Analog Integrated Circuits (TEC-502)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Text Book/Chapter</th>
<th>Lecturers</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1/2, 6 &amp; 7</td>
<td>08</td>
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</tbody>
</table>

**Unit 1: IC OP-AMP applications:**
- OP-AMP Fundamentals (brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics)
- Basic building blocks using OP-AMPS: Inverting/Non-inverting VCVS, Integrators, Differentiators, CCVS and VCCS, Instrumentation Amplifiers.

**Unit 2: Waveform Generator:**
- Square wave generators: 555 Timer, Crystal controlled Oscillator
- Ramp Generator: Triangle generator, Sawtooth generator
- Function Generators: Multi op-amp function generators, IC function generators
- Digitally controlled frequency synthesizer: PLL Fundamentals, PLL synthesizer, Totally digital synthesizer.

**Unit 3: Active Filters:**
- Introduction to filtering: Frequency response, Characteristics and terminology, Active versus passive filters
- Low pass filter: First order low pass active filter, second order active filter model, second order low pass filter characteristics, Sallen-Key unity gain filter, Sallen-Key equal component filter, Higher order filters.
- High pass active filter.
- Band pass filter: single op-amp band pass filter, multistage band pass filter
- State variable filter

**Unit 4: Non-linear Circuits:**
- Logarithmic Amplifiers, Log/Antilog Modules, Precision Rectifier, Peak Detector, Sample and Hold Circuits, OP-AMP as Comparator, Schmitt Trigger, Square and Triangular Wave Generator, Monostable Multivibrator
- IC Analog Multiplier applications
- OTA

**Unit 5: Voltage Regulators:**
- OP-AMP Regulators, IC Regulators, Fixed Voltage Regulators (78/79, XX), SMPS.

**Text Book:**

**Reference Book:**

Microprocessors and Applications (TEC-503)

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<tr>
<th>Unit</th>
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<td>1</td>
<td>1/2, 13, 14, 16</td>
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<td>2/2</td>
<td>10</td>
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**Unit 1: Introduction to Microprocessors:**

**Unit 2: 16-bit Microprocessors (8086/8088): Architecture, Physical address,
<table>
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<tr>
<th><strong>Unit</strong></th>
<th><strong>Topic</strong></th>
<th><strong>Text Book/Chapter</strong></th>
<th><strong>Lectures</strong></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to open loop and closed loop control systems, feedback characteristics of control systems, Mathematical Representation of physical systems Electrical, Mechanical, Hydraulic, Thermal systems, Block diagram algebra and signal flow graphs, Mason’s gain formula.</td>
<td>1/1, 1/2</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td><strong>Time Domain Analysis</strong>: Standard Test Signals, Time response of First, Second and Higher order systems, Performance Indices. <strong>Error Analysis</strong>: Static and Dynamic Error Coefficients, Effect of adding poles and zeroes to the system, response of P, PI, and PID controllers.</td>
<td>1/5</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td><strong>Concept of Stability</strong>: Concept of stability, Asymptotic and conditional stability, Routh Hurcoitz Criterion, Root Locus technique (Concept and construction) <strong>Frequency Response Analysis</strong>: Correlation between time and frequency response, polar and inverse polar plots, Nyquist stability criterion, Bode plots, All pass and minimum phase systems, M and N circle.</td>
<td>1/6, 1/7, 1/8</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td><strong>Design through compensation techniques</strong>: Realization of lag, lead and lag-lead compensators, Design of closed loop control system using root locus and Bode plot Compensation</td>
<td>1/10</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td><strong>Stable Variable Analysis</strong>: Introduction, State space representation, State modes of linear systems, State equations, transfer matrices, diagonalization solution of state equations, controllability and observability, effect of pole zero cancellation in transfer function.</td>
<td>1/12, 1/14</td>
<td>9</td>
</tr>
</tbody>
</table>
Advances in Control Systems: Basic Introduction to Neural Networks and Fuzzy logic control.

