# UNIVERSITY OF MUMBAI
# SCHEME OF INSTRUCTIONS & EXAMINATION
**at**
# B.E.(Electronics Engineering)
**(R-2001)**

**(Revised Scheme Considering 60 Minutes' Period Instead of 45 Minutes' Period as per AICTE Guide-lines)**

**SEMESTER-III**

| **Sr. No.** | **Subjects** | **No. of Periods per Week** | | | **Duration of Theory Paper (Hrs)** | **Marks** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lectures | Practicals | Tutorials | | Theory Paper | Term Work | Practical | Oral | Total |
| 1. | * Applied Mathematics-III | 4 | - | - | 3 | 100 | - | - | - | 100 |
| 2. | # Electronic Circuit Analysis & Design-I | 4 | 3 | - | 3 | 100 | 25 | - | - | 125 |
| 3. | # Electrical Network Analysis and Synthesis | 3 | 2 | - | 3 | 100 | 25 | - | - | 125 |
| 4. | Basics of Communication Engg. | 3 | 3 | - | 3 | 100 | 25 | - | - | 125 |
| 5. | ** Numerical Techniques | 3 | 2 | - | 3 | 100 | 25 | - | - | 125 |
| 6. | Digital Design-I | 3 | 2 | - | 3 | 100 | 25 | - | | 125 |
| **Total** | | **20** | **12** | **-** | **-** | **600** | **125** | **-** | **-** | **725** |

* Subject common with Biomedical, Instrumentation, Electrical and Electronics & Telecommunication Engineering branches.
# Subject common with Biomedical Engineering branch.
** Subject common with Biomedical, Electrical and Electronics & Telecommunication Engineering branches.

## Semester IV

| **Sr. No.** | **Subjects** | **No. of Periods per Week** | | | **Duration of Theory Paper (Hrs)** | **Marks** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lectures | Practicals | Tutorials | | Theory Paper | Term Work | Practical | Oral | Total |
| 1. | * Applied Mathematics-IV | 4 | - | - | 3 | 100 | - | - | - | 100 |
| 2. | # Electronic Circuit Analysis and Design-II | 4 | 3 | - | 3 | 100 | 25 | 25 | 25 | 175 |
| 3. | Control Systems Engineering. | 3 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 4. | Electrical Machines and Instruments. | 3 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 5. | Principles of Microprocessor Systems | 3 | 3 | - | 3 | 100 | 25 | - | 25 | 150 |
| 6. | Digital Design-II | 3 | 2 | - | 3 | 100 | 25 | 25 | 25 | 175 |
| **Total** | | **20** | **12** | **-** | **-** | **600** | **125** | **50** | **125** | **900** |

* Subject common with Biomedical, Instrumentation, Electrical and Electronics & Telecommunication Engineering branches.
# Subject common with Biomedical Engineering branch.

## SEMESTER-V

| **Sr. No.** | **Subjects** | **No. of Periods per Week** | | | **Duration of Theory Paper (Hrs)** | **Marks** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lectures | Practicals | Tutorials | | Theory Paper | Term Work | Practical | Oral | Total |
| 1. | * Applied Mathematics-V | 4 | - | - | 3 | 100 | - | - | - | 100 |
| 2. | # Engineering Electromagnetics | 3 | - | 1 | 3 | 100 | 25 | - | - | 125 |
| 3. | Electronic Measuring Instruments. | 3 | 2 | - | 3 | 100 | 25 | - | - | 125 |
| 4. | Continuous Time Signals and Systems | 4 | - | 2 | 3 | 100 | 25 | - | - | 125 |
| 5. | Microprocessors and Microcontrollers | 3 | 3 | - | 3 | 100 | 25 | - | - | 125 |
| 6. | * Presentation and Communication Techniques | 2 | 2 | - | - | - | 25 | - | 25 | 50 |
| 7 | Electronics Workshop | - | 3 | - | - | - | - | - | 25 | 25 |
| **Total** | | **19** | **10** | **3** | **-** | **500** | **125** | **--** | **50** | **675** |

* Subject common with Biomedical, Instrumentation, Electrical and Electronics & Telecommunication Engineering branches.
# Subject common with Biomedical Engineering branch.

## SEMESTER-VI

| **Sr. No.** | **Subjects** | **No. of Periods per Week** | | | **Duration of Theory Paper (Hrs)** | **Marks** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lectures | Practicals | Tutorials | | Theory Paper | Term Work | Practical | Oral | Total |
| 1. | Microwave and Fiber Optic Communication | 4 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 2. | # Analog Integrated Circuits and Applications | 4 | 3 | - | 3 | 100 | 25 | - | 25 | 150 |
| 3. | Communication Systems. | 3 | 3 | - | 3 | 100 | 25 | - | 25 | 150 |
| 4. | Discrete Time Signal Processing | 3 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 5. | Computer Organization | 3 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 6. | # # Industrial Economics & Management | 3 | - | - | 3 | 100 | - | - | - | 100 |
| **Total** | | **20** | **12** | **-** | **-** | **600** | **125** | **-** | **125** | **850** |

# Subject common with Biomedical Engineering branch.
**##** Subject common with Instrumentation and Electrical and Electronics & Telecommunication Engineering branches.

