like 7490/93 (ripple) and 74192/193(synchronous)
6. Design and implementations of random sequence counter using D FF or JK FF ICs
7. Study of shift registers using IC 7495 for different modes. Design of pulse train generator, ring counter and Johnson' s counter using shift register and decoder circuit
8. Interface TTL and CMOS IC to check the compatibility

Minor in AI ML
[Course Code] Signal Transforms

Teaching Scheme	Examination Scheme
Lectures: 2 hrs./week	MSE - 30 Marks
Self-study: 1 hr./week	TA - 20 Marks
	End Sem Exam - 50 marks

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

1. Identify and differentiate the various types of signals and systems and characterize their responses.
2. Analyze the signals using Fourier transforms.
3. Evaluate time varying signals using STFT and Gabor transform.
4. Determine the DCT and interpret its properties.
5. Apply HAAR transform for signal analysis.

Unit 1 **(5 hrs)**
Classification of Signals and Systems: Introduction and Classification of Signals and Systems, Properties of Systems, LTI system analysis using Impulse Response and Convolution operation.

Unit 2 **(5 hrs)**
Fourier Representations: Fourier series and Fourier transforms for Continuous Time Signals, CTFS and CTFT, Fourier series and Fourier transforms for Discrete Time Signals, DTFS and DTFT, Properties of Fourier Representations.

Unit 3 **(6 hrs)**
Discrete Cosine Transform: Definitions and General Properties. Fast Algorithms for DCT-II. Two Dimensional DCT Algorithms. Performance of the DCT. Applications of the DCT.

Unit 4 **(5 hrs)**
Time-Frequency Analysis: Time-frequency analysis using STFT and Gabor Transforms.

Unit 5 **(6 hrs)**
Haar Transform: Definition, basis function, properties, and application.

Textbooks:

- Simon Haykins and Barry Van Veen, "Signals and Systems", John Wiley and sons.

Reference Book:

- Alan V. Oppenheim, Alan S. Willsky with IAN T. Young, "Signals and Systems", Prentice-Hall.
- Charles L. Phillips, John M. Parr , Eve A. Riskin , "Signals, Systems, And Transforms" Fourth Edition, 2008 Pearson Education.

Signal Transforms Laboratory

Teaching Scheme	Examination Scheme
Practical: 2 hrs./week	In-Sem Evaluation - 50 Marks End Sem Exam - 50 marks

Course Outcomes:

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

1. To use computational tools to do basic operations for signal processing.
2. Apply convolution operations on different signals.
3. Analyze various signals in transform domain.

List of Experiments:

1. To generate discrete sequence, basic signals (Unit step, unit impulse, ramp, exponential, sine cosine etc) and implementation of Arithmetic operations on discrete signals using software tool.
2. To evaluate Linear convolution between two sequences.
3. To plot the magnitude and phase spectrum of a signal using DFT
4. Perform N-point DFT and perform the IDFT to verify the result.
5. Evaluate 1D DCT of a function and plot it.
6. Perform DCT Computations on an image.
7. Verify the separability property of DCT.
8. Perform time frequency analysis using STFT and Gabor Transforms.
9. Implement Haar Transforms for Time Series Data and digital Images.

Semester – IV

[ET-24004] Analog and Digital Communication

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs./week Self-study: 1 hr./week	MSE - 30 Marks TA - 20 Marks End Sem Exam - 50 marks

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

1. Understand performance parameters of Analog and Digital systems.
2. Demonstrate modulation and demodulation techniques for AM and FM.
3. Implement AM and FM applications.
4. Differentiate different digital modulation techniques.
5. Evaluate digital signal enhancement techniques towards signal transmission.
6. Investigate digital modulation and demodulation techniques.

Unit 1 **(6L + 2S)**
Introduction to the Communication Systems: Block diagram of communication systems, Analog and Digital Messages, Signal Transmission through a linear system, Signal distortion over a communication channel, Signal-to Noise ratio and capacity, Modulation and Detection, Signal Energy and Energy spectral density, Signal power and power density.
S: Fourier Transform of periodic and aperiodic signals.

