GUJARAT UNIVERSITY

Revised Syllabus

To be implemented from Year 2024-2025

M. Sc (Electronic Sciences)

SEMESTER – I

Course	Name of the Course	Lect. Hrs. / Week	Marks			Course Credits
			Internal	External	Total	
ELE-401	Digital System Design and Instrumentation - I	4	30	70	100	4
ELE-402	Linear ICs & Fiber optics	4	30	70	100	4
ELE-403	Optoelectronic devices & Microprocessor - I	4	30	70	100	4
ELE-404	Solid State Physics & Electronic communication – I	4	30	70	100	4
ELE-405 PR	Practicals	8	30	70	100	4
ELE-406 PT	Project	8	30	70	100	4
TOTAL		**32**	**180**	**420**	**600**	**24**

M. Sc (ELECTRONIC SCIENCES) SEMESTER – I

ELE-401: Digital System Design and Instrumentation - I

UNIT – I Logic System Design

a. Combinational Logic Design : Design of code converters : BCD to Decimal, Decimal to BCDusing universal gates
b. Design of synchronous sequential digital circuits : Concepts of excitation (transition) tables, Synthesis rules of transition tables, Design of MOD-3, MOD-5, Decade Counter using J-K FlipFlop
c. Design of Driver circuits : Seven segment decoder driver, Multiplexed display
Introduction to HDL, Overview of Digital System Design using HDL, Verilog HDL : VHDLCode, Gate level implementation, VHDL Operators, Basic Combinational logic circuits

UNIT – II

Sequential logic circuit design and specialized ICs

a. Data flow modeling of HDL, Basic arithmetic and combinational logic circuits using VHDL,
b. HDL implementation of Flip-Flop,
c. Register implementation in HDL,
d. Counter design using HDL

UNIT – III: Analytical instrumentations

Analytical instrumentations

Strain gauges and measurement of strain, Ballast circuit, Wheastone bridge, Gauge sensitivity, Temperature compensation, Temperature compensation and cancellation techniques, strain gauge calibration, load cell, strain gauge circuitry, uses of strain gauges. Thickness measurements, measurement of thermal conductivity (gas analyser)

UNIT – IV: Secondary transducers and applications

Ultrasonic transducer types, Magnetostrictive and piezoelectric, Principle of ultrasonic measurement, Generation of ultrasonic wave, applications of ultrasonic waves, testing of materials by ultrasonic, ultrasonic in means of communication, cutting and machining of hard material, soldering and welding by ultrasonic. Digital methods for measurement of angular velocity. Measurement of Liquid levels, Flow measurement using hot wire and thermistor.

Reference Books:

Unit I & II

1. Digital Principles And Applications (Seventh Edition), Donald P Leach, Albert Paul Malvino, Goutam Saha, Tata McGraw Hill Education Private limited, NEW DELHI (2011)
2. Verilog HDL A guide to Digital Design and Synthesis, Samir Palnitkar, SunSoft Press (1996)
3. VHDL: Programming by Example by Douglass L Perry, 4th edition, McGraw-Hill (2002)
4. VHDL Primer J. Bhaskar, Addison Westley Longman (Singapore) Pvt Ltd, (2000).
5. Circuit design with VHDL, Volnei A Pedroni, MIT press
6. VHDL- Analysis and Modeling of Digital systems, Zainalabedin Navabi, McGraw-Hill International Editions.

Unit III & IV

1.R.S.Khandpur, Handbook of Analytical Instruments (TMH)
2. R. S. Khandapur, Hand Book of biomedical Instrumentation, (TMH)
3. A. K. Sawhney, A Course on Electrical and electronic measurements and Instrumentation (Dhanpatrai & Sons).
4. Bennedict and Weiner, Industrial Electronic Sciences
5. G. K. Mittal, Industrial Electronic Sciences, Khanna Pub.
6. H. S. Kalsi, Electronic Instrumentation, TMH
7. Joseph J. Carr, Elements of Electronic Instrumentation and measurement, Restor Book PHI.

M. Sc (ELECTRONIC SCIENCES) SEMESTER – I

ELE-402 Linear ICs & Fiber optics

Unit – I: Comparators & Power Amplifiers

Comparators : Comparator characteristics, Limitations of OpAmp as comparator, Voltage Limiters, High Speed and Precision type Comparator, Window detector - IC LM 1414, IC-BB 4115.

Power Amplifiers :

Level detector for photodiode using LM311, ON/OFF Temperature controller using LM 339 Power amplifier: IC LM 380 and LM 384.

Unit – II: Waveform Generators and Converters:

Waveform Generators: Phase shift Oscillators, Wein bridge Oscillators, Quadrature Oscillators, Square Wave Generator, Triangular Wave Generator, Saw-tooth Wave Generator.
Voltage Controlled Oscillator - IC 566 , Function Generator - IC 8038
Converters : V to F and F to V converters - IC 9400

Unit – III: Fiber optics fundamentals:

Principles of light, transmission in a fiber - propagation with in a fiber, fiber index profiles, Modes of propagation modes in step index fiber, single mode fiber. Losses in fibers – Rayleigh scattering losses, absorption losses, leaky modes, mode coupling losses, bending losses, combined fiber losses. Dispersion - effect of dispersion on pulse transmission, intermodal dispersion, material (chromatic) dispersion, waveguide dispersion, total dispersion and maximum transmission rates. Light sources and detectors for fiber optics. optical receiver circuit. Connectors and splices - losses in connectors and splices, connectors, fibre splices.

Unit – IV: Fiber Optic Communication:

Concepts of wavelength-division multiplexing (WDM) and dense WDM, Passive components – couplers, Communication system design considerations for point-to-point links, Digital systems, Analog systems, System architecture, point to point links, distribution networks, Local area networks, Non-linear effects and system performance, Stimulated Raman scattering, Stimulated Brillouin scattering, Four-wave Mixing, Self- and Cross-phase Modulation, Solitons.

