SYLLABUS

FOR

INTEGRATED MASTER OF SCIENCE IN ELECTRONICS, COMPUTERAND INSTRUMENTATION [M.Sc.(ECI)]

A Five -Year Degree Course

SAURASHTRA UNIVERSITY
RAJKOT

(Effective from June 2016)

Department of Electronics
Saurashtra University
Campus
Rajkot-360005

PhoneNo.0281-2579006/7

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SEMESTER III **(24Credits)**

Paper 9: Advanced circuit and network concepts	**(4 Credits)**
Paper 10: Fundamental of communication electronics	**(4 Credits)**
Paper 11: Power electronics	**(4 Credits)**

Paper 12: Circuit simulation and PCB designing tools **(4 Credits)**
Practicals **(8 Credits)**

SEMESTER IV **(24 Credits)**
Paper 13: Advance communication electronics **(4 Credits)**
Paper 14: Op-Amp and its applications **(4 Credits)**
Paper 15: Elements of C language **(4 Credits)**
Paper 16: Basic instrumentation **(4 Credits)**
Practicals **(8 Credits)**

SEMESTER III

Paper 9: Advance circuit and network concepts

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Laplace transforms and its applications to circuit analysis:

Definitions of Laplace transform – step function – impulse function – functional transforms – operational transforms – Laplace transforms of periodic functions – inverse transforms – initial and final value theorems

Circuit elements in the S-domain – applications – transfer function – use of transfer function in circuit analysis – the transfer function and steady state sinusoidal response – the impulse function in circuit analysis

Unit 2: S-domain analysis and Elements of realizability and synthesis of one port networks:

The concept of complex frequency – physical interpretation of complex frequency – transform impedance and transform circuits – series and parallel combination of elements – terminal pairs or ports – network functions for the one-port and two-port – poles and zeros of network functions – significance of poles and zeros – properties of driving point functions – properties of transfer functions – necessary conditions for driving point functions – necessary conditions for transfer functions – time domain response from pole-zero plot – amplitude and phase response from pole-zero plot – stability criteria for active network – Routh criteria

Hurwits polynomials – positive real functions – frequency response of reactive one-ports – synthesis of reactive one-ports by Foster's method and Cauer method – Synthesis of RL neteworkny Foster and Caur methods – synthesis of RC network by Foster and Cauer method

Unit 3: Two-port networks:

Two-port network – open circuit impedance (Z) -parameters – short circuit admittance parameters – transmission (ABCD) parameters – inverse transmission (A'B'C'D') parameters -hybrid (h) parameters – inverse hybrid (g) parameters – inter relationship of different parameters – inter connection of two port networks – T and π representation – terminated network – lattice networks – image parameters

Unit 4: Filters and attenuators:

Classification of filters – filter networks – equations of filter networks – classification of passband and stopband – characteristics impedance in pass band and stop band – constant-K low pass filter – constant-K high pass filter – m-derived T-section – band pass filter – band elimination filter – attenuators – T-type attenuator – π-type attenuator – lattice attenuator – bridge-T attenuator – L-type attenuator – equalizers – inverse network – series equalizer – full series equalizer – shunt equalizer – full shunt equalizer – constant resistance equalizer – bridge-T attenuation equalizer – bridge-T phase equalizer – lattice attenuation equalizer – lattice phase equalizer

Recommended books:

1. Circuits and networks: Analysis and synthesis

A. Sudhakar amdShyammohan S. Palli
Tata McGraw-Hill Publishing Company Limited
New Delhi

Reference books:

1. Network analysis and synthesis
   A K Chakraborty, LipikaDatta and Shankar Prasad Ghosh
   Tata McGraw-Hill publishing Company Limited
   New Delhi
2. Network analysis & synthesis: A conceptual approach
   U A Bakshi and A V Bakshi
   Technical publications Pune
3. Circuits
   A Bruce Carlson
   Cengage learning
   New Delhi
4. Introduction to circuit analysis and design
   TildonGlisson,Jr.
   Springer
   New Delhi