Unit 2 **(8L + 2S)**
Amplitude modulation and Demodulations: Analog continuous wave modulation, Single and Double sideband Amplitude modulation, Amplitude modulation, Bandwidth-efficient Amplitude demodulation, VSB, Local Carrier synchronization, suppressed sideband modulation.
S: Probability density function.

Unit 3 **(6L + 2S)**
Angle Modulation and demodulation: Nonlinear Modulation, Bandwidth of Angle-modulated Waves, Generating FM waves, Demodulation of FM signals, Nonlinear distortion and interference, Superheterodyne Receivers, FM broadcasting System, power and bandwidth of FM.
S: Commercial applications like television transmission.

Unit 4 **(6L + 2S)**
Sampling and Analog to digital Conversion: Sampling theorem, Sampling and signal reconstruction, Aliasing, Types of sampling, Quantization, PCM, Companding, DPCM, ADPCM, Delta modulation, Adaptive delta modulation, T1 carrier system.
S: Shanon's source coding algorithm.

Unit 5 **(8L + 2S)**
Digital Data Transmission: Components of digital communication system, line coding, pulse shaping, , Regenerative Repeater, Timing Extraction, Detection Error Probability, M-ary communication, Digital Carrier Systems, Equalization.
S: Scrambling and descrambling, eye diagram.

Unit 6 **(6L + 2S)**

Introduction to Digital Carrier Modulation-Demodulation Techniques: Modulation techniques for ASK, FSK, PSK, MSK, BPSK, QPSK, GMSK.

S: Error control coding.

Textbooks:

- Digital and analog communication system by B. P. Lathi and Zhi Ding, fourth edition, Oxford University Press, 2010.
- Digital & Analog Communication Systems by Shanmugam K.S., John Wiley & Sons, NewYork, Jan 2012.

Reference Book:

- Introduction To Analog & Digital Communications By Simon Haykin, Second Hand Book, VISIONIAS, Jan 2020.
- Advanced Electronic Communications Systems by Wayne Tomasi, Sixth Edition, Pearson Education Limited, 2014.

Analog and Digital Communication Laboratory

Teaching Scheme	Examination Scheme
Practical: 2 hrs./week	In-Sem Evaluation - 50 Marks End Sem Exam - 50 marks

Course Outcomes:

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

1. Demonstrate modulation and demodulation techniques for AM and FM.
2. Implement digital modulation and demodulation techniques.
3. Analyze the analog and digital communication using Matlab

List of Experiments:

1. AM Modulation and Demodulation
2. FM Modulation using PLL
3. Pulse Amplitude Modulation and Demodulation
4. Pre-emphasis and De-emphasis
5. Analog Multiplexing
6. Sampling and Reconstruction
7. Delta and Adaptive Delta Modulation
8. A and Mu Law Compression and Decompression
9. Line Coding
10. ASK, FSK and PSK Modulation and demodulation
11. 16 QAM

Software Assignments using Matlab/ Scilab:

1. AM Modulation
2. FM Modulation
3. Observing Spectrum of Different Waveforms
4. ASK, FSK and PSK Modulation
5. Huffman Coding

[ET-24005] Analog Circuits

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./week Self-study: 1 hr./week	MSE - 30 Marks TA - 20 Marks End Sem Exam - 50 marks

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

1. Understand basic configurations and circuits of operational amplifier.
2. Demonstrate the operational amplifier in the form of active filter.
3. Develop the non-linear applications of operational amplifier.
4. Use the operational amplifier as waveform generator.
5. Develop the applications of operational amplifier as ADC and DAC
6. Design circuits with phase lock loop.

Unit 1 **(8L + 2S)**
Advanced Circuit Topologies: Block diagram of OPAMP, Differential Signals, Differential Pair, Bipolar Differential Pair, level shifter, output stage of opamp, Cascade current mirror, Cascode stages, Current Mirrors, Op-Amp parameters, Concept of feedback & their types, Inverting & non inverting configurations, current to voltage converters, voltage to current converters, summing amplifier, difference amplifier, instrumentation amplifier.
S: Biasing of transistor circuits

Unit 2 **(6L + 2S)**
Active Filters: Transfer Function, passive filters, Stability, First order active filters, Standard second order responses, KRC filters, Biquad Filters, audio Filter applications, Sensitivity.
S: Resonance and bandwidth concepts.