Text Books:
1. I J Nagrath & M Gopal, Control System Engineering; New Age International publishers.

Reference Books:
1. B C Kuo, Automatic Control Systems; PHI
2. Norman S Nise, Control System Engineering; John Wiley & Sons, Singapore
3. Dr D Ganesh Rao, Control System; Sanguine Technical Publisher, Bangalore
4. K Ogata, Modern Control Engineering; PHI.

Antenna and Wave Propagation (TEC-505)

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<tr>
<th>Unit</th>
<th>Topic</th>
<th>Text Book/Chapter</th>
<th>Lectures</th>
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<tbody>
<tr>
<td></td>
<td>Network Theorems Directional Properties of Dipole Antenna.</td>
<td>1/11 1</td>
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<td></td>
<td>Antenna Gain, Effective Area, Antenna Terminal Impedance, Practical Antennas and Methods of Excitation, Antenna Temperature and Signal to Noise Ratio.</td>
<td>1/11 4</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Antennas Arrays: Two Element Array, Horizontal Patterns in Broadcast Arrays, Linear Arrays, Multiplication of patterns, effect of the earth on vertical patterns, Binomial array.</td>
<td>1/11 6</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Wave Propagation: Modes of Propagation, Plane Earth Reflection, Space wave and Surface Wave, Refection and refraction waves by the Ionosphere Tropospheric Wave.</td>
<td>1/16 3</td>
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<td></td>
<td>Ionosphere Wave Propagation in the Ionosphere, Virtual Height, MUF Critical frequency, Skip Distance, Duct Propagation, Space wave</td>
<td>1/17 4</td>
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<tr>
<td>5.</td>
<td>Antenna Measurements: Radiation Pattern measurement, Distance requirement for uniform phase, uniform field amplitude requirement, Introduction to phase measurement; Gain Measurement: Comparison method, Near field method, Introduction to current distribution measurement, Measurement of antenna efficiency, measurement of Noise figure and noise temperature of an antenna polarization measurement.</td>
<td>2/18 9</td>
<td></td>
</tr>
</tbody>
</table>

Text Books:

Reference Books:
5. Roy, Sitesh Kumar & Mitra, Monojit / "Microwave Semiconductor Devices" / Prentice Hall (India).

Communication Lab-I (TEC-551)
1. To study Amplitude modulation using a transistor and determine depth of modulation.
2. To study envelope detector for demodulation of AM signal and observe diagonal peak clipping effect.
3. To study frequency modulation using reactance modulator.
4. Study of frequency modulation using varactor modulator.
6. Study of Foster- Seely discriminator.
9. Study of phase lock loop and detection of FM signal using PLL.
11. Study of superheterodyne AM receiver and measurement of sensitivity, selectivity & fidelity.
12. Study and demonstration of active filter (low pass, high pass, and band pass type).

Analog Integrated Circuits Lab (TEC-552)

1. Measurement of Op-amp Parameters. (Open Loop Gain, Input offset Voltage, CMRR, Slew rate)
3. Precision Rectifier
4. Instrumentation Amplifier.
7. IC Voltage Regulator.
8. Voltage Controlled Oscillator.
9. Phase Locked Loop.
10. Frequency Multiplier
12. Second Order Active Filter- High Pass & Low Pass Realization

Microprocessor Lab (TEC-553)

8085/8086 Based Experiments
1. Signed Multiplication using Booth's Algorithm.
2. Recursive routine for finding Factorial N.
3. Look up table method for finding the ASCII of an alphanumeric code.
4. Interfacing with 8255 in I/O mode/BSR mode.
5. Interfacing with 8253.
6. Verification of Interrupts.
7. Interfacing with ADC/DAC.
8. Mini Project on some interfacing applications.
9. Serial communication between two kits through RS-232C using 8251.
Note: In addition, Institutes may include two more experiments based on the expertise

Control System Lab (TEC-554)

1. To use D.C. potentiometers as an error detectors.
2. To verify characteristics of (a) self excited magnetic amplifiers, (b) Self excited magnetic amplifier with (i) Positive feedback (ii) Negative feedback.
3. To draw characteristics of (a) Series connected (b) Parallel connected magnetic amplifier.
4. To draw characteristics of synchro torque transmitters. Also draw the characteristics error detector using of two synchros.
5. To study speed control of universal motor using SCR and stroboscope
6. Speed control of AC motor using TRAIC.