Reference Books:

Unit I & II

1. Ramakant Gayakwad, OpAmp. and Linear Integrated circuits, PHI. (3rd Ed.)
2. K.R. Botkar, Integrated circuits, Khanna Prakashan, (8th Ed).
3. Coughlin and Driscoll, Operational Amplifiers and Linear integrated circuits, PHI

Unit III & IV

1. R. P. Khare, Fiber Optics and Optoelectronic Sciences, 2004 Oxford University Press Topics 11.1 to 11.3, 12.1 to 12.6
2. D. Roddy and J. Coolen, Electronic Communications, 4th Ed., Pearson India, New Delhi (2014).
3. W. Tosmasi, Advanced Electronic Communication System, 6th Ed. Pearson India, New Delhi (2015).
4. G. Keiser, Optical Fiber Communications, 5th Ed., MGH, New Delhi (2017).
5. J. M. Senior, Optical fiber communication – Principles and practices, Prentice Hall, 1999.

M. Sc (ELECTRONIC SCIENCES) SEMESTER – I

ELE- 403 Optoelectronic devices & Microprocessor - I

Unit – I: Sources

LED: Introduction, Radiative transitions, Emission spectra, Methods of excitations, LED-Structures;-Planar LED, Domed shaped LED, Heterojunction LED, Surface Emitting LED, Edge EmittingLED,; Definition of efficiencies; LASER: Laser physics, stimulated emission and population inversion, Laser operating characteristics, Semiconductor Laser: Semiconductor laser structure

Unit – II: Detectors

Introduction, Photoconductor, Photodiodes- General consideration, quantum efficiency, response speed, device noise, p-i-n & p-n photodiodes, Heterojunction photodiode, Metal Semiconductor photodiode, Avalanche photodiode, avalanche gain, avalanche multiplication noise, Phototransistor.

Unit-3: Code Conversion and Interrupt Microprocessor

BCD-to-Binary Conversion, Binary-to-BCD Conversion, BCD-to-Seven-Segment-LED Code Conversion, Binary-to-ASCII-to-Binary Code Conversion, BCD Addition, BCD Subtraction, Introduction to Advanced Instructions and Applications, Multiplication, Subtraction with Carry, the 8085 Interrupt.

Unit-4: **Programmable Interface Devices**

8155 I/O and Timer; 8279 Keyboard/Display Interface

Basic Concepts in Programmable Devices, The 8155: Multipurpose Programmable Device, The 8279 Programmable Keyboard/Display Interface.

General-Purpose Programmable Peripheral Devices

Introduction to the 8255A Programmable Peripheral Interface (PPI), Illustration: Interfacing Keyboard and Seven-Segment Display, Illustration: Bidirectional Data Transfer Between Two Microcomputers,

The 8254(/8253) Programmable Interval Timer, The 8259A Programmable Interrupt Controller, Direct Memory Access (DMA) and the 8237 DMA Controller.

Reference books:

Unit I & II

1. S.M. SZE and Kwok K.Ng, Physics of semiconductor devices 3rd ed. Wiley
2. R.P.Khare , Fiber optics and optoelectronics Oxford university press
3. A.K. Ganguly, Opto electronic Devices and Circuits, (NAROSA)

Unit III & IV

1. R. S. Gaonkar, Microprocessor Architecture, programming and applications,
2. P.K. Ghosh & P.R. Sridhar, 0000 to 8085 Introduction to microprocessors for engineers and scientists.
3. B.Ram, Microprocessors and Microcomputers, Dhanpatrai and Sons.

M. Sc (ELECTRONIC SCIENCES) SEMESTER – I

ELE-404 Solid State Physics & Electronic communication – I

Unit – I: Energy Bands and Fermi Surfaces

Energy Bands:

Introduction, Nearly Free Electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, The Kroning-Penney model, Wave Equation of electron in a periodic potential, Crystal momentum of an electron, Solution of the central equation, Empty lattice approximation, Approximate solution near a zone boundary, Number of orbitals in a band.

Fermi Surfaces and Metals:

Introduction, Periodic zone scheme, Extended zone scheme, Reduced zone scheme, Construction of Fermi surfaces, electron orbits, hole orbits and open orbits, Calculations of energy bands, Tight binding method for energy bands, Experimental methods in Fermi Surface studies, Quantization of orbits in a magnetic field, de - Haas - Van Alphen Effect.

Unit – II: Superconductivity:

Introduction, Occurrence of superconductivity, Destruction of superconductivity of magnetic field, Meissner effect, Heat Capacity, Energy gap, Isotope effect, Thermodynamics of the superconducting transition, London equation, Coherence Length, BCS theory of superconductivity, BCS ground state, Flux quantization in a superconducting ring, Duration of persistence current, Type-I and Type-II superconductors, Vortex state, Estimation of Hc1 and Hc2, Single particle tunnelling, Josephson superconductor tunnelling, DC Josephson effect, AC Josephson effect, Macroscopic quantum interference, Introduction to High Tc Superconductors, Problem Solving.

Unit III :Transmission Lines & Microwave Waveguides:

Transmission Lines: Introduction, Primary Line Constants, Phase Velocity and Line Wavelength, Characteristic Impedance, Propagation Coefficient, Phase and Group Velocities, Standing Waves, Lossless Lines at Radio Frequencies, Voltage Standing-wave Ratio, Slotted-line Measurements atRadio Frequencies, Transmission Lines as Circuit Elements, quarter wave line, stub line Smith Chart, Time-domain Reflectometry.

Microwave Waveguides: Introduction, Rectangular waveguides : solution of wave equation, rectangular coordinates, TE modes in rectangular waveguides, TM modes in rectangular waveguides, power transmission in rectangular waveguides, excitation of modes in rectangular waveguides, characteristics of standard rectangular waveguides, circular waveguides : solution of wave equation in cylindrical coordinates, TE and TM modes in circular waveguide.

Unit IV : Radio wave Propagation :

Propagation in Free space: mode of propagation, Tropospheric Propagation : mode of propagation, radio horizon, attenuation in atmosphere, Ionospheric Propagation : ionospheric layers, mechanism by which ionsophere effects wave propagation, plasma frequency and critical frequency, refraction of radiowaves, Secant law and MUF, skip distance, virtual height, effects ofearth's magnetic field, service range, ionospheric irregularities and fading, Surface Wave : mode of propagation, ground wave.