## SEMESTER VII

| Sr. No. | Subjects | No. of Periods per Week | | | Duration of Theory Paper (Hrs) | Marks | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lectures | Practicals | Tutorials | | Theory Paper | Term Work | Practical | Oral | Total |
| 1. | Basics of VLSI | 4 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 2. | Instrumentation Systems | 3 | 2 | - | 3 | 100 | 25 | - | - | 125 |
| 3. | # Digital Communication | 3 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 4. | Filter Theory and Applications | 4 | 2 | - | 3 | 100 | 25 | - | - | 125 |
| 5. | Elective –I | 4 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 6. | Project –A | - | - | 4 | - | - | 25 | - | - | 25 |
| **Total** | | **18** | **10** | **4** | **-** | **500** | **150** | **-** | **75** | **725** |

# Subject common with Electronics & Telecommunication Engineering branch.

| **Elective I** |
|---|
| Image Processing |
| Process Control & Instrumentation |
| Microcomputer System Design |
| DSP Architectures and Systems |
| Wireless Communication |

## SEMESTER VIII

| Sr. No. | Subjects | No. of Periods per Week | | | Duration of Theory Paper (Hrs) | Marks | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lectures | Practicals | Tutorials | | Theory Paper | Term Work | Practical | Oral | Total |
| 1. | Power Electronics. | 4 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 2. | Data Communication & Networking | 4 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 3. | Mechatronics | 4 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 4. | Elective –II | 4 | 2 | - | 3 | 100 | 25 | - | 25 | 150 |
| 5. | Project –B | - | 8 | - | - | - | 50 | - | 50 | 100 |
| **Total** | | **16** | **16** | **-** | **-** | **400** | **150** | **-** | **150** | **700** |

| **Elective II** |
|---|
| Advanced Digital Signal Processing |
| Biomedical Instrumentation |
| Embedded Systems and Real Time Programming |
| *Robotics |
| Telecom Network Management |
| VLSI Design |

Group size should be restricted to minimum 2 students and maximum 5 students for projects.

* Subject common with Electrical Engg. Branch.

# S.E. (ELECTRONICS) SEMESTER III
## Electronic Circuit Analysis & Design I

| | |
|---|---|
| **Lectures: 4 hours / week** | **Theory Paper: 3 hours and 100 marks** |
| **Practicals: 3 hours / week** | **Termwork: 25marks** |

*Rationale:*
*The subject of Electronic circuit design I shall lay a strong fundamental base in discrete electronics. The emphasis shall be on design of basic electronic circuits. The scope of the subject is completely covered by the textbooks mentioned.*

**Semiconductor Materials and Diodes**
Review of Semiconductor Materials and Properties, The PN Junction, Introduction to Semiconductor Diode Theory. Diode Circuits: DC Analysis and Models, AC Equivalent Circuits, Other Diode Types – Solar Cell, Photodiode, Light–Emitting Diode, Schottky Barrier Diode, Zener Diode, Temperature Effects, Understanding Manufacturer's Specifications.

**Diode Circuits**
Design of Rectifier Circuits, Half Wave Rectification, Full Wave Rectification, Filter, Ripple Voltage and Diode Current, Voltage Doubler Circuit, Zener Diode Circuits, Clipper and Clamper Circuits, Multiple–Diode Circuits, Photodiode and LED Circuits.

**The Bipolar Junction Transistor**
Basic Bipolar Junction Transistor, Transistor Structures, NPN Transistor : Forward–active Mode Operation, PNP Transistor : Forward–active Mode Operation, Circuit Symbols and Conventions, Current–Voltage Characteristics, Non ideal Transistor Leakage Currents and Breakdown, DC Analysis of Transistor Circuits, Common–Emitter Circuits, Load Line and Modes Of Operation, Common Bipolar Circuits: DC Analysis, Basic Transistor Applications – Switch, Amplifier, Bipolar Transistor Biasing – Single Base Resistor Biasing, Voltage Divider Biasing and Bias Stability, Integrated Circuit Biasing, Multistage Circuits.

**Basic BJT Amplifiers**
Analog Signals and Linear Amplifiers, The Bipolar Linear Amplifier, Graphical Analysis and AC Equivalent Circuit, Small Signal Hybrid – $\pi$ Equivalent Circuit of the Bipolar Transistor, Hybrid – $\pi$ Equivalent Circuit Including the Early Effect, Expanded Hybrid – $\pi$ Equivalent Circuit, Other Small – Signal Parameters And Equivalent Circuits, Basic Transistor Amplifier Configurations, Common Emitter Amplifiers, AC Load Line Analysis, Common Collector Emitter Follower Amplifier, Common Base Amplifier, The Three Basic Amplifier configurations: Summary and Comparison, Multistage Amplifiers, Power Considerations, Environmental Thermal Considerations in Transistor Amplifiers, Manufacturers' Specifications.

**The Field Effect Transistor**
Junction Field–Effect Transistor, MOS Field–Effect Transistor, MOSFET DC Circuit Analysis, Basic MOSFET Applications: Switch, Digital Logic Gate and Amplifier. Temperature effects in MOSFETs, Input Protection in MOSFET. The Power FET (VMOS).