Paper 10: Fundamental of Communication Electronics

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Introduction to electronic communication and signal analysis and mixing

Introduction – power measurements (dB, dB_m , and Bel) – electronic communication systems – modulation and demodulation – the electromagnetic frequency spectrum – bandwidth and information capacity – noise analysis –

Signal analysis – complex waves – frequency spectrum and bandwidth – Fourier series for a rectangular waveform – linear summing – non-linear mixing

Unit 2: Oscillators, phase-locked loops, frequency synthesizers and amplitude modulation transmission

Oscillators – feedback oscillators – frequency stability – crystal oscillators – large-signal integration oscillators – phase locked loops – PLL capture and lock ranges – voltage controlled oscillator – phase comparator – PLL loop gain – PLL closed - loop frequency response – integrated-circuit precision phase-locked loop – digital PLLs – frequency synthesizers

Principles of amplitude modulation – AM modulating circuits – linear integrated-circuit AM modulators – AM transmitters – trapezoidal patterns – carrier shift – AM envelopes produced complex non-sinusoidal signals – quadrature amplitude modulation

Unit 3: Amplitude modulation reception and single side-band communication systems

Receiver parameters – AM receivers – AM receiver circuits – double-conversion Am receivers – net receiver gain

Single side-band systems – comparison of single side-band transmission to conventional AM – mathematical analysis of suppressed-carrier AM – single side-band generation – single side-band transmitters – independent sideband – single side-band receivers – amplitude-compandoring single sideband – single-sideband suppressed carrier and frequency-division multiplexing – double-sideband suppressed carrier and quadrature multiplexing – single-sideband measurements

Unit 4: Angle modulation transmission and angle modulation reception and FM stereo

Angle modulation – mathematical analysis – deviation sensitivity – FM and PM waveforms – phase deviation and modulation index – frequency deviation and percent modulation – phase and frequency modulators and demodulators – frequency analysis of angle-modulated waves – bandwidth requirements of angle-modulated waves – deviation ratio – commercial broadcast band FM – phasor representation of an angle modulated wave – average power of an angle-modulated wave – noise and angle modulation – preemphasis and deemphasis – frequency and phase modulators – frequency up-conversion – direct FM transmitters – indirect FM transmitters – angle modulation versus amplitude modulation

FM receivers – FM demodulators – phase-locked-loop FM demodulators – quadrature FM demodulator – FM noise suppression – frequency versus phase

modulation – linear integrated-circuit FM receivers – FM stereo broadcasting – two-way mobile communications service – two-way FM radio communications

Recommended books:

1. Electronic communication systems: Fundamentals through advanced
   Wayne Tomasi
   Pearson education (second impression)
   Delhi

Reference books:

1. Communication systems (Analog & digital)
   Sanjay Sharma
   Katson books (Fourth revised edition)
   New Delhi
2. Communication systems
   Simon Haykin
   Wiley (Fourth edition)
   New Delhi
3. Basics of electronic communications
   NIIT
   Prentice-Hall of India Pvt Ltd
   New Delhi

Paper 11: Power electronics

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Power diodes, transistors and thyristors:

Power semiconductor diode – power bipolar junction transistor – power metal oxide semiconductor FET – enhancement type power mosfet – comparison of bipolar junction transistor(BJT) and field effect transistor – insulated gate bipolar junction transistor – comparison of power mosfet and IGBTs – new semiconductor materials

Thyristors – thyristor turn on methods – gate control – trigger current, trigger voltage – details of turn on process, conduction and turn off process – turn on and turn off times – thyristor specifications and ratings – selection of parameters of triggering circuit – methods to improve di/dt and dv/dt ratings – DIAC – TRIAC: Bi-directional SCR – heat sinks and mountings -uni-junction transistor (UJT) – relaxation oscillator using UJT – SCR triggering circuits – pulse transformer triggering circuit – commutation of SCR – protection of thyristors – thyristors in series – thyristors in parallel – string efficiency, derating – triggering of thyristors in series – triggering of parallel connected thyristors – thyristor family – comparison between transistors and thyristors – power integrating circuits