**YEAR III, SEMESTER-VI**

**Industrial Management (TAS-601)**

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<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Lectures</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>What is Operations Research? OR-research model, solving the OR model, Queuing and simulation models, Art of modeling, Phases of OR study.</td>
<td>2</td>
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<tr>
<td>2</td>
<td><strong>Introduction to Linear Programming:</strong> Two variable L-P model, Graphical LP solution, Analysis of selected LP models.</td>
<td>3</td>
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<td></td>
<td><strong>The Simplex Method:</strong> LP solution space, Graphical to algebraic solution, The simplex method, Artificial starting solution, Special cases in simplex method applications.</td>
<td>4</td>
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<td></td>
<td><strong>Transportation Model and its Variants:</strong> Definition of transportation model, Non-traditional transportation models, Transportation algorithms, Assignment model</td>
<td>4</td>
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<td>3</td>
<td><strong>Network Models:</strong> Network definitions, Minimal spanning tree algorithm, CPM and PERT.</td>
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<td></td>
<td><strong>Game Theory:</strong> Optimal solution of two persons zero sum games, Solution of mixed strategy games.</td>
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<tr>
<td>4</td>
<td>Introduction to Patents and Intellectual Property Right</td>
<td>3</td>
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<td></td>
<td>Notes Supplied by UPTU</td>
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<td>5</td>
<td><strong>Introduction to Engineering Management:</strong> Engineering and Management Historical Development of Engineering Management</td>
<td>3</td>
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<td></td>
<td><strong>Functions of Technology Management</strong> Planning and Forecasting Decision Making Organizing Motivating and Leading Technical People Controlling</td>
<td>6</td>
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<td></td>
<td><strong>Project Management</strong> Project Planning and Acquisition Project Organization, Leadership, and Control</td>
<td>4</td>
</tr>
</tbody>
</table>

Text Books:
2. Babcock & Morse, Managing Engineering and Technology; Pearson Education, 2004

Reference Books:
1. Hillier & Hillier, Introduction to Management Science; TMH Ed 05