**Basic FET Amplifiers**
The MOSFET Amplifier, Basic Transistor Amplifier Configurations, the Common Source Amplifier, The Source Follower Amplifier, The Common Gate Configuration, The Three Basic Amplifier Configuration: Summary and Configuration, Single – Stage Integrated Circuit MOSFET Amplifiers, Multistage Amplifiers, Basic JFET Amplifiers

**Text Books:**

1. Donald A. Neamen, Electronic Circuit Analysis and Design, Second edition, McGraw Hill International edition 2001
2. Martin Roden , Gordon Carpenter, William Wieserman, Electronic Design, Fourth edition, Shroff Publishers, 2002

**Additional Reading:**

1. Donald Schilling & Charles Belove, Electronic Circuits Discrete and Integrated, Third edition, McGraw Hill International edition, 1989

**Termwork:**

The termwork shall consist of atleast six laboratory experiments covering the whole of syllabus, duly recorded and graded as well as atleast four computer simulations using EDA tools like PSPICE duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

# S.E. (ELECTRONICS) SEMESTER IV
## Electronic Circuit Analysis & Design II

| | |
|---|---|
| **Lectures: 4 periods /week** | **Theory Paper: 3 hours and 100 marks** |
| **Practicals: 3 periods /week** | **Termwork: 25marks; Oral*: 25 marks; Practical*: 25 marks** |

*Rationale:*
*The subject of Electronic circuit design II shall lay a strong fundamental base in discrete electronics which will help the student to grasp concepts of integrated circuits easily. The emphasis shall be on design of basic electronic circuits. The scope of the subject is completely covered by the textbooks mentioned.*

**Frequency Response of Amplifiers**
Amplifier Frequency Response, System Transfer Functions, S – Domain Analysis, First – Order Functions, Bode Plots, Short–Circuit and Open–Circuit Time Constants, Frequency Response: Transistor Amplifiers with Circuit Capacitors, Frequency Response: Bipolar Transistor, Frequency Response: The FET, High Frequency Response of Transistor Circuits. Sinusoidal Oscillators: The phase shift Oscillator, The Wien Bridge Oscillator, The Tuned Circuit Oscillator, The Colpitts Oscillator and Hartley Oscillator.

**Output Stage and Power Amplifiers**
Power Amplifiers, Power Transistors – Power BJTs, Power MOSFETs, Heat Sinks, design of heat sinks, Classes Of Amplifiers – Class–A Operation, Class–B Operation, Class–AB Operation, Class–C Operation, Class–A Power Amplifiers, Class–AB Push Pull Complementary Output Stages.

**Differential and Multistage Amplifiers**
The Differential Amplifier, Basic BJT Differential Pair, Basic FET Differential Pair, Differential Amplifier with Active Load, BICMOS Circuits, Gain Stage and Simple Output Stage, Simplified BJT Operational Amplifier Circuit, Differential Amplifier Frequency Response. The Darlington Amplifier and Cascode Amplifier.

**Feedback and Stability**
Introduction to Feed Back, Basic Feedback Concepts, Ideal Close–Loop Gain, Gain Sensitivity Bandwidth Extension, Noise Sensitivity, Reduction of Nonlinear Distortion, Ideal Feedback Topologies, Series–Shunt, Shunt–Series, Series–Series, Shunt–Shunt Configurations, Voltage (Series – Shunt) Amplifiers, Current (Shunt – Series) Amplifiers, Trans Conductance (Series – Series) Amplifiers, Trans Resistance (Shunt – Shunt) Amplifiers, Loop Gain, Stability of The Feedback Circuit, The Stability Problem, Bode Plots: One – Pole, Two – Pole, and Three – Pole Amplifiers, Nyquist Stability Criterion, Phase and Gain Margins, Frequency Compensation Basic Theory, Closed Loop Frequency Response, Miller Compensation.

**Text Books:**
1. Donald A. Neamen, Electronic Circuit Analysis and Design, Second edition, McGraw Hill International edition 2001
2. Martin Roden , Gordon Carpenter, William Wieserman, Electronic Design, Fourth edition, Shroff Publishers, 2002

**Additional Reading:**
1. Donald Schilling & Charles Belove, Electronic Circuits Discrete and Integrated, Third edition, McGraw Hill International edition, 1989

2. Adel Sedra & Kenneth Smith, Microelectronic Circuits, Fourth edition, Oxford University Press, 1998

**Termwork:**

The termwork shall consist of atleast six laboratory experiments covering the whole of syllabus, duly recorded and graded as well as atleast four computer simulations using EDA tools like PSPICE duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

*** Oral and Practical examination will be based on Electronic Circuit Analysis & Design I and Electronic Circuit Analysis & Design II subjects taken together.**

# S.E. (ELECTRONICS) SEMESTER III
## Basics of Communication Engineering

| Lectures: 3 hours / week | Theory Paper: 3 hours and 100 marks |
|---|---|
| Practical: 3 hours / week | Term work: 25 marks |

*Rationale*
*This first subject on telecommunication shall lay a strong base on basic principles in communication systems. It introduces concepts of different communication systems and techniques which would be useful in advanced courses on communication.*

**Introduction:**
Elements of a communication system, modulation and demodulation.
Noise in Communication systems, Signal-to-Noise ratio, Noise factor and Noise Figure, Equivalent Noise Temperature.

