# Syllabus of
# UNDERGRADUATE DEGREE COURSE

# **Electronics & Communication Engineering**


## Rajasthan Technical University, Kota

Effective from session: 2018 – 2019

## 4EC2-01: Advance Engineering Mathematics-II

**Credit: 3** **Max. Marks: 150(IA:30, ETE:120)**

**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 1 |
| 2 | **Complex Variable – Differentiation:** Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties. | 7 |
| 3 | **Complex Variable - Integration:** Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof). | 8 |
| 4 | **Applications of complex integration by residues:** Evaluation of definite integral involving sine and cosine. Evaluation of certain improper integrals. | 4 |
| 5 | **Special Functions:** Legendre's function, Rodrigues formula, generating function, Simple recurrence relations, orthogonal property.<br>Bessel's functions of first and second kind, generating function, simple recurrence relations, orthogonal property. | 10 |
| 6 | **Linear Algebra:** Vector Spaces, subspaces, Linear independence, basis and dimension, Inner product spaces, Orthogonality, Gram Schmidt orthogonalization, characteristic polynomial, minimal polynomial, positive definite matrices and canonical forms, QR decomposition. | 10 |
| | **Total** | 40 |

## 4EC1-03/3EC1-03: Managerial Economics And Financial Accounting

**2 Credit** **Max. Marks: 100 (IA:20, ETE:80)**
**2L:0T:0P** **End Term Exam: 2 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 1 |
| 2 | **Basic economic concepts:** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement. | 3 |
| 3 | **Demand and Supply analysis:** Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply. | 5 |
| 4 | **Production and Cost analysis:** Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation. | 5 |
| 5 | **Market structure and pricing theory:** Perfect competition, Monopoly, Monopolistic competition, Oligopoly. | 4 |
| 6 | **Financial statement analysis:** Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques. | 8 |
| | **Total** | 26 |

## 4EC1-02/3EC1-02: Technical Communication

**2 Credit** **Max. Marks: 100 (IA:20, ETE:80)**
**2L:0T:0P** **End Term Exam: 2 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 1 |
| 2 | **Introduction to Technical Communication-** Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication. | 3 |
| 3 | **Comprehension of Technical Materials/Texts and Information Design & development-** Reading of technical texts, Readingand comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media. | 6 |
| 4 | **Technical Writing, Grammar and Editing-** Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings. | 8 |
| 5 | **Advanced Technical Writing**- Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles. | 8 |
| | **Total** | 26 |

## 4EC4-04: Analog Circuits

**Credit: 3** **Max. Marks: 150(IA:30, ETE:120)**

**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 1 |
| 2 | Diode Circuits, Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers. | 8 |
| 3 | High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin. | 8 |
| 4 | Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation. | 8 |
| 5 | OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines. | 8 |
| 6 | Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog to digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc. | 7 |
| | **Total** | 40 |

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**Course Outcome:**

| Course Code | Course Name | Course Outcome | Details |
|---|---|---|---|
| 4EC4-04 | Analog Circuits | CO 1 | Understand the characteristics of diodes and transistors |
| | | CO 2 | Design and analyze various rectifier and amplifier circuits |
| | | CO 3 | Design sinusoidal and non-sinusoidal oscillators |
| | | CO 4 | Understand the functioning of OP-AMP and design OP-AMP based circuits |
| | | CO 5 | Understanding the designing of ADCs and DACs |

**CO-PO Mapping:**

| Subject | Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EC4-04 Analog Circuits | CO 1 | 3 | | 1 | 1 | 2 | | | | | | | |
| | CO 2 | 1 | 1 | 2 | | 1 | | | | | | | |
| | CO 3 | 3 | 1 | | 1 | | | | | | | | |
| | CO 4 | 2 | | | | 2 | | | | | | | |
| | CO 5 | 2 | 3 | | 2 | | | | | | | | |