Reference Books:

Unit I & II

1. C. Kittle, Introduction to Solid State Physics, 8th Ed., Wiley Eastern Limited, New Delhi (2018).
2. J. P. Srivastava, Elements of Solid State Physics, 4th Ed., PHI Learning Private Limited, Delhi (2016).
3. C. M. Kachhava, Solid State Physics, Solid State Devices and Electronic Sciences, New Age International Publishers, New Delhi (2011).
4. S. O. Pillai, Solid State Physics, 10th Ed. New Age International Publishers, New Delhi (2023).
5. S. L. Kakani and C. Hemrajani, Solid State Physics – Theory, Applications and Problems, Sultan Chand and Sons, New Delhi (2014).
6. B. S. Saxena, P. N. Saxena, R. C. Gupta and J. N. Mandal Fundamentals of Solid State Physics, 32nd Ed., Pragati Prakashan, Meerut (2022).
7. A. K. Saxena, Solid State Physics (With an Introduction to Semiconductor Devices), 3rd Ed., Trinity Press, New Delhi (2014).

Unit III & IV

1. D. Roddy & J. Coolen, Electronic Communications, (4th Ed.), Prentice Hall of India
2. Samuel Y. Liao, Microwave Devices and circuits, Prentice Hall of India.
3. D.C.Sarkar, Microwave Propagation and Technique, S.Chand and Company Ltd. New Delhi.
4. George Kennedy, Electronic Sciences and Communication systems, McGraw Hill Int. Edition.
5. Edward C. Jordan and Keith G. Balman, Electromagnetic waves and Radiating systems, Prentice Hall of India.

M. Sc (ELECTRONIC SCIENCES) SEMESTER – I ELE– 405 PR : PRACTICALS	
Sr.No.	**Title of the Practical**
1	Astable multi-vibrator using OP-AMP
2	R-C Phase shift oscillator using OP-AMP
3	Schmitt trigger using OP-AMP
4	Nonlinear characteristics of OP-AMP
5	Active filter using OP-AMP
6	Optoelectronic Devices Characteristics – I
7	Optoelectronic Devices Characteristics – II
8	Ultrasonic Interferometer
9	Voltage Controlled Oscillator using IC-566
10	Microwave (Guide Wavelength)
11	Study of Transmission Line characteristics using Trainer Kit
12	LASER – measurement of wavelength using foot-rule
13	The sensitivity coefficient of a strain gauge
14	ExpEyes based experiments I
15	ExpEyes based experiments II

15% of new experiments can be introduced AND / OR replaced as per the need, with the permission of the Chairman of Board of studies.

M. Sc (ELECTRONIC SCIENCES) SEMESTER – I

ELE - 406PT : POJECT

- In-house project work of 4-credit to be performed by each student.
- Alternatively, MOOC, Swayam or any other UGC recognized online course in ELECTRONIC SCIENCES of at least 03 weeks duration and equivalent to 4 credits will also be considered for 4-credit in this course.
- Every student shall work on a project under a faculty member of the department.
- Project work may be carried out within the department or in other department, or from other institution (if required).
- Allotment of the supervisors shall be done by the Department.
- The supervisor shall act as the instructor for this course on project and make continuous assessment based on the understanding/ literature survey, experimental/ theoretical formulation, performance, interpretation of results and writing of Report.
- End-semester evaluation will be based on evaluation of report, presentation and viva voce examination of the candidate at the end of the semester by a panel of examiners.

GUJARAT UNIVERSITY

Revised Syllabus

To be implemented from Year 2024-2025

M. Sc. (Electronic Sciences)

SEMESTER – II

Course	Name of the Course	Lect. Hrs. / Week	Marks			Course Credits
			Internal	External	Total	
ELE-407	Microprocessor-II and Microcontroller-I	4	30	70	100	4
ELE-408	DSP-I & Power Electronics - I	4	30	70	100	4
ELE-409	Thin Film Technology	4	30	70	100	4
ELE-410	Instrumentation - II & Microwaves - I	4	30	70	100	4
ELE-411 PR	Practicals	8	30	70	100	4
ELE-412 PT	Project	8	30	70	100	4
TOTAL		**32**	**180**	**420**	**600**	**24**

M. Sc. (Electronic Sciences) SEMESTER – II
ELE - 407: Microprocessor-II and Microcontroller-I

Unit - I: Serial I/O and Data communication:

Basic concepts in serial I/O, Transmission format, Introduction, Types of Communication Systems, Transmissions Standards, Serial Transmission Format, Data Communication over long distances, Block Diagram of Typical Modem device, Modulation Techniques

Interrupt System & Controller:

Features of 8259, Pin configuration of 8259, Functional block diagram of 8259, initialization command words of 8259

8253/8254 Programmable Internal Timer: Introduction Features of Programmable. Interval Timer, Pin Configuration, Functional Block Diagram, Control word register Format, Modes of Operation, Write Operation, Read Operation, Interfacing, Problems.

Unit - II: Microprocessor Application:

Measurement of electric quantities: Frequency Measurement, Interface of frequency measurement, Program flow chart for frequencymeasurement, Frequency measurement using SID line

Measurement of physical quantities: Temperature Measurement & Control, Water Level Indicator, INTEL 8086 Microprocessor: Introduction, INTEL 8086, Pin diagram and Pin Description, Operating Modes, Block Diagram, Pin Description of Minimum Mode/Maximum Mode, Operation of 8086, Register of Intel 8086, Interrupts, Addressing Modes of Intel 8086.

Unit - III: Microcontroller 8051 Architecture and Data moves:

Introduction, microprocessor and microcontroller, 4-Bit/8 Bit/16 Bits/32 Bit/ microcontrollers.

The 8051 Architecture**:** Introduction, 8051 Microcontroller Hardware, Input/output pins, ports and circuits, External memory, counters and timers, serial data input/output, interrupts.

Moving data: Introduction, Addressing modes, External data moves, code memory, Read only data moves, push and pop opcodes data exchange, example programs.

Unit - IV: Logical and Arithmetic operations, Subroutines:

Logical operations: Introduction, Byte-level logical operations, Bit-level logical operations, Rotate and swap operations, Example programs.

Arithmetic operations: Introduction, Flags, Incrementing and Decrementing, Addition, subtraction,multiplication and division, decimal arithmetic, example programs.

JUMP & CALL SUBROUTINES: Introduction, the jump and call program Range, Jump. Calls and subroutines, interrupts and returns, more details on interrupts example problems.

Unit I & II

1. R.S.Gaonkar, Microprocessor Architecture, programming and applications,
2. P.K. Ghosh & P.R. Sridhar, 0000 to 8085 Introduction to microprocessors for engineers and scientists.
3. B.Ram, Microprocessors and Microcomputers, Dhanpatrai and Sons.