**Amplitude Modulation:**
DSB Full carrier AM – principles, modulator circuits, transmitters. Different types of AM, Suppressed – carrier AM, SSB, ISB – Principles, transmitters.

**Angle Modulation:**
Frequency modulation, Phase modulation, Effect of noise, FM modulators, Transmitters.

**Radio receivers:**
Receiver characteristics, TRF and Superheterodyne receivers, AM detectors, FM detectors, Receiver circuits.

**Radio wave propagation:**
Electromagnetic waves, Properties of radio waves, Propagation of waves, Propagation terms and definitions.

**Analog Pulse Modulation:**
Sampling Theorem for Low – pass and Band – pass signals – proof with spectrum, Aliasing. Sampling Techniques – principle, generation, demodulation, spectrum. PAM, PWM, PPM – generation and detection.

**Digital Transmission:**
Quantization, Quantization error, Non-uniform quantizing, Encoding. PCM, DPCM, Delta modulation, Adaptive Delta modulation – transmission system, bandwidth.

**Multiplexing:**
TDM, FDM – Principles, Hierarchy.

**Text Books:**

1. Wayne Tomasi, Electronic Communication Systems, Pearson Education, third edition, 2001.
2. Roy Blake, Electronic Communication Systems, Thomson Asia Pte. Ltd., Singapore, second edition, 2002.
3. Leon W Couch, Digital and Analog Communication Systems, Pearson Education, sixth edition.
4. Herbert Taub and Donald Schilling, Principles of Communication Systems, Tata McGraw-Hill, second edition.

(Text books 3 & 4 for Digital transmission and Multiplexing topics only)

**Termwork:**
The Termwork shall consist of at least eight experiments based on the whole syllabus, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

# S.E. (ELECTRONICS) SEMESTER III
## Digital Design I

| Lectures: 3 hours / week | Theory Paper: 3 hours and 100 marks |
|---|---|
| Practicals: 2 hours / week | Termwork: 25marks |

*Rationale*

*The Digital Design I subject shall lay a strong base in basic principles of digital design that do not change with technology. The subject shall also wed these basic principles with tools and practical techniques that teach how to design for today's technology. These include the VHDL design language. The emphasis will be on combinational circuits.*

**Introduction to digital systems**

Analog VS Digital systems, digital devices, integrated circuits, programmable logic devices, digital design levels, software aspects of digital design.

**Number systems and codes**

Positional number systems, Binary and Hexadecimal number systems, general positional number systems conversions, arithmetic operations, representation of negative numbers, arithmetic operations on signed numbers, binary and gray codes, character codes, codes for detecting and correcting errors.

**Logic circuits**

Logic signals and gates, Boolean Algebra, theorems, combinational circuit analysis, combinational circuit synthesis – minimization, Karnaugh Maps, sum of products and product of sums expressions and their minimization, programmed minimization methods – Quine McCluskey minimization algorithm, timing hazards – static and dynamic hazards, introduction to VHDL hardware description language.

**Combinational logic design practices**

Documentation standards, Circuit timing, Combinational PLDs. Design using SSI and MSI devices Decoders, Encoders, Three state buffers, Multiplexers, Parity circuits, Comparators, Adders, Subtractors, ALUs, Combinational multipliers. Using VHDL and PLDs Combinational circuit design examples – barrel shifter, simple floating – point encoder, cascading comparator.

**Logic families**

CMOS logic; MOS transistors review, basic CMOS inverter circuit, CMOS NAND and NOR gates, fan – in, fan – out, Electrical behavior of CMOS circuits, propagation delay, power consumption, multi source busses, CMOS logic families, bipolar logic introduction, review of BJT, TTL NAND and NOR gates, fan – in, fan – out, Electrical behavior of TTL circuits, propagation delay, power consumption. CMOS / TTL interfacing, Introduction to Emitter – coupled logic. Interpreting Manufacturers' data sheets

**Sequential logic principles**

Bistable elements, Latches and flip–flops, S-R latch, D latch, Edge triggered D flip–flop, Master/slave flip–flops, T flip–flop.

**Textbooks:**

1. John F. Wakerley, Digital Design Principles and Practices, third edition updated, Pearson Education Singapore, 2002.
2. Stephen Brown & Zvonko Vranesic, Fundamentals of Digital logic with VHDL design, first edition, McGraw Hill International edition, 2000.

**Additional Reading:**

3. Robert K. Dueck, Digital Design with CPLD Applications and VHDL, Thomson Asia Pte. Ltd., Singapore, 2001.
4. Alan B. Marcovitz, Introduction to logic design, first edition, McGraw Hill International edition 2002.
5. James Bignell & Robert Donovan, Digital Electronics, fourth edition, Thomson Asia Pte. Ltd., Singapore, 2001.

**Termwork:**

The termwork shall consist of atleast six laboratory experiments covering the whole of syllabus, duly recorded and graded as well as atleast four computer simulations using VHDL, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

# S.E. (ELECTRONICS) SEMESTER IV
## Digital Design II

| | |
|---|---|
| **Lectures: 3 hours / week** | **Theory Paper: 3 hours and 100 marks** |
| **Practicals: 2 hours / week** | **Termwork: 25marks; Practical: 25 marks; Oral*: 25 marks** |

*Rationale*
*The subject Digital Design II subject shall lay a strong base in Sequential circuits and sequential circuit design. Modern concepts of testability and reliability are also covered.*

**Sequential logic design**
Clocked synchronous state machine analysis, Clocked synchronous state machine design, designing state machines using state diagrams, state machine synthesis using transition lists, decomposing state machines, feedback sequential circuits, VHDL sequential circuit design features.