Unit 3 **(8L + 2S)**
Non-linear circuits: Schmitt trigger, Voltage comparators, comparator applications, precision rectifiers, analog switches, peak detectors, sample & hold circuits, Integrators & differentiators, log/antilog amplifiers.
S: PSPICE simulation of opamp based circuits.

Unit 4 **(6L + 2S)**
Signal Generators: Sine wave generators, Multi vibrators, Triangular wave generators, Saw tooth generators, V to F and F to V converters, function generator IC.
S: Monolithic timers IC 555 based circuits.

Unit 5 **(6L + 2S)**
D-A and A-D Converters & regulators: Performance specifications, D-A conversion techniques, A-D Conversion techniques, single chip implementation of DAC and ADC. Performance specifications of regulators, linear regulators, modifications for variable voltage, current boost & protection circuits.
S: Datasheets of DAC and ADC chips, ADC in microcontrollers.

Unit 6 **(6L + 2S)**
Phase Locked Loops & multipliers: Block diagram of PLL free running frequency, lock range, capture range and Sample circuits for each block. Applications of PLL - Frequency synthesizer FM

demodulator, AM demodulator, FSK demodulator, Analog multiplier, Multiplier IC.
S: Voltage controlled oscillator.

Textbooks:

- Op-Amps and Linear Integrated Circuits", by Ramakant A. Gayakwad, PHI, Fourth edition, May 2015.
- Linear Integrated Circuits, by D. Roy Choudhary and Shail B Jain, New Age Int, Fourth Edition, July 2021.

Reference Book:

- Design with Operational Amplifiers and Analog Integrated Circuits, by Sergio Franco, Tata McGraw Hill, Third Edition, July 2017.
- Operational Amplifiers, by G.B. Clayton and Steve Winder, EDN Series for Design Engineers, Second Edition, March 2003.

Analog Circuits Laboratory

Teaching Scheme	Examination Scheme
Practical: 2 hrs./week	In-Sem Evaluation - 50 Marks End Sem Exam - 50 marks

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

1. Demonstrate the linear and non-linear applications using operational amplifier.
2. Implement active filters.
3. Analyze different parameters of phase lock loop and waveform generator chips

List of Experiments:

1. I Op-amp applications-I: Integrator, Differentiators.
2. Op-amp applications-II: Comparator (LM 339), Schmitt trigger.
3. Design, build and test Precision rectifier.
4. Design, build and test a Square wave generator using op-amp.
5. Design, build and test a Sine wave generator using op-amp.
6. Design, build and test a second order filter using op-amp.
7. Implementation of function generator IC8038.
8. Design, build and test different types DAC & study ADC IC.
9. To study the operation of IC 565 as PLL and measure lock range, capture range & one application.

Open Elective
[Course Code] Principles of Electronic Communication

Teaching Scheme	Examination Scheme
Lectures: 2 hrs./week	MSE - 30 Marks TA - 20 Marks End Sem Exam - 50 marks

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

1. Explain need of modulation, techniques in communications and overview of

electromagnetic spectrum.
2. Analyze analog, pulse and digital modulation techniques.
3. Distinguish various communication networks and their topologies.
4. Conceptualize principles and applications of satellite and optical communications.
5. Comprehend various cellular telephone systems and wireless technologies.

Unit 1 **(4 hrs)**
Basics of Electronic Communication: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

Unit 2 **(8 hrs)**
Simple description on Modulation: Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

Unit 3 **(4 hrs)**
Telecommunication Systems: Telephones Telephone system, Paging systems, Internet Telephony.
Communication Networks: Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

Unit 4 **(6 hrs)**
Satellite Communication: Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.
Optical Communication: Optical Principles, Optical Communication Systems, Fiber Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

Unit 5 **(6 hrs)**
Cellular and Mobile Communications: Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA.
Wireless Technologies: Wireless LAN, PANs and Bluetooth, Zig Bee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

Textbooks:

- Principles of Electronic Communication Systems, Louis E. Frenzel, Fourth Edition, McGraw Hill publications, 2016.