Unit III & IV

1. Kenneth J.Ayala, The 8051 Microcontroller, Architecture, Programming & Application, Penram, International. West Publication Company
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi," The 8051 microcontroller and embedded systems using Assembly and C",second edition, Pearson education /Prentice hall of India, 2007.
3. D.Karunasagar, "The 8051 microcontroller", Cengage Narosa Publication House Pvt. Editions 2011.

M. Sc.(Electronic Sciences) SEMESTER – II

ELE - 408: DSP-I & Power Electronics - I

Unit – I: Digital Signal Processing

Discrete time signals, Discrete time systems, Analysis of discrete time linear time invariant systems. Solving difference equations using Z – Transformation, Responses of systems Voice processing, Application of radar, Application to image processing, Adaptive canceling of mother's ECG infoetal ECG, Adaptive telephone echo cancellation.

Unit – II: Discrete Fourier Transform

Introduction, computation of DFT, inverse discrete Fourier transformation, periodicity and symmetry properties of DFT, Comparison between DTFT and DFT, Circular convolution property of DFT, Solving convolution problems using various methods, Additional properties of DFT, Block convolution Application of digital signal processing: Introduction, Application of DSP classification, Applications in broader sense.

UNIT-III: Thyristors

Turn on methods of a thyristor, dynamic turn-on switching characteristics, Turn-off mechanism, Turn off methods, Thyristor types, Thyristor rating, di/dt and dv/dt protection. Series and parallel operation of Thyristor.

Gate triggering circuits : Firing of Thyristors pulse transformers, optical isolators, gate trigger circuits, programmable UJT (PUT), Phase control using pedestal and ramp triggering.

UNIT-IV: Phase control rectifiers and Thyristor applications :

Introduction, Phase angle control, single-phase half/full wave controlled rectifier, single phase half-controlled bridge rectifier. Thyristor applications : Overvoltage protection, Fan regulator, Automatic battery charger, zero voltage switch, Integral cycle triggering, switch mode power supplies (SMPS), Uninterruptable power supply (UPS), ARC welding, Automatic voltage regulator using relays and servomotor.

Reference books:

Unit I & II

1. B. Somanathan Nair, Digital signal processing theory, analysis and digital filter design,
2. John G. Proakis and D.G. Manolakis, Digital signal processing principles, Algorithms and applications
3. S. Salivahanan, A Vallavraj and C. Gnanapriya, Digital Signal processing,TMH

Unit 3 & 4

1. M.D.Singh & K.B. Khancdandani, Power Electronic Sciences, THM.
2. M.H.Rashid, Power Electronic Sciences, PHI.
3. G.K.Mithal, Industrial Electronic Sciences, Khanna Publishers Delhi (1973).
4. P.S.Bimbhra, Power Electronic Sciences, KP
5. H.C. Rai, Power Electronic Sciences, devices and system

M. Sc. (Electronic Sciences) SEMESTER – II

ELE - 409 : Thin Film Technology

Unit – I : Vacuum Techniques and deposition

Creation of Vacuum with different Vacuum Pumps, Measurement of Vacuum with different Gauges.

Evaporation Theory. Physical Vapour Deposition methods, Direct, Flash, Electron Beam, Inductive Heating Evaporation. Uniform deposition. Types of substrate holders. Deposition Monitoring.

Unit – II : Thin Film Growth

Diode Sputtering, DC and RF mode. Magnetron Sputtering DC and RF mode. Ion Beam Sputtering Yield and Influenced factors. ECR Sputtering Technique. CVD methods. Various types of CVD reactions.

Growth of thin films: Substrates Cleaning, Condensation, Nucleation Structural Consequences. Growth stages.

Unit – III : Thin Flm Characterization

Surface and bulk structure determination techniques: X-ray Diffraction, Grazing Incidence XRD, Electron Diffraction, LEED, RHEED Techniques, Electron Microscopy: Scanning Electron Microscopy, Transmission Electron Microscopy, Chemical analysis: Electron Probe Microanalysis- EDAX, Auger Electron Spectroscopy, X-ray photoelectron spectroscopy, ESCA.

Unit – IV : Thin Film Devices

Thin Film Passive Devices: Resistors Materials, Design of Resistors. Measurement of Sheet Resistance, Trimming of Resistors, TCR of resistor. Thin Film Capacitors: TFC materials criteria,TFC materials, Design flow.

Thin Film Active Devices: Thin Film Field Effect Transistors, Designing techniques, Effect of design process on I-V characteristics, Thin Film Diodes, Thin Film circuits: complementary invertors

Reference Books:

1. Leon I. Maissel and Reinhard Glang, Handbook of Thin Film Technology, Tata McGraw Hill Int. Edition
2. K. L. Chopra and L. K. Malhotra, Thin film technology and applications, Tata McGraw Hill, India
3. J. J. Coutts, Active and passive Thin Film Devices, Academic Press
4. Milton Ohring, The Materials Science of thin films, Academic Press
5. K. L. Chopra, Thin Film Phenomena, Tata McGraw Hill, India
6. John L. Vossen and Werner Kern, Thin Film processes, edited, Academic Press

M. Sc. (Electronic Sciences) SEMESTER – II

ELE - 410: Instrumentation - II & Microwaves - I

Unit -I : Bioelectric potentials :

The Electrocardiogram. Electrodes : Electrode theory, Biopotential Electrodes : Microelectrodes, Body surface electrode, Needle electrodes, Electrocardiography : History, Electrodes and leads : Electrodes, Leads, ECG Recorder principles. Measurement of blood pressure using - sphygmomanometer, programmed Electrosphygmomanometer, Electronic sphygmomanometer.

Spectrophotmeters : Radiation sources, Monochromator, Sample counters, detectors, Indicators, UV, Visible and IR spectrophotometers (Single beam and double beam).