**Sequential logic design practices**
Sequential circuit documentation standards, use of latches and flip–flops in examples like switch de-bouncing, bus holder circuit, counters – ripple and synchronous, MSI counters and applications, decoding binary counter states, counters in VHDL. Shift registers, structure, MSI shift registers, serial / parallel conversion, shift register counters, ring counters, Johnson counters, linear feedback shift register counters, shift registers in VHDL. Synchronous design methodology, impediments to synchronous design, synchronizer failure and metastability. Design examples like a few simple machines, and traffic light controller, done in VHDL.

**Memory, CPLDs and FPGAs**
Types of memory devices, Read-Only Memory (ROM), Read / write memory, Static RAM, Dynamic RAM, Introduction to Xilinx XC9500 CPLD family and Xilinx XC 4000 FPGA family.

**Additional topics**
Computer Aided Design (CAD) tools, Concept of design for testability, concept of digital system reliability, introduction to transmission lines, reflections and termination.

**Textbooks:**

1. John F. Wakerley, Digital Design Principles and Practices, third edition updated, Pearson Education Singapore, 2002.
2. Stephen Brown & Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, first edition, McGraw Hill International edition, 2000.


**Additional Reading:**

1. John M. Yarbrough, Digital Logic Applications and Design, first edition, Thomson Asia Pte. Ltd., Singapore, 2001


**Termwork:**
The termwork shall consist of atleast six laboratory experiments covering the whole of syllabus, duly recorded and graded as well as atleast four computer simulations using VHDL, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

*** Oral examination will be based on Digital Design I and Digital Design II subjects taken together.**

# S.E. (ELECTRONICS) SEMESTER III

## Electrical Network Analysis & Synthesis

***Rationale***

*The subject Electrical Network Analysis & Synthesis lays a base for many subjects like Electronic Circuit Design I & II, Control System Engineering, Analog Integrated Circuits & applications and Continuous Time Signals and Systems. It involves understanding basic fundamentals of network, and applying efficient tools for its analysis. The subject also involves concepts of network synthesis.*

| | |
|---|---|
| **Lectures: 3 hours / week** | **Theory Paper: 3 hours and 100 marks** |
| **Practicals: 2 hours / week** | **Termwork: 25marks** |

**Review**

D.C. & A.C circuits.

**Mesh & Node Analysis**

Mesh & Node Analysis of circuits with independent & dependent sources.

**Linearity, Superposition & Source Transformation**

Linearity, Superposition, Current & Voltage Source Transformation.

**Network Theorems**

Thevenin's & Norton's Theorem (with independent & dependent sources), Maximum power transfer theorem.

**Circuit Analysis**

Introduction to Graph Theory. Tree, link currents, branch voltages, cut set & tie set.
Mesh & Node Analysis, Gauss Elimination Technique, Duality.

**Time & Frequency Response of Circuits**

First & second Order Differential equations, initial conditions. Evaluation & analysis of Transient and Steady state responses using Classical Technique as well as by Laplace Transform (for simple circuits only). Transfer function, Concept of poles and zeros. Frequency response of a system (concepts only).

**Two - port Networks**

Concept of two- port network. Driving point & Transfer Functions, Open Circuit impedance (Z) parameters, Short Circuit admittance (Y) parameters, Transmission (ABCD) parameters. Inverse Transmission (A'B'C'D') parameters. Hybrid (h) parameters. Inter Relationships of different parameters. Interconnections of two - port networks. T & Pi representation. Terminated two - port networks.

**Fundamentals of Network Synthesis**

Positive real functions, Driving Point functions, Brono's Positive real functions, Properties of Positive real functions. Testing Positive real functions, Testing driving point functions, Maximum modulus theorem, Properties of Hurwitz polynomials, Residue computations, Even & odd functions, Sturm's theorem. Driving Point Synthesis with L-C, R-C, R-L and R-L-C networks.

**Text books:**

1. A. Sudhakar & S. P. Shyammohan, Circuits and Networks, Tata McGraw Hill, thirteenth reprint, 2000.
2. William. H. Hayt, Jack E. Kemmerly & Steven M. Durbin, Engineering Circuit Analysis, McGraw Hill International, sixth edition, 2002.
3. Raymond A. DeCarlo & Pen-Min Lin, Linear Circuit Analysis, Oxford University Press, second edition, 2001.
4. M. E. Van Valkenburg, Introduction to Modern Network Synthesis, Wiley Eastern Ltd.

**Additional Reading:**

2. Artice M. Davis, Linear Circuit Analysis, Thomson Asia Pte. Ltd., Singapore, first edition, 2001
3. M. E. Van Valkenburg, Network Analysis, Prentice Hall of India, third edition.