Reference Book:

- Electronic Communications systems, Kennedy, Davis 4e, MC Graw Hill Education, 1999.
- Theodore Rapp port, Wireless Communications - Principles and practice, Prentice Hall, 2002.
- Roger L. Freeman, Fundamentals of Telecommunications, Second Edition, Wiley publications.
- Introduction to data communications and networking, Wayne Tomasi, Pearson Education, 2005.

[ET-24006] Microcontrollers and Applications

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./week Self-study: 1 hr./week	MSE - 30 Marks TA - 20 Marks End Sem Exam - 50 marks

Course Outcomes:

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

1. Differentiate various architectures of microcontrollers.
2. Impart microcontroller programming and design skills.
3. Undertake problem identification formulation and selection of appropriate microcontroller as per the applications.
4. Interface and use different peripherals with microcontrollers.
5. Compare and analyze different microcontrollers for the real world applications.
6. Evaluate and compare the performance of microcontrollers.

Unit 1 **(8 hrs)**

Introduction to Microcontroller: Numbering system, Microcontrollers Vs Microprocessors, RISC and CISC architecture comparison. Von-Neumann vs. Harvard architecture, comparison between 8-bit, 16-bit, 32-bit microcontroller. Stack and use of stack pointer. Memory structure, Data Memory, Program Memory and execution of programs.

Unit 2 **(8 hrs)**

Programming with microcontroller: Programming: Concept of assembler directives, editor, linker, loader, debugger, simulator, emulator. Instruction set, basic programming using assembly instructions. Introduction to embedded-C, Integrated Development Environment (IDE), cross compiler, ISP, software delay generation.

Unit 3 **(8 hrs)**

8 Bit micro-controller: Introduction to 8 bit microcontroller, Addressing Modes & Instruction Set, architecture and PIN description, Interrupts and Operating Modes, Analog Input-Output and PWM, Digital Input-Output, Memory Mapping (internal as well as external) of microcontroller.

Unit 4 **(6 hrs)**

I/O Interfacing: I/O programming, interfacing with simple switch, LED, Keypad programming. Timers, various modes of operations of timers, counters, PWM programming.

Unit 5 **(6 hrs)**

Communication Protocols: Serial peripheral interface (SPI), SPI based memory interfacing, Universal Serial Communications Interface (USCI) interfacing and programming, Interrupt understanding and interfacing, I2C based RTC interfacing , WDT (Watch dog timer).

Unit 6 **(6 hrs)**

External Peripheral Interfacing: Analog to digital convertor, interfacing with external serial and parallel ADC's, Digital to analog convertor (DAC), Interfacing with DAC, Interfacing with stepper motor and DC motor, Comparative analysis of different 8 bit microcontrollers.

Textbooks:

- Mazidi, "8051 microcontroller & embedded system" Third Edition, Pearson

- Mazidi, "PIC microcontroller & embedded system" Third Edition, Pearson
- Kenneth J. Ayala, "8051 Microcontroller: Programming, Architecture and Interfacing", Thomas Delmar Learning, Third Edition, 2007.
- John H Davies, "MSP430 Microcontroller Basics", Newnes, First Edition, 2010

Reference Book:

- Kenneth J. Ayala, "The 8051 Micro-controller – Architecture, Programming & Applications", Penram International & Thomson Asia, Second Edition.
- John B. Peatman, "Design with PIC Micro-controllers", Pearson Education Asia, Low Price Edition.
- MSP430 Technical Reference Manual.
- Newnes Publication, 2009 *Texas Instruments MSP 430 microcontroller, Guide and Datasheet.
- Muhammad A. Mazidi, "AVR Microcontroller and Embedded Systems: Assembly and C", Pearson; 1st edition, 2015.

Microcontrollers and Applications Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs./week	In-Sem Evaluation - 50 Marks End Sem Exam - 50 marks

Course Outcomes:

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

1. Understand and apply the fundamentals of assembly/embedded 'c' level programming of microprocessors and microcontroller
2. Analyze problems and apply a combination of hardware and software to address the problem.