Digital Communication (TEC-601)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Text Book/ Chapter</th>
<th>Lectures</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Elements of Digital Communication and Information Theory</strong></td>
<td>1/9</td>
<td>5</td>
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<td></td>
<td>Model of a Digital Communication, System, Probability Theory</td>
<td>1/9</td>
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<td></td>
<td>and Random Variables, Logarithmic Measure of Information, Entropy</td>
<td>1/9</td>
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<td></td>
<td>and Information Rate, Conditional Entropy and Redundancy, Source Code</td>
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<td></td>
<td>Words, Source Coding Theorem, Prefix Doing and Kraft Inequality,</td>
<td>1/9</td>
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<tr>
<td></td>
<td>Shannon-Fanno and Huffman Coding.</td>
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<td>2</td>
<td><strong>Digital Base band Transmission</strong></td>
<td>1/4</td>
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<td></td>
<td>PCM Coding, DM, DPCM, ADCM, Data Transfer Rate, Line Coding and Its</td>
<td>1/4</td>
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<tr>
<td></td>
<td>Properties, NRZ &amp; RZ Types, Signalling Format For Unipolar, Polar,</td>
<td>1/5</td>
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<td></td>
<td>Bipolar(AMI) &amp; Manchester Coding and Their Power Spectra (No Derivation)</td>
<td>1/4</td>
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<td></td>
<td>Matched Filter Reciever, Derivation of Its Impulse Response and Peak</td>
<td>1/4</td>
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<td>Pulse Signal to Noise Ratio.</td>
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<td>Correlation Detector Decision Threshold and Error Probability For</td>
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<td></td>
<td>Binary, Unipolar(ON-OFF) Signalling, ISI, Nyquist Criterion For Zero</td>
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<td>ISI &amp; Raised Cosine Spectrum.</td>
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<td>3 &amp; 4</td>
<td><strong>Digital Modulation Techniques</strong></td>
<td>1/6</td>
<td>11</td>
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<td></td>
<td>Gram-Schmidt Orthogonalization Procedure, Types of Digital Modulation</td>
<td>1/3</td>
<td>3</td>
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<td></td>
<td>Wave forms for Amplitude, Frequency and Phase Shift Keying, Method of</td>
<td>1/3</td>
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<td>Generation and Detection of Coherent &amp; Non-Coherent Binary ASK, FSK</td>
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<td></td>
<td>&amp; PSK Differential Phase Shift Keying, Quadrature Modulation Techniques</td>
<td>1/3</td>
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<td></td>
<td>QPSK, Probability of Error and Comparison of Various Digital Modulation</td>
<td>1/3</td>
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<td></td>
<td>Techniques.</td>
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<td>5</td>
<td><strong>Digital Multiplexing</strong></td>
<td>1/10</td>
<td>9</td>
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<tr>
<td></td>
<td>Fundamentals of Time Division Multiplexing, Electronic Commutator, Bit</td>
<td>1/10</td>
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<td>Byte Interleaving T1 Carrier System, Synchronization and Signaling of</td>
<td>1/10</td>
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<td></td>
<td>T1, TDM, PCM Hierarchy, T1 to T4 PCM TDM System (DS1 to DS4 Signals)</td>
<td>1/10</td>
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Text Book:

References Books:
Digital Signal Processing (TEC-602)

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<th>Unit</th>
<th>Topic</th>
<th>Text Book/Chapter</th>
<th>Lectures</th>
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<tbody>
<tr>
<td>2.</td>
<td>Efficient Computation of DFT Efficient Computation of the DFT: FFT Algorithms, Direct Computation of the DFT. Radix-2 FFT algorithms. Efficient computation of the DFT of two real sequences, computations, Efficient computation of the DFT of a 2N-Point real sequences, Gortezel Algorithm, Chirp Z-transform algorithm.</td>
<td>1/6 10</td>
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<tr>
<td>3.</td>
<td>Basic IIR Filter Structures: Direct forms (I &amp; II), cascade and parallel realizations. Signal flow graph, Transposed structure, Basic FIR filter structures-. Direct form structure, frequency sampling structure, Lattice structure, Linear phase FIR structure . FIR structures.</td>
<td>1/7 08</td>
<td></td>
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<tr>
<td>4.</td>
<td>Symmetric and Anti-symmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windows, Design of Linear-Phase FIR Filters by the Frequency Sampling Method, Design of FIR, Equiripple filter design Differentiators. Design of Hilbert Transformers.</td>
<td>1/8 08</td>
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Text Books:

Reference Books:

VLSI Technology and Design (TEC-603)