**3: Strongly** **2: Moderate** **1: Weak**

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**Lecture Plan:**

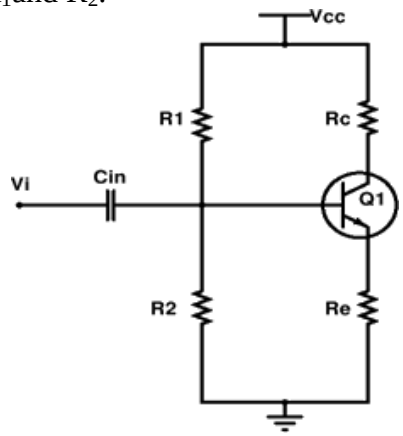
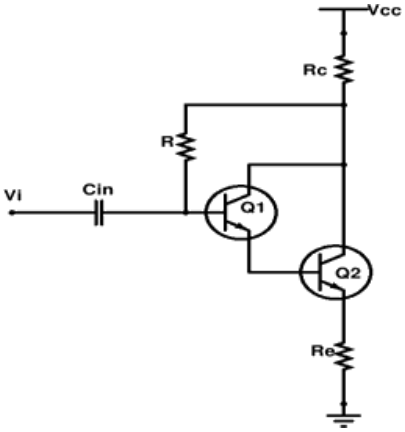
| Lecture No. | Content to be taught |
|---|---|
| Lecture 1 | Zero Lecture |
| Lecture 2 | Diode Circuits and Amplifier models |
| Lecture 3 | Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier |
| Lecture 4 | Biasing schemes for BJT and FET amplifiers |
| Lecture 5 | Bias stability in various configurations such as CE/CS, CB/CG, CC/CD |
| Lecture 6 | Small signal analysis of BJT and FET |
| Lecture 7 | low frequency transistor models |
| Lecture 8 | Estimation of voltage gain, input resistance, output resistance etc. |
| Lecture 9 | Design procedure for particular specifications, low frequency analysis of multistage amplifiers. |
| Lecture 10 | High frequency transistor models |
| Lecture 11 | frequency response of single stage and multistage amplifiers |
| Lecture 12 | Cascode Amplifier |
| Lecture 13 | Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues |
| Lecture 14 | Feedback topologies: Voltage series, current series, voltage shunt, current shunt |
| Lecture 15 | Effect of feedback on gain, bandwidth etc., |
| Lecture 16 | Calculation with practical circuits |
| Lecture 17 | Concept of stability, gain margin and phase margin. |
| Lecture 18 | Basics of oscillator |
| Lecture 19 | Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.) |

| | |
|---|---|
| Lecture 20 | LC oscillators (Hartley, Colpitt, Clapp etc.) |
| Lecture 21 | Non-sinusoidal oscillators. Current mirror: Basic topology and its variants, |
| Lecture 22 | V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. |
| Lecture 23 | Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. |
| Lecture 24 | OP-AMP design: design of differential amplifier for a given specification |
| Lecture 25 | Design of gain stages and output stages, compensation |
| Lecture 26 | OP-AMP applications: review of inverting and non-inverting amplifiers |
| Lecture 27 | Integrator and differentiator, summing amplifier |
| Lecture 28 | Precision rectifier, Schmitt trigger and its applications |
| Lecture 29 | Active filters: Low pass, high pass |
| Lecture 30 | Band pass and band stop Filters |
| Lecture 31 | Filter Design guidelines |
| Lecture 32 | Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc |
| Lecture 33 | Analog to digital converters (ADC): Single slope, dual slope |
| Lecture 34 | successive approximation, flash TYPE ADC |
| Lecture 35 | Switched capacitor circuits: Basic concept |
| Lecture 36 | Switched capacitor circuits: practical configurations |
| Lecture 37 | Switched capacitor circuits: applications |
| Lecture 38 | Spill over classes |
| Lecture 39 | Spill over classes |
| Lecture 40 | Spill over classes |

**Content delivery method:**

1. Chalk and Duster
2. PPT
3. Hand-outs

**Sample assignments:**

| | |
|---|---|
| **Assignment 1** | **Q1.** Assume that a silicon transistor with β =50, $V_{BEactive}$=0.7 V, $V_{CC}$ =15V and $R_C$=10K is used in the Fig.1.It is desired to establish a Q-point at $V_{CE}$=7.5 V and $I_C$=5mA and stability factor S≤5.Find Re,$R_1$and $R_2$.   |
| | **Q2.** In the Darlington stage shown in Fig.2 , $V_{CC}$=15V , $\beta_1$=50, $\beta_2$=75,$V_{BE}$=0.7,$R_C$=750 Ω and $R_E$=100 Ω. If at the quiescent point $V_{CE2}$=6V determine the value of R.   |
| | **Q3.** For the amplifier shown in Fig.3 using a transistor whose parameters are $h_{ie}$=1100,$h_{re}$=2.5×10$^{-4}$,$h_{fe}$=50,$h_{oe}$=24μA/V.Find $A_I$, $A_V$, $A_{VS}$ and $R_i$. |

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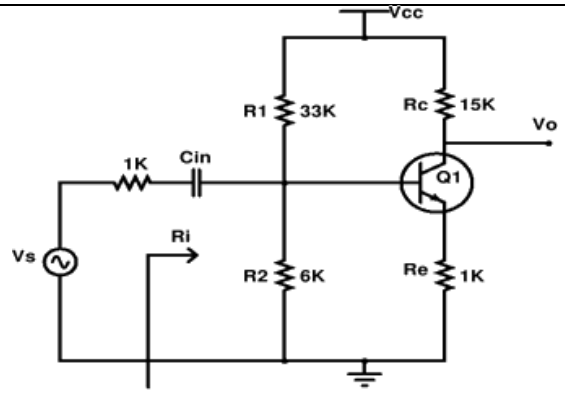
| | |
|---|---|
| |  |
| **Assignment 2** | **Q1.** Discuss the applications of operational amplifier. |
| | **Q2.** Discuss different types of filters. |
| | **Q3.** Discuss Dual counter type DAC and its applications |