Unit 2: controlled rectifiers and inverters

Performance indices pf rectifiers – single phase half wave converter – single phase half wave converter with R-L load and freewheeling diode – single phase full wave converter – single phase bridge converter – fully controlled bridge converter – fully controlled bridge converter with RLE load – semi-converter, resistive load – semi-converter, RLE load – single phase series converter – three phase full controlled bridge converter – three phase semi-converter – conversion of 3 phase and single phase converters – effect of source impedance on converter operation – single phase dual converter – three phase dual converter – twelve pulse converter

Series inverter – parallel inverter - single phase bridge inverter – commutation of single phase bridge inverter circuits – three phase bridge inverter – voltage and frequency control of single phase inverter – pulse width modulation – voltage control of 3 phase inverters – waveform control(Harmonic reduction) – waveform control using filters – current source inverter

Unit 3: choppers and AC regulators:

Chopper principle – control techniques – analysis of step-down chopper with resistance load – analysis of step-down chopper with RLE load – Fourier analysis of output voltage wave – classification of choppers – commutation methods for choppers – Jones chopper – Morgan chopper – multiphase chopper – step up chopper – AC chopper

Principle of integral cycle control – single phase half wave regulator – single phase full wave regulator(resistive load) – single phase full wave regulator with R-L load – three phase full wave regulator – static on-load tap changing of transformers – static multistage tap changer – industrial applications of AC regulators

Unit 4: cycloconverters and applications of thyristors:

Principle of operation – single phase cycloconverter using center tapped transformer – single phase bridge configuration – three phase to single phase bridge cycloconverter – three phase to three phase cycloconverter – blocked group operation – output voltage – circulating current mode of operation – reduction of harmonics in output of cycloconverters comparison of cycloconverter and DC link converter – difference between dual converter and cycloconverter

Overvoltage protection using thyristor – crowbar circuit – circuit breakers – zero voltage switch – integral cycle triggering – soft start – time delay circuit – logic gates using thyristors -controlled electric heating – induction heating – induction cooking – dielectric heating – comparison of induction heating and dielectric heating – electric welding – electrical system of automobiles – battery charging – illumination control using TRIAC – space heating and air conditioning – high frequency fluorescent lighting – excitation systems for alternators – static VAR system – HVDC system – application of power electronics in solar energy utilization – application of power electronics in wind energy utilization

Recommended book:

1. Power electronics
   Dr. B.R.Gupta and VandanaSinghal
   S.K.Kataria& sons(Fifth edition- reprint 2007 – 2008)
   Delhi

Reference books:

1. Power electronics
   M D Singh and K B Khanchandani
   Tata McGraw Hill (Second edition)
   New Delhi
2. PowerElectronics
   P.C. Sen,
   TMH Publication.
3. PowerElectronics: Circuits, Devices and Application
   Rashid,
   Pearson Education

Paper 12: Circuit simulation and PCB designing tools

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Introduction, tutorial, general concepts, graphics, properties and object specifics:

A guided tour of the ISIS editor – picking, placing and wiring up components – labeling and moving part references – block editing functions – practice makes perfect – annotating the diagram – creating new devices – finishing touches – saving, priniting and plotting – more about creating devices – symbols and the symbol library – report generation – a larger design

Screen layout – coordinate system – filing commands – general editing dacilities – wiring up – the automatic annotator – miscellaneous – graphics tutorial — object properties – sheet properties – design properties – parameterized circuits – the property assignment tool – property definitions

Components – dots – wire labels – scripts – buses – sub-circuits – terminals pin objects – simulator gadgets – 2D graphics – markers

Unit 2: library facilities, multi-sheet designs, netlist generation, report generation, hard copy generation and ISIS and ARES

General points about libraries – symbol library – device libraries – multi-sheet flat designs – hierarchical designs – net names – duplicate pin names – hidden power pins – special net names syntaxes – bus connectivity rules – generating netlist file – netlist formats – bill of materials – ASCII data import – electric rules check – printer output – plotter output – clipboard and graphics file generation – packaging – net properties and routing strategies – forward annotation-engineering changes – pin-swap / gate swap – re-annotation – back-annotation with ISIS