List of Experiments:

Design build and test the circuits of ---

1. GPIO toggling.
2. Seven segment LED interfacing with microcontroller
3. Keypad interfacing with microcontroller.
4. ADC interfacing with microcontroller with the help of waveform generation.
5. Timers and counters.
6. UART interfacing.
7. Interrupts in microcontrollers.
8. PWM generation using a microcontroller.
9. DC/stepper motor interfacing with a microcontroller.
10. I2C and SPI based peripheral interfacing.

Minor in IoT
[Course Code] Introduction to Microcontrollers

Teaching Scheme	**Examination Scheme**
Lectures: 2 hrs./week Self-study: 1 hr./week	MSE - 30 Marks TA - 20 Marks End Sem Exam - 50 marks

Course Outcomes:

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

1. Understand architectures of microcontrollers.
2. Compare and analyze different microcontrollers for the real world applications.

Unit 1 **(4 hrs)**
Microcontrollers' architecture: Architecture of 8051 family Microcontrollers, I/O Ports, Memory organization, Addressing modes and instructions.

Unit 2 **(4 hrs)**
Microcontrollers: Interrupts, Timers, Serial Communication, Pipelining and Hazards.

Unit 3 **(4 hrs)**
Communication Protocols: Serial peripheral interface (SPI), Inter Integrated Circuit (I2C), Universal Serial Communications Interface (USCI), RS232.

Unit 4 **(4 hrs)**
Introduction to Arduino: Architecture of Arduino board, Board specifications, IDE, plugins, Software and Development tools.

Unit 5 **(4 hrs)**
Arduino Interfacing and Programming: Embedded C, Interfacing of Arduino Uno with ultrasonic sensor, Temperature and humidity Sensor, accelerometer, PIR sensor, MQ Gas sensor.

Unit 6 **(4 hrs)**
Hardware Platforms for IoT application Development: ESP8266, Raspberry Pi, STM32, Beagle Bone, Comparison of these boards with Arduino board.

Textbooks:

- Mazidi, Naimi, Naimi, "AVR Microcontroller and Embedded Systems: Using Assembly and C", First Edition, Pearson.
- Kenneth J. Ayala, "The 8051 Microcontroller, Architecture, Programming and Applications", Third edition, Penram International

Introduction to Microcontrollers Laboratory

Teaching Scheme	Examination Scheme
Practical: 2 hrs./week	In-Sem Evaluation - 50 Marks End Sem Exam - 50 marks

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

1. Develop programming ability using C/C++/Assembly language.
2. Explore to the interconnection and integration of the real time parameters and the smart application

List of Experiments:

1. To study Arduino IDE and different types of Arduino Board.
2. Write a program to calculate the distance using ultrasonic sensor.
3. Write a program to measure room-temperature , humidity and heat index.
4. To determine the gas level/smoke using MQ2 Gas sensor
5. Write a program to detect motion using PIR sensor.

6. Write a program to detect change in displacement using accelerometer.
7. To study Timers and Counters
8. To study interrupts in Microcontrollers
9. Assembly Programs on Arithmetic, Logical and Data transfer operations.

Minor in AI ML
[Course Code] Image and Video Processing

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs./week Self-study: 1 hr./week	MSE - 30 Marks TA - 20 Marks End Sem Exam - 50 marks

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

1. Comprehend digital image processing fundamentals and image formation and visualization.
2. Select and apply the different image enhancement techniques in spatial domain.
3. Interpret image analysis techniques in frequency domain.
4. Design and analyze image compression techniques.
5. Illustrate basics of video processing.
6. Assess and justify different video coding techniques.

Unit 1 **(5 hrs)**
Digital image fundamentals: Includes simple image models, digital image formation, sampling, quantization, resolutions, and representation, the relationship between pixels, and types of digital images.

Unit 2 **(8 hrs)**
Image Processing in Spatial domain: Includes point processing, such as intensity transformations, histogram processing and modification, image averaging, image subtraction, and spatial filtering, such as smoothing filters and sharpening filters.

Unit 3 **(5 hrs)**
Image Processing in Frequency domain: Frequency Domain Filtering: Filtering: Low-pass (Smoothing) & High-Pass (Sharpening), Ideal, Butterworth and Gaussian Filtering, Unsharp Masking and High-Boost Filtering.