## 4EC4-05: Microcontrollers

**Credit: 3** **Max. Marks: 150(IA:30, ETE:120)**

**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 1 |
| 2 | Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access, instruction sets of microprocessors (with examples of 8085 and 8086); | 10 |
| 3 | Interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters; Arithmetic Coprocessors; System level interfacing design; | 8 |
| 4 | Concepts of virtual memory, Cache memory, Advanced coprocessor Architectures- 286, 486,<br>Pentium; Microcontrollers: 8051 systems, | 10 |
| 5 | Introduction to RISC processors; ARM microcontrollers interface designs. | 11 |
| | **Total** | 40 |

**Course Outcome:**

| Course Code | Course Name | Course Outcome | Details |
|---|---|---|---|
| 4EC4-05 | Microcontrollers | CO 1 | Develop assembly language programming skills. |
| | | CO 2 | Able to build interfacing of peripherals like, I/O, A/D, D/A, timer etc. |
| | | CO 3 | Develop systems using different microcontrollers. |
| | | CO 4 | Explain the concept of memory organization. |
| | | CO 5 | Understand RSIC processors and design ARM microcontroller based systems. |

**CO-PO Mapping:**

| Subject | Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EC04-05Microcontrollers | CO 1 | | | 3 | 1 | | | | | | | | |
| | CO 2 | | | 3 | | 1 | | | | | | | |
| | CO 3 | 1 | 2 | 3 | | | | | | | | | |
| | CO 4 | 3 | 2 | 1 | | | | | | | | | |
| | CO 5 | | | 3 | 2 | 1 | | | | | | | |

**3: Strongly 2: Moderate 1: Weak**

**Lecture Plan:**

| Lecture No. | Content to be taught |
|---|---|
| Lecture 1 | Zero Lecture |
| Lecture 2 | Overview of microcomputer systems and their building blocks |
| Lecture 3 | Overview of microcomputer systems and their building blocks |
| Lecture 4 | Memory interfacing |
| Lecture 5 | Memory interfacing |
| Lecture 6 | Concepts of interrupts |

| | |
|---|---|
| Lecture 7 | Direct Memory Access |
| Lecture 8 | Direct Memory Access |
| Lecture 9 | Instruction sets of microprocessors (with examples of 8085 and 8086) |
| Lecture 10 | Instruction sets of microprocessors (with examples of 8085 and 8086) |
| Lecture 11 | Instruction sets of microprocessors (with examples of 8085 and 8086) |
| Lecture 12 | Instruction sets of microprocessors (with examples of 8085 and 8086) |
| Lecture 13 | Interfacing with peripherals |
| Lecture 14 | Timer |
| Lecture 15 | Serial I/O |
| Lecture 16 | Parallel I/O |
| Lecture 17 | A/D and D/A converters; |
| Lecture 18 | A/D and D/A converters |
| Lecture 19 | Arithmetic Coprocessors |
| Lecture 20 | System level interfacing design |
| Lecture 21 | Concepts of virtual memory, Cache memory |
| Lecture 22 | Concepts of virtual memory, Cache memory |
| Lecture 23 | Advanced coprocessor Architectures- 286, 486, Pentium |
| Lecture 24 | Advanced coprocessor Architectures- 286, 486, Pentium |
| Lecture 25 | Advanced coprocessor Architectures- 286, 486, Pentium |
| Lecture 26 | Microcontrollers: 8051 systems, |
| Lecture 27 | Microcontrollers: 8051 systems, |
| Lecture 28 | Microcontrollers: 8051 systems, |
| Lecture 29 | Microcontrollers: 8051 systems, |
| Lecture 30 | Microcontrollers: 8051 systems, |
| Lecture 31 | Introduction to RISC processors |
| Lecture 32 | Introduction to RISC processors |
| Lecture 33 | Introduction to RISC processors |
| Lecture 34 | ARM microcontrollers interface designs |
| Lecture 35 | ARM microcontrollers interface designs |
| Lecture 36 | ARM microcontrollers interface designs |
| Lecture 37 | ARM microcontrollers interface designs |
| Lecture 38 | ARM microcontrollers interface designs |
| Lecture 39 | Spill Over Classes |
| Lecture 40 | Spill Over Classes |