Unit 3: Introduction to DIP trace, pattern library creation, component library creation, designing schematics:

Dip trace installation – programs and formats – Dip trace on the web – problems statements – basic keywords – introduction to pattern editor – creating new pattern library – designing single pattern – using pattern templates – more about pattern templates – polygonal pads – edge connectors – mounting holes – import pattern form DXF – practical lesson #1 – practical lesson #2 – introduction to component editor – creating new component library – building single component – attaching pattern – creating net port connection – multi-part components – using pin manager – additional features of component editor – spice settings – practical lesson #3 – practical #4 – practical #5 – introduction to schematic – setting up workspace – working with libraries – placing components- nets and buses – multi-sheet schematic – component properties – design manager – hierarchical schematic – bill of material – spice settings – practical lesson #6 – practical lesion #7 – practical lesson #8

Unit 4: PCB layout:

Introduction to PCB layout – setting up workspace – components and nets – preparation to placement and routing – placement features – routing board – copper pours – post-routing features – design verification – manufacturing outputs

Recommended book:

1. Proteus tutorial manual
2. Dip Trace training manual

Reference books:

1. Printed circuit boards: design and technology
   Bosshart
   Tata McGraw Hill Education
2. Printed Circuit Board
   Dr. H.N. Pandya
   UniversityGranthNirman Board
   Gandhinagar
   Gujarat State
3. UnderstandingPCBDesigning
   Dr. H. N. Pandya,
   SaurashtraUniversityPublication

SEMESTER IV

Paper 13: Advance communication electronics

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Digital modulation and digital transmission:

Introduction – information capacity, bits, bit rate, baud, and M-ary encoding – amplitude shift-keying – frequency-shift keying – phase-shift keying – quadrature-amplitude modulation – bandwidth efficiency – carrier recovery – clock recovery – differential phase-shift keying – trellis code modulation – probability of error and bit error rate – error performance

Pulse modulation – PCM – PCM sampling – signal-to-quantization noise ratio – linear versus non-linear PCM codes – idle cannel noise – coding methods – companding – vocoders – PCM line speed – delta modulation PCM – adaptive delta modulation PCM – differential PCM – pulse transmission – signal power in binary digital signals

Unit 2: Digital T-carrier and multiplexing and telephone instruments and signals:

Time-division multiplexing – T1 digital carrier – north American digital hierarchy – digital carrier line encoding – T carrier system – European digital carrier system – digital carrier frame synchronization – bit versus word interleaving – statistical time-division multiplexing – codecs and combo chips – frequency-division multiplexing – At &T's FDM hierarchy – composite baseband signal – formation of a master group – wavelength-division multiplexing

- The subscriber loop – standard telephone set – basic telephone call procedures - call progress tones and signals – cordless telephones – caller ID – electronic telephones – paging

System

Unit 3: The public telephone network and cellular telephone concepts:

Telephone transmission system environment – the public telephone network – instruments, local loops, trunk circuits and exchanges – local central office telephone exchanges – operator-assisted local exchanges – automated central office switches and exchanges – north American telephone numbering plan areas – telephone service – north American telephone switching hierarchy – common channel signaling system No. 7 (SS7) and the post divestiture north American switching hierarchy

Mobile telephone service – evolution of cellular telephone – cellular telephone – frequency reuse – interference – cell splitting, sectoring, segmentation and dualization – cellular system topology – roaming and handoffs – cellular telephone network components – cellular telephone call procedure

Unit 4: Cellular telephone systems and satellite communication:

First-generation analog cellular telephone – personal communication system – second-generation cellular telephone systems – N-AMPS – digital cellular telephone – interim standard 95 (IS-95) – north American cellular and PCS

summary – global system for mobile communication – personal satellite communication system