**Termwork:**
The termwork shall consist of atleast four laboratory experiments covering the whole of syllabus, duly recorded and graded as well as atleast four tutorial assignments, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

# S.E. (ELECTRONICS) SEMESTER III

## Numerical Techniques

| Lectures: 3 hours / week | Theory Paper: 3 hours and 100 marks |
|---|---|
| Practical: 2 hours / week | Term work: 25 marks. |

*Rationale:*

*The subject of Numerical Techniques shall lay a strong fundamental base in computational methods. The emphasis shall be on understanding of various techniques and their application in engineering problems-particular to electronics, electrical engineering problems.*

**Errors in numerical computation**
Error types, analysis and estimation. Error propagation.

**Roots of Equations –** (including relevant engineering applications)
Bracketing Methods – The Bisection method, The False position method. Open Methods – The Newton-Raphson method, The Secant method.

**Systems of Linear Algebraic equations**- (including relevant engineering applications)
Gauss-Elimination method – Technique, pitfalls, improvement. Gauss-Jordan method. LU decomposition and matrix inversion. Gauss-Seidel method.

**Curve fitting -**(including relevant engineering applications)
Interpolation – Newton's divided difference, Lagrange Interpolating polynomials. Approximation - Least square approximation technique, linear regression, and polynomial regression.

**Numerical differentiation** (including relevant engineering applications)
Methods based on interpolation and finite differences.

**Numerical Integration**- (including relevant engineering applications)
The Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule

**Solution to Ordinary differential equations** (including relevant engineering applications)
Taylor series method, Picard's method of successive approximation. Runge – Kutta methods – Euler's method, Euler's predicator-corrector method, Runga-kutta method of second and fourth order. Boundary – value problems, Eigen value problems (concepts only).

**Optimization** - (including relevant engineering applications and transportation problems)
One-dimensional unconstrained - Golden-section Search, quadratic Interpolation, Newton's method. Multidimensional unconstrained – Direct method, Gradient method. Linear programming - Graphical solution and simplex method.

**Text Books**

1. Seven C. Chapra , Raymond P. Canale, Numerical Methods for Engineers ,Fourth Edition, Tata McGraw Hill, 2002.
2. Robert J. Schilling , Sandra L. Harris, Applied Numerical Methods for Engineers (Using MATLAB and C), first edition, Thomson Asia Pte. Ltd., 2002

**Termwork:**
The Termwork shall consist of at least eight programs (implemented in C / C++ ) based on methods covering the whole syllabus, duly recorded and graded as well as at least five computer simulations using MATLAB, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

# S.E. (ELECTRONICS) SEMESTER IV
## Principles of Microprocessor Systems

| | |
|---|---|
| **Lectures: 3 hours / week** | **Theory Paper: 3 hours and 100 marks** |
| **Practicals: 3 hours / week** | **Termwork: 25marks; Orals: 25 marks** |

***Rationale:*** *The first subject on microprocessors introduces the topics with a real world microprocessor - the Intel 8085. The organization, architecture, interfacing and software aspects are covered with suitable examples to lay a strong base for understanding advanced microprocessor architectures and systems.*

**Introduction**
Introduction to Microprocessors, Microcomputers, and Assembly Language.
**Microprocessor Architecture and Microcomputer Systems**
Microprocessor Architecture and its operations, Input and output (I/O) devices.
**8085 Microprocessor Architecture and Memory Interfacing**
The 8085 architecture, Instruction cycles, machine cycles and T states. Concept of wait states. Minimum system design. Memory interfacing with timing considerations. Clock, Reset and buffering circuits. Testing and troubleshooting memory interface circuits.

**8085 Assembly Language Programming**
The 8085 programming model, Instruction classification, Instruction and Data format, process of writing, assembly and execution of simple assembly language programs.

**8085 Instructions**
Data transfer operations, Arithmetic & Logic operations, Branch operations, Writing assembly language programs, Debugging a program.

**Programming Techniques**
Looping, Counting and indexing, counters and timers, Code conversion, BCD arithmetic and 16 bit data operations. Software Development Systems and Assemblers.

**Stack and Subroutines**
Concept of Stack and subroutines, parameter passing techniques, Re-entrant and recursive subroutines.

**I/O data transfer techniques**
Basic interfacing concepts, Interfacing input and output devices with examples, Memory mapped I/O and I/O mapped I/O. Testing and troubleshooting I/O interface circuits. I/O data transfer classification, Programmed I/O, Interrupt driven program controlled I/O, Hardware I/O (Direct Memory Access).

**Interrupts**
Requirements, Single level interrupt, Multi level interrupt, Vectored interrupt. 8085 interrupt structure and operation. 8259A programmable interrupt controller features and operation.

**Programmable Interface Devices**
Features and operating modes of working of 8155 multifunction device, 8255A programmable peripheral interface, 8254, programmable interval timer. Direct memory access (DMA) and DMA controller 8237, 8279 programmable keyboard/display interface.

**Serial I/O and Data Communication**:
Basics concepts in serial I/O, 8085 serial I/O lines.

**Microprocessor Applications:** Interfacing scanned multiplexed displays and liquid crystal display, interfacing matrix keyboard, Introduction to emulators and logic analyzers.

**Textbooks:**

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, fourth edition, Penram International Publishing (India), 2000.
2. Microprocessors and Programmed Logic, second edition, Prentice Hall of India, 1987.
3. Intel Corporation, Intel Data Manual for 8085, 1976.