**Content delivery method:**

1. Chalk and Duster
2. PPT
3. Hand-outs

**Assignments:**

| | |
|---|---|
| **Assignment 1** | **Q1.** Compare between microprocessor & microcontroller based on no. of instructions used, registers, memory and applications. |
| | **Q2.** Interface external program memory with 8051 & explain how the data is transfer. |
| | **Q3.** List the I/O ports of microcontroller 8051. Explain their alternative function? |
| **Assignment 2** | **Q1.** Explain RISC and CISC? |
| | **Q2.** Without using MUL instruction, perform multiplication operation on any two operands, with both of them being:<br>a. Positive numbers<br>b. One positive and other negative number<br>c. Both negative numbers<br>Verify the values computed. |
| | **Q3.** Can you brief up the evolution of ARM architecture? |

## 4EC3-06: Electronics Measurement & Instrumentation

**Credit: 3** **Max. Marks: 150(IA:30, ETE:120)**

**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 1 |
| 2 | **THEORY OF ERRORS** - Accuracy & precision, Repeatability, Limits of errors, Systematic & random errors, Modeling of errors, Probable error & standard deviation, Gaussian error analysis, Combination of errors. | 8 |
| 3 | **ELECTRONIC INSTRUMENTS** - Electronic Voltmeter, Electronic Multimeters, Digital Voltmeter, and Component Measuring Instruments: Q meter, Vector Impedance meter, RF Power & Voltage Measurements, Introduction to shielding & grounding. | 8 |
| 4 | **OSCILLOSCOPES** – CRT Construction, Basic CRO circuits, CRO Probes, Techniques of Measurement of frequency, Phase Angle and Time Delay, Multibeam, multi trace, storage & sampling Oscilloscopes. | 7 |
| 5 | **SIGNAL GENERATION AND SIGNAL ANALYSIS** - Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators. Signal Analysis - Measurement Technique, Wave Analyzers, and Frequency - selective wave analyser, Heterodyne wave analyser, Harmonic distortion analyser, and Spectrum analyser. | 8 |
| 6 | **TRANSDUCERS** - Classification, Selection Criteria, Characteristics, Construction, Working Principles and Application of following Transducers:- RTD, Thermocouples, Thermistors, LVDT, Strain Gauges, Bourdon Tubes, Seismic Accelerometers, Tachogenerators, Load Cell, Piezoelectric Transducers, Ultrasonic Flow Meters. | 8 |
| | **Total** | 40 |

## Course Outcome:

| Course Code | Course Name | Course Outcome | Details |
|---|---|---|---|
| 4EC3-06 | ELECTRONIC MEASUREMENT & INSTRUMENTATION | CO 1 | **Describe** the use of various electrical/electronic instruments, their block diagram, applications, dnd principles of operation, standards eorrs and units of measurements. |
| | | CO 2 | **Develop** basic skills in the design of electronic equipments |
| | | CO 3 | **Analyse** different electrical/electronic parameters using state of equipments of measuring instruments which is require to all types of industries. |
| | | CO 4 | **Solve :**Identify electronics/ electrical instruments, understanding associated with the instruments |
| | | CO 5 | **Explain** use of transducers in different types of field applications |

## CO-PO Mapping:

| Subject | Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EC3-06 ELECTRONIC MEASUREMENT & INSTRUMENTATION | CO 1 | 3 | 2 | 1 | | | | | | | | | |
| | CO 2 | 2 | 2 | 2 | 3 | | | | | | | | |
| | CO 3 | 2 | 3 | | | | | | | | | | |
| | CO 4 | 2 | 1 | 1 | | | | 2 | | | | | |
| | CO 5 | 3 | 1 | | | | | | | | | | 2 |

**3: Strongly** **2: Moderate** **1: Weak**

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## Lecture Plan:

| Lecture No. | Content to be taught |
|---|---|
| Lecture 1 | Zero Lecture |
| Lecture 2 | Theory of errors |
| Lecture 3 | Accuracy & precision, Repeatability |
| Lecture 4 | Limits of Time-Hours errors |
| Lecture 5 | Systematic & random errors |
| Lecture 6 | Modeling of errors |
| Lecture 7 | Probable error |
| Lecture 8 | standard deviation |
| Lecture 9 | Gaussian error analysis |
| Lecture 10 | Combination of errors |
| Lecture 11 | Electronic instruments - Electronic Voltmeter |
| Lecture 12 | Electronic Multimeters |
| Lecture 13 | Digital Voltmeter |
| Lecture 14 | Component Measuring Instruments: Q meter |
| Lecture 15 | Vector Impedance meter |
| Lecture 16 | RF Power & Voltage Measurements |
| Lecture 17 | Introduction to shielding & grounding |
| Lecture 18 | Oscilloscopes - CRT Construction |
| Lecture 19 | Basic CRO circuits, CRO Probes |
| Lecture 20 | Techniques of Measurement of frequency, Phase Angle and Time Delay |
| Lecture 21 | Multibeam, multi trace, storage & sampling Oscilloscopes |
| Lecture 22 | Multibeam, multi trace, storage & sampling Oscilloscopes |
| Lecture 23 | Signal generation and signal analysis - Sine wave generators, |
| Lecture 24 | Frequency synthesized signal generators |
| Lecture 25 | Sweep frequency generators |
| Lecture 26 | Signal Analysis - Measurement Technique |
| Lecture 27 | Wave Analyzers, and Frequency - selective wave analyser |
| Lecture 28 | Heterodyne wave analyser |
| Lecture 29 | Harmonic distortion analyser |
| Lecture 30 | Spectrum analyser |
| Lecture 31 | Transducers – Classification |
| Lecture 32 | Selection Criteria Characteristics |
| Lecture 33 | Construction, Working Principles and Application of following Transducers:- RTD |