History of satellites – Kepler's laws – satellite orbits – geosynchronous satellites – antenna look angles – satellite classifications, spacing and frequency allocation – satellite antenna radiation patterns: foot prints – satellite system link models – satellite system parameters – satellite system equations – link budget

Recommended books:

1. Electronic communication systems: Fundamentals through advanced
   Wayne Tomasi
   Pearson education (second impression)
   Delhi

Reference books:

1. Communication systems (Analog & digital)
   Sanjay Sharma
   Katson books (Fourth revised edition)
   New Delhi
2. Communication systems
   Simon Haykin
   Wiley (Fourth edition)
   New Delhi
3. Basics of electronic communications
   NIIT
   Prentice-Hall of India Pvt Ltd
   New Delhi

Paper 14: Op-Amp and its applications

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit1: IntroductiontoOperationalAmplifiers:

Introduction,TheOperationalAmplifier,Block Diagram Representation of a Typical Op-Amp, Analysis Of Typical Op-Amp Equivalent Circuit,SchematicSymbol,IntegratedCircuits,TypesofIntegratedCircuits,Manufacturers' Designationsfor Integrated Circuits,DevelopmentofIntegratedCircuits,IntegratedCircuit PackageTypes,PinIdentification, andTemperatureRanges,OrderingInformation,Device Identification,PowerSuppliesforIntegratedCircuits.Introduction,InterpretingaTypicalSet ofDataSheets,TheIdealOp-Amp,EquivalentCircuitofanOp-Amp,IdealVoltageTransfer Curve, Open-Loop Op-Amp Configuration, PSpiceSimulation, Introduction, Input Offset Voltage,InputBasicCurrent,InputOffsetCurrent,TotalOutputOffsetVoltage,Thermal Drift,EffectofVariationinPowerSupplyVoltagesonOffsetVoltage,ChangeinInputOffset VoltageandInputOffsetCurrentwithtime,OtherTemperatureandsupplyVoltageSensitive Parameters,Noise,Common-ModeConfiguration and Common-ModeRejection Ratio.

Unit2: An Op-Amp with negative Feedback and Frequency Response of an Op-Amp:

Introduction, BlockDiagram Representation of Feedback Configurations, Voltage-Series Feedback Amplifier, Voltage Shunt Feedback Amplifier, Differential Amplifiers, PSPICE Simulation.

Introduction, Frequency Response, Compensating Networks,FrequencyResponseofInternallyCompensatedOp-Amps,FrequencyResponseof Non-compensatedOp-Amps,HighFrequencyop-AmpEquivalentCircuit,OpenLoopVoltage GainasaFunctionofFrequency,Closed Loop FrequencyResponse,CircuitStability,Slew Rate

Unit3: GeneralLinearApplications, ActiveFilters andOscillators:

Introduction,DCandACAmplifiers,ACAmplifierswitha SingleSupplyVoltage,ThePeakingAmplifier,Summing,Scaling,andAveragingAmplifier, Instrumental Amplifier, Differential Input and Differential Output Amplifier, Voltage to CurrentConvertorwith Floating Load,VoltagetoCurrentConvertorwithGroundedLoad, Current to Voltage Convertor, Very High Input Impedance Circuit, The Integrator, The Differentiator, PSpiceSimulation.

Introduction, Active Filters,First-OrderLow-Pass Butterworth Filter,Second-OrderLowPassButterworthFilter,First-OrderHighPassButterworthFilter, SecondOrder HighPassButterworthFilter,HigherOrderFilters,Band-PassFilters,Band- RejectFilters,All-PassFilters, Oscillators,PhaseShiftoscillator,WienBridgeOscillator, QuadratureOscillator,SquareWaveGenerator, TriangularWaveGenerator,SawtoothWave Generator, VoltageControlled Oscillator, PSpiceSimulation.