Special purpose oscilloscopes : Multi beam oscilloscope, Multi trace oscilloscope, sampling oscilloscope, Impulse waveform oscilloscopes, scanning oscilloscope, Digital storage oscilloscope, power scope, spectrum analyzer, electron microscope, synchroscope

Unit -II: Data Acquisition systems

Analog input, Analog Output, Digital I/O, Timing I/O, Data Acquisition Configurations-Local Data acquisition, GPIB Data Acquisition, Data Acquisition Using Serial Interfaces, Networked Data Acquisition

Data Acquisition Using GPIB Overview, GPIB Commands, GPIB Programming, Expanding GPIB; IEEE-488.2, SCIPI 417, HS488 Protocol

Data Acquisition Using Serial Interfaces Serial Communication, Serial interface Standards, PC serial port, Microcontroller Serial Interfaces, USB, IEEE1394, Remote I/O Modules

UNIT III : Microwave components and Strip lines

Microwave components : Microwave cavities (Rectangular cavityresonators, circular cavity resonator and semicircular cavity resonator, Q-factor ofa cavity resonator), Microwave hybrid circuits (Waveguide Tees, magic Tees, hybrid rings, waveguide corner bends and twists). Directional couplers (Two hole directional couplers, S-matrix of directional coupler, hybrid couplers), Circulators and Isolators (microwave circulators and microwave isolators).

Strip lines : Microstrip lines (Characteristics impedance of microstrip line, Effective dielectric constant, Transformation of rectangular conductor into equivalent circular conductor, characteristic impedance equation, Losses in microstrip lines, Quality factor Q of microstrip lines).Parallel striplines (Distributed parameters, characteristic impedance, Attenuation losses), coplanner strip lines,shielded strip lines.

Unit IV: Microwave Tubes:

Microwave Tubes: Conventional Vacuum triodes, tetrodes & pentodes (Lead inductance and interelectrode-capacitance effect, transit angle effect, Gain band, Width limitations).

Klystrons (Reentrant cavities, velocity modulation process, bunching process, output power and beam loading, state of the art), Multicavity Klystron amplifiers, beam current density, output current and output power of two cavity Klystron). Reflex Klystrons (Velocity modulation, power output and efficiency, electronic admittance). Helix Travelling-Wave Tubes TWTs (Slow wave structures, amplification process, convection current, axial electric field, wave modes, Gain considerations). Magnetron Oscillators (Cylindrical magnetron, equation of electron motion, cyclotron angular frequency, power output and efficiency).

MMIC: Monolithic microwave integrated circuits (Materials, substrate materials, conductor materials, Dielectric materials, Resistive materials), MMIC Fabrication techniques, Fabrication examples, Thin Film Formation (Planner resistor Film, Planer inductor Film, Planer capacitor Film), Hybrid integrated circuit fabrication.

Reference books:

Unit 1 & 2

1. R. S. Khandpur, Handbook of Analytical Instruments, 2nd Ed., TMH, New Delhi (2006).
2. R. S. Khandapur, Hand Book of Biomedical Instrumentation, 3rd Ed., TMH, New Delhi (2014).
3. A. K. Sawhney and P. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpatrai & Sons, New Delhi (2015).
4. L. Cromwell and F. Weibell, Biomedical Instrumentation and measurements, 2nd Ed., PHI, New Delhi (1990).
5. H. S. Kalsi, Electronic Instrumentation and Measurements, 4th Ed., TMH, New Delhi (2019).
6. J. J. Carr, Elements of Electronic Instrumentation and Measurement, 3rd Ed., Pearson Education India, New Delhi (2003).
7. D. A. Bell, Electronic Instrumentation and Measurements, 2nd Ed., PHI, New Delhi (2003).
8. R. A. Barapate, Feedback Control Systems, 11th Ed., Tech-Max Publication, Pune (2009).
9. S. C. Goyal and V. A. Bakshi, Principles of Control Systems, 7th Ed., Technical Publications, Pune (2007).
10. I. J. Nagrath and M. Gopal, Control Systems Engineering, 7th Ed., New Age International, New Delhi (2022).
11. F. Golnaraghi and B. C. Kuo, Automatic Control Systems, 9th Ed., Wiley, New Delhi (2014).

Unit 3 & 4

1. Samuel Y.Liao, Microwave Devices and circuits, Prentice Hall of India.
2. R.E.Coolins, Foundation of Microwave Engineering, McGraw Hill Book Company.
3. D.C.Sarkar, Microwave Propagation and Techniques, S.Chand and Company Ltd.
4. M.Kulkarni Microwave and Radar Engineering, Umesh Publications.
5. Dennis Roddy and John Coolen, Electronic Communications, Prentice Hall of India, (4th Ed.)
6. Robert E.Collins, Antennas and radiowave propagation, MGH.
7. George Kennedy, Electronic Sciences and Communication systems, MGH Inter. Edition.
8. Edward C. Jordan and Keith G. Balman, Electromagnetic waves and Radiating systems, PHI
9. H.A.Atwater, Introduction to Microwave Theory, McGraw Hill Book Company.
10. Om P.Gandhi, Microwave Engineering and Applications, Macmillan International Edition.

M. Sc (ELECTRONIC SCIENCES) SEMESTER – II ELE– 411 PR : PRACTICALS	
Sr.No.	**Title of the Practical**
1	Counter using microprocessor I
2	Microprocessor Experiment II
3	Peripheral IC 8155
4	Peripheral IC 8255
5	Mode characteristics of Klystron
6	R.C. Control ckt. for Scr
7	Resistance Trigger ckt. for Scr
8	RC Triggered ckt. for SCR Connected In A Bridge
9	Resistivity By Four Probe Method
10	Power Electronics – Diac – Triac
11	Pulse Amplitude Modulator & Demodulator
12	Pulse Position Modulator & Demodulator
13	X-ray powder pattern
14	Design of second order filter using OPAMP
15	Experiments of microprocessor using software

15% of new experiments can be introduced AND / OR replaced as per the need, with the permission of the Chairman of Board of studies.

M. Sc (ELECTRONIC SCIENCES) SEMESTER – II

ELE - 412 PT : POJECT

- In-house project work of 4-credit to be performed by each student.
- Alternatively, MOOC, Swayam or any other UGC recognized online course in Electronic Sciences of at least 03 weeks duration and equivalent to 4 credits will also be considered for 4-credit in this course.
- Every student shall work on a project under a faculty member of the department.
- Project work may be carried out within the department or in other department, or from other institution (if required).
- Allotment of the supervisors shall be done by the Department.
- The supervisor shall act as the instructor for this course on project and make continuous assessment based on the understanding/ literature survey, experimental/ theoretical formulation, performance, interpretation of results and writing of Report.
- End-semester evaluation will be based on evaluation of report, presentation and viva voce examination of the candidate at the end of the semester by a panel of examiners.