| | |
|---|---|
| Lecture 34 | Thermocouples |
| Lecture 35 | Thermistors |
| Lecture 36 | LVDT Strain Gauges, Bourdon Tubes |
| Lecture 37 | Seismic Accelerometers |
| Lecture 38 | Tachogenerators, Load Cell, |
| Lecture 39 | Piezoelectric Transducers |
| Lecture 40 | Ultrasonic Flow Meters |

## Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

## Sample assignments:

| | | |
|---|---|---|
| **Assignment 1** | **Q1.** | Write the principal of an AC Bridge used for the measurement of Unknown capacitor |
| | **Q2.** | Distinguish Between Accuracy and Precision? |
| | **Q3.** | Explain flow measurement with a suitable example. |
| **Assignment 2** | **Q1.** | What are primary sensing elements and transducers? |
| | **Q2.** | A Wheatstone Bridge requires to change of 7Ω in unknown arm of bridge to change in deflection of 14 mm. of galvanometer deter mine the sensitivity and deflection factor. |
| | **Q3.** | Explain the terms static error, static correction, relative error and percentage relative error. |

## 4EC4-07: Analog and Digital Communication

**Credit: 3** **Max. Marks: 150(IA:30, ETE:120)**
**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 1 |
| 2 | Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. | 8 |
| 3 | Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation. | 7 |
| 4 | Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers. | 8 |
| 5 | Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. | 8 |
| 6 | Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation. | 8 |
| | **Total** | 40 |

**Course Outcome:**

| Course Code | Course Name | Course Outcome | Details |
|---|---|---|---|
| 4EC4-07 | Analog and Digital Communication | CO 1 | Analyze and compare different analog modulation schemes for their efficiency and bandwidth |
| | | CO 2 | Analyze the behavior of a communication system in presence of noise |
| | | CO 3 | Investigate pulsed modulation system and analyze their system performance |
| | | CO 4 | Analyze different digital modulation schemes and can compute the bit error performance |
| | | CO 5 | Design a communication system comprised of both analog and digital modulation techniques |

**CO-PO Mapping:**

| Subject | Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EC4-07 Analog & Digital Communication | CO 1 | 3 | 3 | | 3 | | 1 | | | | 1 | | |
| | CO 2 | 3 | 2 | | 3 | | 1 | | | | | | |
| | CO 3 | 3 | 2 | | 3 | | 2 | | | | | | |
| | CO 4 | 3 | 3 | | 3 | | 2 | | | | 1 | | |
| | CO 5 | 3 | 2 | 3 | 3 | | 3 | | | 2 | 2 | | |

**3: Strongly 2: Moderate 1: Weak**

**Content delivery method:**

1. Chalk and Duster
2. PPT

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**Lecture Plan:**

| Lecture No. | Content to be taught |
|---|---|
| Lecture 1 | Introduction to the COURSE |
| Lecture 2 | Review of signals and systems, Frequency domain representation of signals |
| Lecture 3 | Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations |
| Lecture 4 | Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations |
| Lecture 5 | Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations |
| Lecture 6 | Angle Modulation, Representation of FM and PM signals |
| Lecture 7 | Angle Modulation, Representation of FM and PM signals |
| Lecture 8 | Spectral characteristics of angle modulated signals. |
| Lecture 9 | Review of probability and random process |
| Lecture 10 | Review of probability and random process |
| Lecture 11 | Noise in amplitude modulation systems |
| Lecture 12 | Noise in amplitude modulation systems |
| Lecture 13 | Noise in Frequency modulation systems |
| Lecture 14 | Pre-emphasis and Deemphasis |
| Lecture 15 | Threshold effect in angle modulation |
| Lecture 16 | Pulse modulation. Sampling |
| Lecture 17 | Pulse Amplitude and Pulse code modulation (PCM) |
| Lecture 18 | Pulse Amplitude and Pulse code modulation (PCM) |
| Lecture 19 | Differential pulse code modulation |
| Lecture 20 | Delta modulation |
| Lecture 21 | Noise considerations in PCM |