Unit4: Comparators, Convertors and Specialized IC Applications:
Introduction, Basic Comparator,Zero-Crossing Detector,SchmittTrigger,Comparator Characteristics,Limitations ofOp-Ampas Comparator,VoltageLimiters,HighSpeedandPrecisionTypeComparators, WindowDetector,Voltageto FrequencyandFrequencytoVoltageConvertors,Analogto DigitalandDigitaltoAnalogConvertors, ClippersandClampers,AbsoluteValueOutput Circuit,PeakDetector,SampleAndHoldCircuit,PSpiceSimulation.UniversalActiveFilters, SwitchedcapacitorFilter,The555Timer,PhaseLockedloops,Power Amplifiers,Voltage Regulators, PSpiceSimulation.

Recommended-Book:

1. "Op-Amps andLinearIntegrated Circuits"byGayakwad, Pearson Education.

Reference-Book:

1. Electronics devices andcircuits
J.B. Gupta, S.K. Kataria and son's publication,
New Delhi
2. Operational Amplifiers withLinearIntegrated Circuits"
Stanley,
Pearson Education.

Paper 15: Elements of C language

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Overview of C, constants, variables, data types, operators abd expressions:

History of C – importance of C – sample program 1: printing a message – sample program 2: adding two numbers – sample program 3: interest calculation – sample program 4: use of subroutines – sample program 5: use of math functions – basic structure of C programs – programming style – unix system – MS-DOS system

Character set – C tokens – keywords and identifiers – constants – variables – data types – declaration of variables – declaration of storage class – assigning values to variables – defining symbolic constants – declaring a variable as constant – declaring a variable as volatile – overflow and underflow of data

Arithmetic operators – relational operators – logical operators – assignment operators – increment and decrement operators – conditional operators – bitwise operators – special operators – arithmetic expressions – evaluation of expressions – precedence of arithmetic operators – some computational problems – type conversions in expressions – operator precedence and associativity – mathematical functions

Unit 2: Managing input, output operations, decision making and branching, decision making and looping:

Reading a character – writing a character – formatted input – formatted output

Decision making with if statement – simple if statement – the if…else statements - nesting of if…else statements – the else if ladder – the switch statemen – the ?: operator – the goto statement – the while statement – the do statement – the for statement – jumps in loops – concise test expressions

Unit 3: Arrays, character arrays, strings, and user defined functions:

One-dimensional arrays – declaration of one-dimensional arrays – initialization of pne-dimensional arrays – two-dimensional arrays – initialing two-dimensional arrays – dynamic arrays – more about arrays

Declaring and initializing string variables – reading strings from terminal – writing strings to screen – arithmetic operations on characters – putting strings together – comparison of two strings – string-handling functions – table of strings – other features of strings

Need for use defined functions – a multi-function program – elements of user-defined functions – definition of functions - return values and their types – function calls – function declaration – category of function – no arguments and no return values – arguments but no return values – arguments with return values – no arguments but returns a value – functions that return multiple values – nesting of functions – recursion – passing arrays to functions – passing arrays to functions – passing strings to functions – the scope, visibility and lifetime of variables – multifile programs

Unit 4: structures, unions, pointers and file management in C:

Defining a structure – declaring structure variables – accessing structure members – structure initialization – copying and comparing structure variables – operations on individual members – arrays of structures – arrays within structures – structures within structures – structures and functions – unions – size of structures – bit fields

Understanding pointers – accessing the address of a variable – declaring pointer variables – initialization of pointer variables – accessing a variable through its pointer – chain of pointers – pointer expression – pointer increments and scale factor – pointers and arrays – pointers and character strings – array of pointers – pointers as function arguments – functions returning pointers – pointers to functions – pointers to structures – troubles with pointers

Defining and opening a file – closing a file – input/output operations on files – error handling during I/O operations – random access to files – command line arguments

Recommended book:

1. Programming in ANSI C
   E Balagurusami
   Tata McGraw Hill (Sixth edition)
   New Delhi

Reference books:

1. Let us C
   YashvantKanitkar
   BPB publication
   New Delhi
2. C and data structures
   Prof. P.S.Deshpande and Prof. O.G.Kakde
   Dreamtech Press