**Termwork:**
The Termwork shall consist of at least ten programs covering the whole syllabus, duly recorded and graded, out of which atleast four programs should be on interfacing techniques. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

# S.E. (ELECTRONICS) SEMESTER IV
## Electrical Machines and Instruments

| | |
|---|---|
| **Lectures: 3 hours / week** | **Theory Paper: 3 hours and 100 marks** |
| **Practicals: 2 hours / week** | **Termwork: 25marks; Oral: 25 marks** |

*Rationale*

*The subject Electrical Machines and Instruments familiarizes the student with concepts of construction and working of electrical measuring instruments. It discusses a few materials used in electrical engineering. Concepts of working of electrical motors widely used in industry are introduced.*

**Measuring Instruments**

Principle of Permanent Magnet Moving Coil (PMMC), Moving Iron Instruments, Ammeters & Voltmeters, Operating Principles of the Electrodynamometer Instruments. Wattmeter, Energy meter, Electrostatic Instruments, Rectifier type Instruments, Extension of Ranges of Voltmeters and Ammeters. Principle of Power Factor & Frequency meter. Use of Current & Potential Transformers.

**Measurement of R, L, and C**

Measurement of low, medium & high resistances – Wheatstone & Kelvin bridge, Ohmmeter, Megger. A.C. bridge circuits for measurement of inductance & capacitance-Maxwell's, Hay's & Anderson's bridge, Schering bridge.

**Potentiometers**

Principles of D.C & A.C. Potentiometers & their applications.

**Magnetic Properties of Materials**

The magnetic dipole movement, diamagnetism. The origin of permanent magnetic dipoles in matter, Paramagnetism, Ferromagnetism.

**D.C. Motors**

Principles of working, E.M.F. equation, back – EMF, torque equations, methods of excitation, characteristics of D.C. shunt, series & compound motors, speed – torque characteristic of D.C. motors, starters, principles of speed control.

**Three Phase Induction Motors**

Rotating magnetic field, construction & principle of operation, slip, rotor frequency, development of equivalent circuit, torque equation, maximum torque, torque – speed characteristics, speed control. Starting methods, motor ratings.

**Stepper Motor**

Principle of working, characteristics & applications.

**Text Books:**

1. Sawhney A.K., A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpatrai and Sons, 1993.
2. Golding, Electrical Measurements & Measuring Instruments, Wheeler Publishing, fifth edition, 1994.
3. Nagrath & Kothari, Electrical Machines, Tata McGraw Hill, second edition, 1997
4. Dekker A. J., Electrical Engineering Materials, Prentice Hall of India, twelfth reprint, 1987.
5. Srinivasan M. P., Stepping Motors, CEDT: Indian Institute of Science, 1985.

**Termwork:**

The termwork shall consist of atleast eight laboratory experiments covering the whole of syllabus, duly recorded and graded. This shall carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

# S.E. (ELECTRONICS) SEMESTER IV
## Control Systems Engineering

| | |
|---|---|
| **Lectures: 3 hours / week** | **Theory Paper: 3 hours and 100 marks** |
| **Practical: 2 hours / week** | **Term work: 25 marks, Oral: 25 marks.** |

*Rationale*

*The subject Principles of control Systems is an introductory course in control system theory and practice. This course teaches conventional control systems, which would be useful in advanced courses in electronics, communication and signal processing.*

**Introduction to control system analysis**

Introduction, examples of control systems, open loop control systems, closed loop control systems. Transfer function and impulse response of systems.

**Control system components**

DC and AC servomotors, servoamplifier, potientiometer, synchro transmitters, synchro receivers, synchro control transformer, stepper motors.

**Mathematical modeling of systems**

Importance of a mathematical model, Block diagrams, signal flow graphs, Masan's gain formula and its application to block diagram reduction.

**Transient-Response Analysis**

Impulse response function, First order system, second order system, time domain specifications of systems, analysis of transient-response using Second order model.

**Steady – state Error Analysis**

Classification of control systems according to "Type" of systems, Steady – state errors, static error constants, Steady – state analysis of different types of systems using step, ramp and parabolic input signals.

**Stability Analysis**

Introduction to concept of stability, Stability analysis using Routh's stability criterion, Absolute stability, Relative stability.

**Root-Locus Analysis**

Introduction, Root–Locus plots, summary of general rules for constructing Root–Locus, Root–Locus analysis of control systems.

**Frequency-Response Analysis**

Introduction, Frequency domain specifications, resonance peak and peak resonating frequency, relationship between time and frequency domain specification of systems.

**Frequency-Response Plots**

Bode plots, Polar plots, Log–magnitude Vs phase plots, Nyquist stability criterion, stability analysis, Relative stability, gain margin, phase margin, stability analysis of system using Bode plots.

**Closed-Loop Frequency Response**
Constant gain and phase loci, Nichol's chart and their use in stability study of systems.

**Controller Principles**
Discontinuous controller modes, continuous controller modes, composite controllers.

**Textbooks:**

1. K. Ogata, Modern Control Engineering, Prentice Hall of India, third edition.
2. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, seventh edition.
3. Madan Gopal, Control Systems Principles and Design, Tata McGraw Hill, seventh edition, 1997.