Unit 4 **(8 hrs)**
Compression models: Includes lossy and lossless, Huffmann coding, arithmetic coding, LZW coding, run length coding, bit plane coding, transform coding, predictive coding, image compression standards.

Unit 5 **(6 hrs)**
Basic steps of video processing: Video Formation, Perception and Representation. Video Sampling.

Unit 6 **(8 hrs)** **Two-Dimensional Motion Estimation:** Optical Flow, General Methodologies, Pixel-Based Motion Estimation, Block-Matching Algorithm. Block-Based Transform Coding, Predictive Coding, Video Coding Using Temporal Prediction and Transform Coding. Video Compression Standards.

Textbooks:

- Fundamentals of Digital Image Processing-A.K. Jain, PHI,1989
- S. Sridhar, "Digital Image Processing", Oxford University Press, Second Edition, 2018
- "Handbook on Image and Video Processing", A.I.Bovik, Academic Press

Reference Book:

- Digital Image Processing using Matlab, Rafeal C. Gonzalez, Richard E. Woods, Steven L. Eddins, Pearson Education.
- M. Tekalp, "Digital video Processing", Prentice Hall International.
- Bovik, "Handbook of Image & Video Processing", Academic Press, 2000.

e-Learning Resources:

Image and Video Processing Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs./week	In-Sem Evaluation - 50 Marks End Sem Exam - 50 marks

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

1. Describe digital image representation, manipulation and illustrate the use of histograms.
2. Verify various image enhancement techniques.
3. Apply various filters in the frequency domain and understand the concept of edge detection.
4. Analyze video processing methods.

List of Experiments:

1. Contrast stretching: Stretching the contrast of a low contrast image.
2. Histogram creation: Creating a histogram and histogram equalization.
3. Find the discrete Fourier transform of a gray scale image and performing an inverse transform to get back the image.
4. Analyzing the rotation and convolution properties of the Fourier transform using any gray scale image
5. Perform Edge detection using high pass filters in spatial and frequency domain.
6. Apply Image compression techniques-bit plane and LZW to different images.
7. Extract frames from Video.
8. Perform object detection using frame difference.
9. Apply Block-Based Transform Coding for video coding.
10. Application of image/video processing

Exit Course
[Course Code] Advanced PCB Design

Teaching Scheme	**Examination Scheme**

Lectures: 1 hr./week Self-study: 1 hr./week	CIE - 100 Marks

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

1. Understand base material for PCB making and their characterization.
2. Differentiate the low and high frequency design aspects of PCB.
3. Develop the concept of flexible PCB design.
4. Use the IPC standards in designing PCB.
5. Develop the reliability aspects.
6. Design the PCB for given assignment

Unit 1 **(6 hrs)**
Base Material: Fundamental of electronic components and their packages, basic electronic circuits, Need for PCB, Types of PCBs: Single and Multilayer, Technology: Plated Through Hole, Surface Mount. PCB Material Basics of printed circuit board and its properties like moisture absorption, insulation resistance, Impact of LEAD-free on assembly on base materials, designing: Layout planning, general rules and parameters, ground conductor considerations,.

Unit 2 **(4 hrs)**
Analog and RF design: Design Issues: Transmission line, Cross talk and Thermal management, Track width, current and frequency constraints in analog and RF PCB designs, High density interaction.

Unit 3 **(3 hrs)**
Flexible PCB designing concepts: Base dielectrics, Conductor materials, Copper-clad laminates, Coverlay, Adhesive sheets, Dimension stability, Manufacturing process.

Unit 4 **(3 hrs)**
IPC Standards: IPC Standard for Schematic Design, IPC Standard for PCB Designing, IPC Standard for PCB Materials, IPC Standard for Documentation and PCB Fabrication.

Unit 5 **(4 hrs)**
Reliability: Thermal stress, Chemical stress, Environmental stress, mechanical stress in PCBs.

Unit 6 **(4 hrs)**
Project work: Making the schematic of Academic and Industrial projects, PCB Designing of these projects.

Textbooks:

- Printed Circuits Handbook, Sixth Edition, Clyde F. Coombs, The McGraw-Hill, 2008.
- PCB Designing E-Learning Book, Sai Kiran, DigiMind.