GUJARAT UNIVERSITY

Revised Syllabus

To be implemented from Year 2025-2026

M. Sc (Electronic Sciences)

SEMESTER – III

Course	Name of the Course	Lect. Hrs. / Week	Marks			Course Credits
			Internal	External	Total	
ELE-501	IC Technology	4	30	70	100	4
ELE-502	DSP - II and Microcontroller-II	4	30	70	100	4
ELE-503	Control systems & Power Electronics - II	4	30	70	100	4
ELE-504	Microwaves - II & Electronic communication - II	4	30	70	100	4
ELE-505 PR	Practicals	8	30	70	100	4
ELE-506 PT	Project	8	30	70	100	4
TOTAL		**32**	**180**	**420**	**600**	**24**

M. Sc. (Electronic Sciences) SEMESTER – III

ELE-501: IC Technology

Unit - I: SILICON GROWTH TECHNOLOGY

Classification of IC's, Electronic grade Silicon, Czoschralski and Float zone crystal, Growing Methods, Oxygen and carbon in silicon, segregation coefficients, silicon shaping and wafer preparation, Different silicon orientation. Epitaxy: Vapour Phase epitaxy.

Unit-II : OXIDATION, LITHOGRAPHY AND ETCHING

Oxidation-Thermal, Dry and Wet, High pressure and plasma oxidation, Lithography - Optical Lithography, Photomask, Photo resist and process, Electron Lithography, Ion beam Lithography. Etching - wet chemical Etching, Reactive Plasma etching

Unit – III : DOPING, METALLIZATION AND PACAGING

Impurity Doping – Diffusion: Models of Diffusion in Solids, Fick's One dimensional Diffusion equations, Measurement Techniques, Ion implantation, Metallization - Desired properties of metals for contact and interconnect metallization, Metallization choices, AlSi and AlSiCu Alloy for Shallow junction devices, Electromigration resistance. Packaging: Package types, Design considerations of Typical ICs, Die Bondings

Unit – IV: VLSI DESIGN AND FABRICATION REQUIREMENTS

Integrated Elements, Isolation of circuits, Bipolar Technology: NPN Transistors, Integrated Diodes, Semiconductor resistor and capacitor. MOS Technology: NMOS & CMOS IC Technology. Non silicon Technology (GaAs ICs), Future trends. Fabrication Facilities and Environment-pure water system and clean room. Causes of IC failures - Electrostatic Discharge Damage and Alpha particle Induced soft errors

Reference books:

1. S. M. Sze, VLSI Technology (Tata McGraw Hill 2nd Edition).
2. W.R. Wesley and K.E. Bean, Semiconductor Integrated, Integrated Circuit Processing technology (Addison - Wesley Publishing Co.).
3. Peter Gise and Rechard Blanchard, Modern Semiconductor Fabrication Technology (Reston Book - Prentice Hall)
4. James W. Mayer and S. S. La, Electronic Materials Science: For Integrated circuit in Si and GaAs (McMillan Publishing Co., New Delhi).
5. Hong H. Lee, Fundamentals of microelectronics processing, (McGraw Hill publishing Co.).
6. S. M. Sze, Semiconductor Devices: Physics and Technology (John Wiley and Sons).
7. Douglas A. Packness and Kamran Eshraghian, Basic VLSI Design: Systems and circuits (Prentice Hall of India, New Delhi).

M. Sc. (Electronic Sciences) SEMESTER – III

ELE - 502: DSP - II and Microcontroller-II

Unit-I: Theory and design of IIR digital Filters

Introduction, Designing of Butterworth digital IIR filters, Chebyshev digital IIR filters: Type-I and Type-II, Frequency transformation: Low-pass frequency transformation, High-pass frequency transformation, Band-pass frequency transformation, IIR filter Structures: Direct form-I IIR filter structures, Direct form-II IIR filter structures, Lattice structure of IIR filter, Examples.

Unit-II : Theory and design of FIR digital Filters

Introduction, Basic principles of FIR filter design, Low-pass FIR filter without using window function, Designing other type of FIR filters: High-pass FIR filter, Band-pass FIR filter, Band-stop FIR filter, FIR filter Structures: Direct form-I FIR filter structure, Cascade form FIR filter structure, Lattice structure of FIR filters, Examples

Unit III: 8051 microcontroller design

Introduction, A microcontroller specification, A microcontroller design, testing the design, timing subroutines look-up tables for the 8051, serial data transmission, serial data communication: Introduction, Network configuration, 8051 data communication modes, example programs.

Unit IV: Applications of Microcontroller

Applications: Introduction, keyboard, displays, pulse measurement, D/A and A/D conversions, multiple interrupts, putting it all together. Microcomputer board using Intel 8031.

Reference books:

Unit I & II

1. B. Somanathan Nair, Digital signal processing theory, analysis and digital filter design,
2. John G. Proakis and D.G. Manolakis, Digital signal processing principles, Algorithms and applications
3. S. Salivahanan, A Vallavraj and C. Gnanapriya, Digital Signal processing,TMH

Unit III & IV

1. Kenneth J.Ayala, The 8051 Microcontroller, Architecture, Programming & Application, Penram, International. West Publication Company
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi," The 8051 microcontroller and embedded systems using Assembly and C",second edition, Pearson education /Prentice hall of India, 2007.
3. D.Karunasagar, "The 8051 microcontroller", Cengage Narosa Publication House Pvt. Editions 2011. pdf

M. Sc. (Electronic Sciences) SEMESTER – III

ELE - 503: Control systems & Power Electronics - II

Unit-I: Control systems - I

Introduction to control system: Requirement of good control system, classification of control systems.

Dynamic models and responses: Transfer function, Properties of transfer function, Advantage and disadvantage of transfer function, poles and zeros of transfer functions, State Variable Method.

Block diagram Algebra: Canonical form of feedback control system, Rules for block diagram reduction.

Signal Flow Graph: Rules, Properties, Mason gain equation, Use of Mason's gain formula for electrical network.

Feedback control system Characteristics: Stability and sensitivity of a system, Standard test signal, Derivation of steady state error, Analysis of first and second order systems, Role of 'ξ' in second order system, Transient response specification.

Stability Analysis: System stability bounds, Location of poles and stability, Hurwitz criterion, Routh's stability criterion, Routh's criterion special cases, Application of Routh's criterion.