**Additional reading:**

1. Curtis Johnson, Process Control Instrumentation Technology, Prentice Hall of India, fourth edition.
2. Paul Zbar, Industrial Electronics – A Text Lab Manual, Tata McGraw Hill, first edition, 1983.

**Termwork:**
The Termwork shall consist of at least ten experiments and assignments based on the whole syllabus, duly recorded and graded. This will carry a weightage of fifteen marks. A test shall be conducted and will carry a weightage of ten marks.

S.E. (ELECTRONICS) SEM-IV

**Subject: - APPLIED MATHEMATICS -IV**

**Lectures:** 4 Hours / week

**Paper:** 100 Marks,
**Duration:** 3 Hours

1. **Vector calculus & Analysis**:
   - 1.1 Scalar and vector point functions, Directional derivative, Curl and divergence, Conservative, Irrotational and solenoidal fields.
   - 1.2 Line integral, Green's theorem for plane regions and properties of line integral, Stoke's theorem , Gauss's divergence theorem (with out proof) related identities and deductions.

2. **Matrices(II)**:
   - 2.1 Brief revision of vectors over real field , Inner product , Norm , Linear independence and orthogonality of vectors.
   - 2.2 Characteristic polynomial , characteristic equation , characteristic roots and characteristic vectors of a square matrix, Properties of characteristic roots & vectors of different Types of matrices such as Orthogonal matrix, Hermitian matrix ,Skew –Hermitian matrix, Diagonable matrix, Cayley Hamilton's theorem(without proof), Functions of a square matrix, Minimal polynomial and Derogatory matrix.
   - 2.3 Quadractic forms , congruent and orthogonal reduction of quadratic form, Rank, index ,signature and class value of quadratic form.

3. **Complex variables**:
   - 3.1 Line integral of a function of complex variable.,Cauchy's theorem for analytic function (with proof), Cauchy's Goursat theorem (without proof), properties of Line integral,Cauchy's integral formula and deductions.
   - 3.2 Singularities and poles:
     Taylor's and Laurent's development (without proof) , Residue at isolated singularity and its evaluation.
   - 3.3 Residue Theorem application to evaluate real integrals of type
     $_o\int^{2\pi} f(\cos\theta \ ,\sin\theta)d\theta$ and $_{\infty}\int^{\infty} f(x)dx$.

**References:**


1. Complex Variable - Churchill, McGraw Hill, 2nd edition, 1960.
2. Theory of Function Complex Variable - Shantinarayanan, S. Chand & Co. , 1979.
3. Engineering Mathematics - S.S.Sastri, Prentice Hall of India, 2nd edition, 1989.
4. Element of Applied Mathematics - P.N.Wartikar/J.N.Wartikar, Pune Vidyarthi Griha Prakashan, 1981.

S.E. (ELECTRONICS) SEM-III

**Subject: - Applied Mathematics –III**

**Lectures:** 4 Hours / week  **Paper:** 100 Marks
**Duration:** 3 Hours

1. Laplace Transform:
   1.1. Functions of bounded variation
   Laplace transforms of 1, $t^n$, $e^{at}$, sinat, cosat, sinhat and coshat, erf(t) Linear Property of L.T. First shifting theorem, Second shifting theorem
   L{$t^n$ f(t)}, L{f(t)/t}, L{∫ f(u)du}, L{$d^n/dt^n$ f(t)}. Change of scale property of L.T. Unit step functions, Heaviside, Dirac delta functions, Periodic functions and their Laplace transforms.
   1.2 Inverse Laplace Transforms
   Evaluation of Inverse L.T, Partial fractions method ,Convolution theorem
   1.3 Applications to solve initial and boundary value problems involving ordinary diff. Equations with one dependent variable

2. Matrices(I)
   2.1 Types of matrices, Adjoint of a matrix, Inverse of a matrix, Rank of Matrix, Linear dependence and independence of rows and columns of a matrix over a real field, Reduction to normal form and partitioning of a matrix.
   2.2 Systems of Homogeneous and non-homogeneous equations, their consistency and solutions.

3. Complex Variables.
   3.1 Functions of complex variables, Continuity and derivability of a function, Analytic functions, Necessary condition for f(z) to be analytic, sufficient condition (without proof),Cauchy-Riemann conditions in polar forms. Analytical and Milne-Thomson method to find analytic functions f (z)= u+ iv where (i) u is given (ii) v is given (iii) u+v (iv) u-v is given, Harmonic functions and orthogonal trajectories
   3.2 Mapping
   Conformal mapping, Bilinear mapping, Fixed points and standard transformation, inversion, reflection, rotation and magnification.

4. Fourier Series:
   4.1 Orthogonality and orthonormal functions, Expression for a function in a series of orthogonal functions, Dirichlet's conditions, Fourier series of peroidic functions with period $2\pi$ and $2l$
   (Derivations of fourier coefficients $a_o$, $a_n$, $b_n$ is not expected) Dirichlets Theorem Even and Odd functions. Half range sine and cosine expansions Parseval's Identities (without proof)
   4.2 Complex form of Fourier Series
   Fourier integral and fourier transform with properties in detail.

References:


1. P.N.Wartikar/J.N.Wartikar, Text book Applied Mathematics, Pune Vidyarthi Griha Prakashan, 1981.
2. Matrices Shantinarayan
3. Vector Analysis Murray R. Stiegel, Schaum Series.