| | |
|---|---|
| Lecture 22 | Time Division multiplexing, Digital Multiplexers |
| Lecture 23 | Elements of Detection Theory |
| Lecture 24 | Optimum detection of signals in noise |
| Lecture 25 | Coherent communication with waveforms- Probability of Error evaluations |
| Lecture 26 | Coherent communication with waveforms- Probability of Error evaluations |
| Lecture 27 | Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion |
| Lecture 28 | Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion |
| Lecture 29 | Pass band Digital Modulation schemes |
| Lecture 30 | Phase Shift Keying |
| Lecture 31 | Frequency Shift Keying |
| Lecture 32 | Quadrature Amplitude Modulation |
| Lecture 33 | Continuous Phase Modulation and Minimum Shift Keying. |
| Lecture 34 | Digital Modulation tradeoffs |
| Lecture 35 | Optimum demodulation of digital signals over band-limited channels |
| Lecture 36 | Optimum demodulation of digital signals over band-limited channels |
| Lecture 37 | Maximum likelihood sequence detection (Viterbi receiver) |
| Lecture 38 | Equalization Techniques |
| Lecture 39 | Synchronization and Carrier Recovery for Digital modulation |
| Lecture 40 | Synchronization and Carrier Recovery for Digital modulation |

**Assignments:**

| | |
|---|---|
| **Assignment 1** | **Q1.** Design Modulator and Demodulator of SSB-SC Modulation based on its mathematical expression. |
| | **Q2.** Derive the figure of merit in<br>a) FM Receiver b) PM Receiver |
| | **Q3.** A Carrier signal c(t) = 20 cos ($2\pi 10^6$t) is modulated by a message signal having three frequencies 5 KHz, 10 KHz & 20 KHz. The corresponding modulation indexes are 0.4, 0.5 & 0.6. Sketch the spectrum. Calculate bandwidth, power and efficiency. |
| **Assignment 2** | **Q1.** Derive the expression for probability of error in ASK, FSK and PSK systems and compare them. |
| | **Q2.** With block diagrams explain about DPCM & DM. also compare them. |
| | **Q3.** A message signal m(t) = 4 cos ($2\pi 10^3$t) is sampled at nyquist rate and transmitted through a channel using 3-bit PCM system.<br>i. Calculate all the parameters of the PCM.<br>ii. If the sampled values are 3.8, 2.1, 0.5, -1.7, -3.2 & -4 then determine the quantizer output, encoder output andquantization error per each sample.<br>iii. Sketch the transfer characteristics of the quantizer. |

## 4EC4-21: Analog and Digital Communication Lab

**Credit: 1.5** **Max. Marks: 75(IA:45, ETE:30)**

**0L+0T+3P**

| **List of Experiments** | |
|---|---|
| **Sr. No.** | **Name of Experiment** |
| **1.** | Observe the Amplitude modulated wave form & measure modulation index and demodulation of AM signal. |
| **2.** | Harmonic analysis of Amplitude Modulated wave form. |
| **3.** | Generation & Demodulation of DSB – SC signal. |
| **4.** | Modulate a sinusoidal signal with high frequency carrier to obtain FM signal and demodulation of the FM signal. |
| **5.** | Verification of Sampling Theorem. |
| **6.** | To study & observe the operation of a super heterodyne receiver. |
| **7.** | PAM, PWM & PPM: Modulation and demodulation. |
| **8.** | To observe the transmission of four signals over a single channel using TDM-PAM method. |
| **9.** | To study the PCM modulation & demodulation and study the effect of channel like attenuation, noise in between modulator & demodulator through the experimental setup. |
| **10.** | To study the 4 channel PCM multiplexing & de-multiplexing in telephony system. |
| **11.** | To study the Delta & Adaptive delta modulation & demodulation and also study the effect of channel like attenuation, noise in between modulator & demodulator through the experimental setup. |
| **12.** | To perform the experiment of generation and study the various data formatting schemes (Unipolar, Bipolar, Manchester, AMI etc.) |
| **13.** | To perform the experiment of generation and detection of ASK, FSK, BPSK, DBPSK signals with variable length data pattern. |

**Course Outcome:**

| Course Code | Course Name | Course Outcome | Details |
|---|---|---|---|
| 4EC4-21 | Analog and Digital Communication Lab | CO 1 | Understand different analog modulation schemes and evaluate modulation index |
| | | CO 2 | Able to understand the principle of superhetrodyne receiver |
| | | CO 3 | Develop time division multiplexing concepts in real time applications |
| | | CO 4 | Develop and able to comprehend different data formatting schemes |
| | | CO 5 | Comprehend and analyze the concepts of different digital modulation techniques in communication. |