Unit-II : Control systems - II

Root Locus: Relation between OLTF and CLTF poles and Zeros, Angle and magnitude criterion, General method for drawing root Loci.

Frequency Domain analysis: Limitation of time domain analysis, Frequency response, Performance specifications in frequency domain, Effect of adding zeros and poles.

Frequency Response analysis using Bode plot: Standard form for GH(jω), Bode plots of standard factors, Advantage of Bode plots, Frequency domain specifications, Determination of resonant frequency (ωp) and Resonant peak(Mp), Relative stability.`

Control Actions: Two positions or ON-Off controllers, Proportional controller (P), Integral controller(I), Rate Feedback Controller, Proportional + Derivative controllers (PD), PI controller, PID controllers.

Unit – III : Polyphase Rectifiers

Polyphase rectifier, three phase half wave delta-wave rectifier, six phase star half wave rectifier, three phase delta-wye bridge rectifier, voltage and current relationship in polyphase rectifier, general mphase rectifier circuit, transformer utility factor, rectifier performance. Resistance welding, digital weld control timer, types of resistance welding, energy storage welding systems, spot welder timer with time sequence.

Unit – IV: Induction heaters and relays

Principle of induction/dielectric heating, Theory of induction/dielectric heating, Merits of induction heating, dielectric properties of materials, thermal losses in dielectric heating, Applications of induction/dielectric heating. Resistance sensitive relay, voltage sensitive relay, photosensitive relay, fast photo relay solid-state relays. LCD displays.

Reference books:

Unit I & II

1. R. A. Barapate, Feedback Control Systems, Tech-Max Publication.
2. S.C. Goyal & V.A. Bakshi, Princples of control systems, I Publications
3. I. J. Nagrath & M. Gopal, Control System Engineering, Wiley Eastern
4. B.C. Kuo, Automatic Control Systems, PHI
5. H.T. Kashipura, Control System Engineering, Akshat Publication.

Unit III & IV

1. M. D. Singh & K.B. Khancdandani, Power electronics, THM.
2. M. H. Rashid, Power electronics, PHI.
3. P. S. Bimbhra, Power electronics, KP
4. H.C. Rai, Power electronics, devices and system
5. G. K. Mittal, Industrial electronics, Kedarnath & Sons
6. Chute & Chute, Electronics in industry,

M. Sc. (Electronic Sciences) SEMESTER – III

ELE – 504: Microwaves II & Electronic communication – II

Unit-I: Microwave Semiconductor Devices-I

Transferred Electron Devices TEDS Gunn-effect diodes-GaAs diode, background, Gunn effect, Ridley-Watkins-Hilsum (RWH) Theory, differential negative resistance, two valley model theory, High field domains, modes of operation), microwave generation and amplifications).Avalanche Transit-time Devices (Read diode, avalanche multiplication, carrier current and external current, output power and quality Factor Q, IMPATT Diode, physical structure, negative resistance, power output and efficiency, Trapatt diode, physical structure, principle of operation, power output and efficiency). Parametric Devices (Physical description, non-linear resistance and Manley-Rowe power relations, parametric amplifiers, applications).

Unit-II : Microwave Semiconductor Devices-II and Measurements

Microwave transistors: Microwave bipolar transistors (physical structure, power frequency limitations), Heterojunction bipolar transistors (HBTs), Microwave Tunnel Diodes (Principles of operation, Microwave characteristics), Microwave Field effect Transistors (Metal semiconductor Field-effect Transistors MESFETS, physical structure, principle of operation, small-signal equivalent circuit, drain current Id, cutoff frequency and maximum oscillation frequency, High electron-Mobility Transistors HEMTs (Physical structure, operational mechanism, performance characteristics, equivalent circuit, electronic applications).

Microwave Measurements:

Frequency measurements, measurement of power, attenuation measurements, measurement of Phase Shift, measurement of voltage standing wave ratio VSWR, measurement of impedance, measurement of insertion loss, measurement of dielectric constant, measurement of noise factor, measurement of Q of a cavity resonator.

Unit – III : Radar and Satellite communication

Radar system, Basic principles, Fundamentals, Radar performance factors, Pulse system, Basic pulse Radar system, Antennas and scanning. Display methods, Pulse radar systems, Moving target indicator (MTI), Radar beacon, CW Doppler radar, FM CW radar.

Satellite communication: Introduction, Kepler's Laws, Satellite orbits, Geostationary orbit, Power Systems, Attitude Control, Satellite station Keeping, Antenna look angle and limits of visibility (description), Frequency Plans and Polarization, Satellite antenna radiation patterns, Transponders, Satellite system parameters, Uplink Power Budget Calculations, Downlink Power Budget Calculations, Overall Link Budget Calculations, Multiple-access Methods : FDMA, TDMA, CDMA, Satellite radio navigation and GPS, INSAT

Unit – IV: Mobile communication

Cellular telephone, Frequency reuse, Interference, Cell splitting sectoring segmentation and dualization, Cellular system topology, Roaming and handoff, Cellular telephone network components, First generation analog cellular telephone, Personal communication system, Second generation cellular telephone systems, N-Amps, Digital cellular telephone. Interim standard 95. Global system for mobile communication, Personal satellite communication systems.

Reference books:

Unit I & II

1. Samuel Y.Liao, Microwave Devices and circuits, P H I.
2. M. Kulkarni, Microwave and Radar Engineering, Umesh Publications.
3. K. C. Gupta, Microwaves, Wiley Eastern Limited, India.

4. H. A. Watson (ed.), Microwave semiconductor Devices and their circuit Application, McGraw Hill Book Company.
5. D.C.Dube, Microwave Devices and Applications, Narosa Publishing House

Unit III & IV
1. D. Roddy and J. Coolen, Electronic Communication, PHI, 4th edition, 2005
2. W. Tomasi, Advanced Electonics Communications Systems, 6th ed., PHI, 2007
3. G. Kennedy, Electronic Communication Systems, Tata McGraw Hill, New Delhi
4. M. Kulkarni, Microwave and Radar Engineering, Umesh Publications

M. Sc (Electronic Sciences) SEMESTER – III ELE– 505 PR : PRACTICALS	
Sr.No.	**Title of the Practical**
1	Hall Effect
2	Design of frequency counter
3	Microcontroller logic experiment-1
4	Microcontroller logic experiment-2
5	Analog Sampling
6	Time Division Multiplex And Demultiplex
7	Keyboard Interface
8	Message Display (Lcd Kit) Using Microcontroller
9	Square Of A Number ≤ 9 Using Microcontroller
10	Addition Of Numbers Using Microcontroller
11	Design of an amplifier/regulated power supply using Chemical Etching
12	Measurement of Q of a microwave cavity resonator
13	Measurement of dielectric constant of a material at microwave frequency
14	Design of time period measurement circuit
15	Circuit Simulation/VHDL

15% of new experiments can be introduced AND / OR replaced as per the need, with the permission of the Chairman of Board of studies.