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<td>Unit</td>
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</tbody>
</table>
| 1.   | **1. Era of Integrated Circuit:** Introduction to Monolithic Integrated Circuit Technology, Bipolar & MOS IC, Film IC  
      **2. Crystal Growth:** Silicon wafer Preparation & characterization, Oxidation: Thermal oxidation, Oxide thickness measurement, Oxidation system. | 1 | 2 |
|      | **Diffusion** of dopants: Diffusion Eqns. Dopant profiles, sheet resistance, diffusion furnace, liquid and gaseous dopants, **Ion Implantation:** Ion implantation techniques, dopant profiles, apparatus used, **Epitaxy:** Epitaxial growth of Si, apparatus for epitaxy, Photolithography techniques for pattern transfer, Mask making, photo resist & **Etching** techniques.  
      **Film Deposition:** Vacuum deposition & Sputtering apparatus, CVD Processes and its applications in IC Lab, **Metallization** | 1 | 8 |
      **2. CMOS Basic Circuits:** MOS Inverters, static & dynamic characteristics, NAND, NOR, AOI Circuits, Design Considerations, Layout Design, Micron & Submicron technologies, parasitic effects, Physical limitations, Concepts of SPICE for Circuit simulation. | 2 | 6 |
| 3.   | **Standard Digital ICs:** Combinational and Sequential MOS Logic Circuits, Design of standard Cells for LSI, VLSI Circuits, Computer-Aided Design Technology, Semiconductor Memories: DRAM, SRAM, Flash | 3 | 7 |
| 4.   | **Programmable Logic Devices:** PLA, PAL, PLD/CPLD, FPGA/FPGA, ASIC, VLSI Testing. | 3 | 7 |
| 5.   | **Text Books:**  
      2. Basic VLSI Design by D.A. Pucknell & Eshraghian (PHI)  
      3. Modern VLSI Design Systems on Silicon by Wayne Wolf (Pearson Pub.)  
      **References**  
      2. Modern VLSI Design Systems on Silicon by Wayne Wolf (Pearson Pub.)  
      4. Introduction to Digital Microelectronics Circuits by K. Gopalan (TMH)  
      6. Microelectronics by Milman & Grabel (Mc Graw-Hill) | | |

**Microwave & Radar Engineering (TEC-604)**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Text Book/ Chapter</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Propagation through waveguides: Rectangular waveguide, solution of wave equation in rectangular co-ordinates, Derivation of field equations for TE &amp; TM modes degenerate and dominant mode, Power Transmission and Power loss, Excitation of waveguides, non existence of TEM mode in waveguides, Introduction to circular Waveguides, Stripline and microstripline.</td>
<td>¾, 11/11</td>
</tr>
</tbody>
</table>
2. Microwave cavity resonators:
   Rectangular and cylindrical cavities, Quality factor, Excitation of
cavities.
Microwave components:
Waveguide couplings, bends and twists, Transitions, Directional
couplers, hybrid couplers, Matched load, Attenuators and phase
shifters, E-plane, H-plane and Hybrid Tees, Hybrid ring,
Waveguide discontinuities, Windows, Iris and Tuning screws,
Detectors, wave meters; Isolators and Circulators, tunable detector,
slotted line carriage, VSWR meter. Scattering Matrix.

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<td>1/4</td>
<td>2/6</td>
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3. Microwave Measurements:
   Measurement of frequency, Wave length, VSWR, Impedance,
   Attenuation, Low and high power. Radiation pattern.

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4. Limitation, of conventional active devices at Microwave
   frequency.

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<td>1/9</td>
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5. Microwave Tubes : Klystron, Reflex Klystron, Magnetron, TWT,
   BWO: Their schematic, Principle of operation, performance
   characteristics and application.

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<td>1/10</td>
<td>6</td>
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6. Microwave Semiconductor Devices:
   PIN diode, Tunnel diode, LSA diode, varactor diode, Gunn
   Devices, IMPATT and TRAPATT, their Principal of operation,
   characteristics and applications.

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<td>1/5, 1/7, 1/8</td>
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7. Principles of Radar:
   Radar Block diagram operation, Radar Range equation, Radar
   Frequencies, Pulse and C.W. Radar, Introduction to Doppler and
   M.T. Radar. Applications.

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<td>1/1, 1/2, 1/3</td>
<td>6</td>
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8. Radar Transmitters & Devices:
   Block diagram of radar receiver for C.W. and pulse radar, front end
   amplifier, Receiver noise figure, Duplexers Radar antennas, Radar
   Displays, Introduction to Radar clutter.

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<td>1/10, 1/11, 1/7</td>
<td>8</td>
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</tbody>
</table>

**Text Book:**
1. Liao, S.Y. / Microwave Devices & Circuits; PHI 3rd Ed.
2. M.I. Skolnik, Introduction to Radar Engineering; THM

**Reference:**
1. Collin, R.E. Foundations for Microwave Engineering; TMH 2nd Ed.
2. Rizzi, Microwave Engineering: Passive Circuits; PHI.
3. A Das and S.K. Das, Microwave Engineering; TMH.