**CO-PO Mapping:**

| Subject | Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EC4-21 Analog and Digital Communication Lab | CO 1 | 3 | 2 | | 1 | | | | | | | | |
| | CO 2 | 3 | 2 | 1 | | | | | | | | | |
| | CO 3 | 3 | 3 | 2 | 2 | 1 | | | | | | | |
| | CO 4 | 3 | 3 | 2 | 2 | 1 | | | | | | | |
| | CO 5 | 3 | 3 | 2 | 2 | 1 | | | | | | | |

**3: Strongly** **2: Moderate** **1: Weak**

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## 4EC4-22: Analog Circuits Lab

**Credit: 1.5** **Max. Marks: 75(IA:45, ETE:30)**

**0L+0T+3P**

| **List of Experiments** | |
|---|---|
| **Sr. No.** | **Name of Experiment** |
| **1.** | Study and implementation of Voltage Series and Current Series Negative Feedback Amplifier. |
| **2.** | Study and implementation of Voltage Shunt and Current Shunt Negative Feedback Amplifier. |
| **3.** | Plot frequency response of BJT amplifier with and without feedback in the emitter circuit and calculate bandwidth, gain bandwidth product with and without negative feedback. |
| **4.** | Study and implementation of series and shunt voltage regulators and calculate line regulation and ripple factor. |
| **5.** | Plot and study the characteristics of small signal amplifier using FET. |
| **6.** | Study and implementation of push pull amplifier. Measure variation of output power & distortion with load and calculate the efficiency. |
| **7.** | Study and implementation of Wein bridge oscillator and observe the effect of variation in oscillator frequency. |
| **8.** | Study and implementation of transistor phase shift oscillator and observe the effect of variation in R & C on oscillator frequency and compare with theoretical value. |
| **9.** | Study and implementation of the following oscillators and observe the effect of variation of capacitance on oscillator frequency: (a) Hartley (b) Colpitts. |
| **10.** | Study and implementation of the Inverting And Non-Inverting Operational Amplifier. |
| **11.** | Study and implementation of Summing, Scaling And Averaging of Operational Amplifier |
| **12.** | Implementation of active filters using OPAMP. |

**Course Outcome:**

| Course Code | Course Name | Course Outcome | Details |
|---|---|---|---|
| 4EC4-22 | Analog Circuits Lab | CO 1 | Discuss and observe the operation of a bipolar junction transistor and field-effect transistor in different region of operations. |
| | | CO 2 | Analyze and design of transistor Amplifier and Oscillators. Importance of negative feedback. |
| | | CO 3 | Analyze the frequency response of amplifiers and operational amplifier circuits. Develop an intuition for analog circuit behavior in both linear and nonlinear operation. |
| | | CO 4 | Design op-amps for specific gain, speed, or switching performance. Compensate operational amplifiers for stability. |
| | | CO 5 | Design and conduct experiments, interpret and analyze data, and report results. |

**CO-PO Mapping:**

| Subject | Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EC4-22 Analog Circuits Lab | CO 1 | 3 | 2 | 1 | 2 | 2 | | | | | | | |
| | CO 2 | 2 | 3 | 1 | 2 | 3 | | | | | | | |
| | CO 3 | 1 | 3 | 2 | 3 | 2 | | | | | | | |
| | CO 4 | 1 | 2 | 3 | 2 | 3 | | | | | | | |
| | CO 5 | 1 | 2 | 3 | 3 | 3 | | | | | | | |

**3: Strongly** **2: Moderate** **1: Weak**

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

## 4EC4-23: Microcontrollers Lab

**Credit: 1.5** **Max. Marks: 75(IA:45, ETE:30)**

**0L+0T+3P**

| **List of Experiments** | |
|---|---|
| **Sr. No.** | **Name of Experiment** |
| **Following exercises has to be Performed on 8085** | |
| **1.** | Write a program for<br>1.1 Multiplication of two 8 bit numbers<br>1.2 Division of two 8 bit numbers |
| **2.** | Write a program to arrange a set of data in Ascending and Descending order. |
| **3.** | Write a program to find Factorial of a given number. |
| **4.** | Write a program to generate a Software Delay.<br>4.1 Using a Register<br>4.2 Using a Register Pair |
| **8085 Interfacing Programs** | |
| **5.** | 5.1 Write a program to Interface ADC with 8085. |
| | 5.2 Write a program to interface Temperature measurement module with 8085. |
| **6.** | Write a program to interface Keyboard with 8085. |
| **7.** | Write a program to interface DC Motor and stepper motor with 8085. |
| **Following exercises has to be Performed on 8051** | |
| **8.** | Write a program to convert a given Hex number to Decimal. |
| **9.** | Write a program to find numbers of even numbers and odd numbersamong 10 Numbers. |
| **10.** | Write a program to find Largest and Smallest Numbers among 10 Numbers. |
| **11.** | 11.1 To study how to generate delay with timer and loop. |
| | 11.2 Write a program to generate a signal on output pin using timer. |
| **8051 Interfacing Programs** | |
| **12** | 12.1 Write a program to interface Seven Segment Display with 8051. |
| | 12.2 Write a program to interface LCD with 8051. |
| **13** | Write a program for Traffic light Control using 8051. |
| **14** | Write a program for Elevator Control using 8051. |