Paper 16: Basic instrumentation

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Qualities of Measurements:
Introduction, Performance Characteristics, Static Characteristics, Types of Static Error, Sources Of Errors, Dynamic Characteristic, Statistical Analysis, Standard, Automatic Frequency And Time Standards, Electrical Standards, Graphical Representation Of Measurements As Distribution.
Indicators and Display Devices: Basic Meter Movement, Taut band instrument, Electrodynamometer, Moving Iron Types Instruments, Concentric Vane Repulsion Instrument, Digital Display System and Indicators, classification of Displays, Display Devices, LED, LCD, Other Displays

Unit 2: Ammeters, Voltmeters and Multimeters:
DC Ammeter, Multirange Ammeter, The Aryton
Shunt or Universal Shunt, Requirements of a Shunt, Extending of Ammeter Ranges, Effect of Frequency on Calibration, Measurement of Very Large Currents by Thermocouples.
Basic meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter, Extending Voltmeter Ranges, Loading, Transistor Voltmeter, Chopper Type DC Amplifier Voltmeter, Solid State Voltmeter, AC Voltmeter using Rectifiers, AC Voltmeter Using Half Wave Rectifiers, AC Voltmeter Using Full Wave Rectifier, Multirange AC Voltmeter, Peak Responding Voltmeter, True RMS Voltmeter, True RMS Meter, Considerations in Choosing an Analog Voltmeter.
Ohmmeter, Shunt Type Ohmmeter, Calibration of DC Instrument, Calibration of Ohmmeter. Multimeter, Multimeter Operating Instructions.

Unit 3: Digital Voltmeters and Digital Instruments:
Ramp Technique, Dual Slope, Integrating Type DVM, Integrating Type DVM, Most Commonly Used Principles of ADC, Successive Approximation, 3½ Digit, Resolution And Sensitivity of a DVM, General Specification of a DVM, Microprocessor Based Ramp Type DVM.
Digital Multimeters, Digital Frequency meter, Digital Measurement of time, Universal Counter, Decade Counter, Electronic Counter, Digital Measurement of frequency, Digital Tachometer, Digital Phase meter, Digital capacitance meter, microprocessor based instruments, The IEEE 488 Bus.

Unit 4: Oscilloscope and Signal Generators:
CRT Features, Basic Principle of Signal Display, Block Diagram of Oscilloscope, Simple CRO, Vertical Amplifier, Horizontal Deflecting System, Triggered Sweep CRO, Trigger pulse Circuit, Delay Line in Triggered Sweep, Sync Selector for Continuous Sweep CRO, Typical CRT Connections, High Frequency CRT, Dual Beam CRO, Dual Trace Oscilloscope, sampling Oscilloscope, Storage Oscilloscope, Measurement of Frequency by Lissajous Method, Spot Wheel Method, Gear Wheel Method, Checking of Diodes, Basic Measurement of Capacitance and inductance, Use of Lissajous Figures For Phase
Measurement, Probes for CRO, Attenuators, Applications of Oscilloscope, Delayed Sweep, Digital Storage Oscilloscope,
Fixed Frequency AF Oscillator, Basic Standard Signal Generator, Standard Signal Generator, Modern Laboratory signal Generator, AF sine and square wave generator, Function Generator, Square and pulse Generator, Random Noise Generator, Sweep Marker Generator,

Wobbluscope

Recommended books:

1. Electronic Instrumentation
   H S Kalsi, Second Edition,
   Tata McGraw-Hill Companies.

Reference-Books:

1. Electrical and Electronic Measurements and Instrumentation
   A K Sawhney.
   Dhanpat Rai & Sons publications.
2. Electronic Instruments and Instrumentation Technology
   M.M.S. Anand,
   PHI.
3. Electronic Instrumentation and Measurements
   Bell,
   PHI.
4. Modern Electronic Instrumentation and Measurement Techniques
   Albert Helfric& William Cooper;
   PHI
5. Industrial Instrumentation & Control
   S.K.Singh
   Tata McGraw-Hill Companies
6. Instrumentation, Measurement and Analysis
   Nakra B. C. and Chaudhary K. K.
   Tata McGraw-Hill Companies