M. Sc (Electronic Sciences) SEMESTER – III

ELE - 506 PT : POJECT

- In-house project work of 4-credit to be performed by each student.
- Alternatively, MOOC, Swayam or any other UGC recognized online course in Electronic Sciences of at least 03 weeks duration and equivalent to 4 credits will also be considered for 4-credit in this course.
- Every student shall work on a project under a faculty member of the department.
- Project work may be carried out within the department or in other department, or from other institution (if required).
- Allotment of the supervisors shall be done by the Department.
- The supervisor shall act as the instructor for this course on project and make continuous assessment based on the understanding/ literature survey, experimental/ theoretical formulation, performance, interpretation of results and writing of Report.
- End-semester evaluation will be based on evaluation of report, presentation and viva voce examination of the candidate at the end of the semester by a panel of examiners.

GUJARAT UNIVERSITY

Revised Syllabus

To be implemented from Year 2025-2026

M. Sc (Electronic Sciences)

SEMESTER – IV

Course Number	Course Name	Credit	Internal Marks	External marks	Total Marks
ELE-507	PROJECT DISSERTATION	20	150	350	500
ELE-508	SCIENTIFIC WRITNIG AND FIELD WORK	04	30	70	100
TOTAL		**24**	**180**	**420**	**600**

M. Sc (Electronic Sciences) SEMESTER – IV

ELE-507: PROJECT DISSERTATION

Modalities of Major Project/Dissertation:

- Every student shall work on a research project under a faculty member of the department.
- Project work may be carried out within the department or in other department, or from other institution (if required).
- Allotment of the supervisors shall be done by the Department. As far as possible, equal distribution of students should be maintained per faculty member, and the allotment may be done during the third semester.
- The supervisor shall act as the instructor for this course on Dissertation and make continuous assessment based on the understanding, literature survey, experimental/ theoretical formulation, performance, interpretation of results and writing of Report and Dissertation.
- End-semester evaluation will be based on evaluation of report, dissertation, presentation and viva voce examination at the end of the fourth semester by a panel of examiners.
- Student should opt for full semester long dissertation work on the campus or outside the campus in some Laboratories/Institutes/Universities / Industry/ organisation of National Importance.
- For carrying out the dissertation work outside the campus, student will have to produce an invitation/acceptance letter from external supervisor by the end of Semester III.
- Permission from the Department is required for pursuing the project work outside the campus. Student may complete the dissertation project under the guidance of a supervisor of the Department.
- Student who will pursue the project outside GU will have one internal supervisor and one external supervisor. Internal supervisor will periodically interact with student and external supervisor. Supervisor will be responsible for internal assessment of the candidate from time to time.
- Student will be allowed to work with external supervisor at other outside institutions only after completing all the documentation process at GU.
- Students must follow the timeline strictly issued by Department from time to time.
- Department will have no financial obligation regarding the project work carried out by the student.
- Student must abide by the attendance rules and regulations of the Gujarat University.
- Two typed/computerised bound copies of the dissertation shall be submitted to the University during the final M.Sc. at least fifteen days before the commencement of the final examination.
- Presentation and viva-voce: Student shall present and defend the report to examiners. Examiners will test the research skills and knowledge of the student based on the submitted hard copy of the dissertation and the oral presentation.

M. Sc (Electronic Sciences) SEMESTER – IV

ELE-508: SCIENTIFIC WRITNIG AND FIELD WORK

Modalities and general guidelines:

- The candidate is required to show the scientific topic on which candidate want to write a detailed report to the supervisor before initiating the work and take necessary approval from the supervisor.
- Student has to either choose to study Concepts in Research Methodology or undergo field work or attend a workshop/ seminar/ conference of state/ national/ international level and submit a report. Concepts in research methodology are the principles and techniques that guide the design and conduct of a research project. They include topics such as research paradigms, research questions, literature review, data collection methods, data analysis methods and ethical issues.
- Students opting to study Concepts in Research Methodology must learn the following:
- Searching interest of research, Defining the research question, Approaches and Methodology, objectives, significance and techniques of research
- Introduction to kinds of scientific documents: research paper, review paper, book reviews, theses, and project reports (for the scientific community and for funding agencies).
- Ethics in research: Honesty and integrity, Misconducts: Falsification, fabrication, plagiarism. Best/ standard practices of research.
- Redundant publication: duplication and overlapping of publications, selective reporting and misinterpretation of data. Conflict of interest, Violation of publication ethics: authorship and contributorship.
- Introduction to spreadsheet applications, features o Generating charts / graph and other features, Tools – Microsoft Excel or similar. o Using formulae and functions, Data storage, Standard deviation, standard error
- Web Search: Use of Publication search engines and libraries (PubMed, PubMed central, CrossRef, Google scholar).
- Use of automated referencing softwares (Mendley, Zotero, EndNote, etc.)
- Presentation tools: Introduction, features and functions, slide presentation
- Key aspects of research presentations
- Dully certified two typed/computerised bound copies of the scientific report and the details regarding the field work shall be submitted to the University for the end semester evaluation.

Report evaluation:

- Dully certified report submitted by the candidate should be evaluated by the panel of examiners.

- The supervisor shall act as the instructor for this course make continuous assessment based on the understanding, literature survey, experimental/ theoretical formulation, performance, interpretation of results and writing of Report.
- End-semester evaluation will be based on evaluation of report, presentation and viva voce examination of the candidate at the end of the fourth semester by a panel of examiners.
- Student has to give a seminar on the scientific report and conducted field work to an audience of peers and experts. It is usually accompanied by slides or other visual aids and followed by a question-and-answer session.
- The purpose of presentation/seminar is to share the findings to demonstrate their conceptual understanding of the topic.