Reference Book:

- R. S. Khandpur, "Printed circuit board design, fabrication assembly and testing", Tata McGraw Hill 2006.
- Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards, Simon Monk, Duncan Amos, McGraw Hill, 2017.

E-Resource:

- Open source EDA Tool KiCad Tutorial: http://kicad-pcb.org/help/tutorials/

Advanced PCB Design Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 4 hrs./week	CIE - 100 Marks

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

1. Understand PCB making and their optimization.
2. Differentiate the analog and RF design aspects of PCB.
3. Design the PCB for different applications.

List of Experiments:

Part A: Hands on experience experiment on PCB design which includes

- Study on types of PCB layers, through Hole and SMD Components.
- Schematic Creation and simulation of an electronic circuit
- Mapping Components of an electronic circuit
- Set Parameters for PCB Design.
- Laying Tracks on PCB.
- Create PCB Layout of an Electronic Circuit.
- Create Device Model and simulation

Part B: Hands on experience experiment on PCB production using SMT Line Setup that consists of Solder Paste Printer (SPP), Screen Printing Process-Stencil Design, Solder paste Inspection (SPI), Pick and place Machine (PPM), Pick and place Feeders, Heads and Nozzles, P & P Programming concepts, Reflow Oven (RO), Reflow Heating Process, Reflow Solder Defects, Reflow profiling, Automatic Optical Inspection(AOI).

Exit Course
[Course Code] Electronic Product Design

Teaching Scheme	**Examination Scheme**
Lectures: 1 hr./week Self-study: 1 hr./week	CIE - 100 Marks

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

1. Understand basic configurations and circuits of operational amplifier.
2. Demonstrate the operational amplifier in the form of active filter.
3. Develop the non-linear applications of operational amplifier.
4. Use the operational amplifier as waveform generator.
5. Develop the applications of operational amplifier as ADC and DAC
6. Design circuits with phase lock loop

Unit 1 **(4 hrs)**
Design Process: Requirements and specifications to design, architectural design, consideration of power supplies, high frequency circuits, user interface, system updating and servicing aspects.

Unit 2 **(4 hrs)**
Electromagnetic Interference: Overview of Electromagnetic Interference and

Electromagnetic Compatibility, Occurrence of EMI, Considerations for EMC and EMI.

Unit 3 **(4 hrs)**

Ergonomics and Aesthetics in Electronic Product Design: Overview of Electronic Product Design, Top-Down and Bottom-Up Approach, Considering Power Supply Design as an example, Ergonomic and Aesthetics.

Unit 4 **(4 hrs)**

Product Reliability: Introduction to concepts of reliability, nature of reliability problems in electronic equipment, series configuration, Parallel Configuration, Mixed Configuration.

Unit 5 **(4 hrs)**

Packaging Overview: Packaging & Enclosures of Electronic System, Effect of environmental factors on electronic system (environmental specifications), nature of environment and safety measures. Packaging's influence and its factors. Cooling in/of Electronic System.

Textbooks:

- Product Design and Development by Karl T. Ulrich and Steven D. Eppinger, Sixth Edition, Publisher: Mc Graw Hill, 2012
- Designing the Internet of Things by Adrian McEwen and Hakim Cassimally, Publisher: Wiley, 2013.

Reference Book:

- Systems analysis and design by Alan Dennis, Barbara Haley Wixom, Roberta M. Roth.– Fifth Edition, Publisher: Wiley, 2012.
- Designing Electronic Product Enclosures by Tony Serksnis, Publisher: Springer, 2019.

Electronic Product Design Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 4 hrs./week	CIE - 100 Marks

Course Outcomes:

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

1. Understand product making and their optimization.
2. Differentiate the various design aspects of an electronic product.
3. Design the robust product for different applications considering environment issues.

List of Experiments:

Considering any electronic product, following stages should be implemented:

- Study on design process.
- Schematic creation after understanding specifications and customer needs
- Planning the project for implementation
- Architecture the project in modular form
- Industrial design of the project from updating and servicing view point
- Articulate the project design from environment aspect
- Incorporate the robust design of the product