**Course Outcome:**

| Course Code | Course Name | Course Outcome | Details |
|---|---|---|---|
| 4EC4-23 | Microcontrollers Lab | CO 1 | Develop skills related to assembly level programming of microprocessors and microcontroller. |
| | | CO 2 | Interpret the basic knowledge of microprocessor and microcontroller interfacing, delay generation, waveform generation and Interrupts. |
| | | CO 3 | Interfacing the external devices to the microcontroller and microprocessor to solve real time problems. |
| | | CO 4 | Illustrate functions of various general purpose interfacing devices. |
| | | CO 5 | Develop a simple microcontroller and microprocessor based systems |

**CO-PO Mapping:**

| Subject | Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EC4-23 Microcontrollers Lab | CO 1 | 2 | 1 | 2 | 1 | 3 | | | | | | | |
| | CO 2 | 3 | 2 | 1 | 2 | 1 | | | | | | | |
| | CO 3 | 1 | 1 | 3 | 1 | 3 | | | | | | | |
| | CO 4 | 2 | 2 | 1 | | | | | | | | | |
| | CO 5 | 1 | 1 | 3 | 2 | 2 | | 2 | | | | | |

**3: Strongly** **2: Moderate** **1: Weak**

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## 4EC4-24: Electronics Measurement & Instrumentation Lab

**Credit: 1.5** **Max. Marks: 75(IA:45, ETE:30)**

**0L+0T+3P**

| List of Experiments | |
|---|---|
| **Sr. No.** | **Name of Experiment** |
| **1.** | Measure earth resistance using fall of potential method. |
| **2.** | Plot V-I characteristics & measure open circuit voltage & short circuit current of a solar panel. |
| **3.** | Measure unknown inductance capacitance resistance using following bridges (a) Anderson Bridge (b) Maxwell Bridge |
| **4.** | To measure unknown frequency & capacitance using Wein's bridge. |
| **5.** | Measurement of the distance with the help of ultrasonic transmitter & receiver. |
| **6.** | Measurement of displacement with the help of LVDT. |
| **7.** | Draw the characteristics of the following temperature transducers (a) RTD (Pt-100) (b) Thermistors. |
| **8.** | Draw the characteristics between temperature & voltage of a K type thermocouple |
| **9.** | Calibrate an ammeter using D.C. slide wire potentiometer |
| **10.** | Measurement of strain/force with the help of strain gauge load cell. |
| **11.** | Study the working of Q-meter and measure Q of coils. |
| **12.** | Calibrate a single-phase energy meter (Analog and Digital) by phantom loading at different power factor by: (i) Phase shifting transformer (ii) Auto transformer. |

## Course Outcome:

| Course Code | Course Name | Course Outcome | Details |
|---|---|---|---|
| 4EC4-24 | Electronic Measurement & Instrumentation Lab | **CO 1** | Understanding of the fundamentals of Electronic Instrumentation. Explain and identify measuring instruments. |
| | | **CO 2** | Able to measure resistance, inductance and capacitance by various methods. |
| | | **CO 3** | Design an instrumentation system that meets desired specifications and requirements. |
| | | **CO 4** | Design and conduct experiments, interpret and analyze data, and report results. |
| | | **CO 5** | Explain the principle of electrical transducers. Confidence to apply instrumentation solutions for given industrial applications. |

## CO-PO Mapping:

| Subject | Course Outcomes | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4EC4-24 Electronic Measurement & Instrumentation Lab | **CO 1** | 3 | 2 | 1 | 2 | 2 | | | | | | | |
| | **CO 2** | 2 | 3 | 1 | 2 | 3 | | | | | | | |
| | **CO 3** | 1 | 3 | 2 | 3 | 2 | | | | | | | |
| | **CO 4** | 1 | 2 | 3 | 2 | 3 | | | | | | | |
| | **CO 5** | 1 | 2 | 3 | 3 | 3 | | | | | | | |

**3: Strongly** **2: Moderate** **1: Weak**