**Communication Lab-II (TEC-651)**

1. Study of Sample and hold circuit using Op-amp- ST2101
2. Study of PAM generation and detector and observe characteristics of both single and dual polarity
   pulse amplitude modulation.
3. Study of pulse width modulation and demodulation.
4. Study of pulse position modulation demodulation.
5. Study of delta modulation and demodulation and observe effect of slope overload DCL-07.
8. Study of amplitude shift keying modulator and demodulator.
9. Study of frequency shift keying modulator and demodulator.
10. Study of phase shift keying modulator and demodulator ST-467
12. Study of Pulse code modulation and demodulation.
Digital Signal Processing Lab (TEC-652)

1. Sampling & Waveform Generation.
2. Quantization
3. PCM Encoding
4. Delta Modulation
5. Digital Modulation Schemes (ASK, PSK, FSK)
6. Error Correcting Codes
7. DFT Computation.
9. FIR Filter implementation.
10. IIR Filter implementation.
11. DSP Processor Implementation
12. Computational Experiments with Digital Filters

Electronics CAD Lab (TEC-653)

1. Design, Simulation and Analysis of following circuits using Circuit simulator:
   a. Pushpull Amplifier.
   b. Differential Amplifier
   c. NMOS and CMOS inverter
   d. Two input NAND Gate
   e. Two input NOR Gate
2. Layout Design of NMOS and CMOS Inverter using Layout Generator
3. Layout Design of Two Input NAND Gate
4. Simulation of Full Adder using HDL
5. Chip Design using VHDL (Mini Project).

Microwave Engineering Lab (TEC-654)

1. Measurement of guide wavelength and frequency of the signal in a rectangular waveguide.
3. Study of mode characteristics of reflex Klystron and determination of mode number, transit time & electronic tuning sensitivity.
4. Study of characteristics of Gunn oscillator.
5. Study of Gunn diode as modulated source (PIN modulation) and determination of modulation depth.
7. Study of insulation & coupling coefficient of a magic T.
8. Measurement of attenuation using substitution method and plot of attenuation versus frequency characteristics.
9. Study of waveguide horn and its radiation pattern and determination of the beam width.
10. Study of a ferrite circulator and measurement of isolation, insertion loss, cross coupling and input VSWR.
11. Measurement of microwave power using power meter
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Syllabus of 3\textsuperscript{rd}yr. (V & VI Semester)

1. Electronics & Communication Engineering
2. Electronics Engineering
3. Electronics & Telecommunication Engineering

B.TECH. COURSES
This a course covering fundamental underpinnings of Analog circuit design. Course material pdf at: https://chic.caltech.edu/links/.

Integrated circuit biasing, current mirrors, headroom. Ali Hajimiri. Ali Hajimiri. Analog integrated circuit design / Tony Chan Carusone, David A. Johns, Kenneth W. Martin. â€œ2nd ed. p. cm. Includes index.Å. Also, as integrated circuits integrate more functionality, it is much more likely that at least some portion of a modern integrated circuit will include analog circuitry to interface to the real world. Moreover, the continued scaling of digital circuits has led to the emergence of new problems that require analog solutions, such as on-chip power management and the generation of stable clock signals. Although it may constitute only a small portion of total chip area, analog circuitry is often the limiting factor on overall system performance and the most difficult part of the IC to design. As Analog Integrated Circuit Design ET4252. DC sources and references Translinear Circuits. edited by: Wouter A. Serdijn Delft University of Technology, Faculty of Information Technology and Systems, Electronics Research Laboratory, Mekelweg 4, 2628 CD Delft, the Netherlands, phone: +31-15-2781715, fax: +31-15-2785922, email: W.A.Serdijn@tudelft.nl. November 3, 2008. 2 W.A. Serdijn: â€œAnalog Integrated Circuit Designâ€. Contents. 1 Integrable DC sources and references.