SYLLABUS FOR

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

A Five year Degree Course

SAURASHTRA UNIVERSITY
RAJKOT
(Effective from June2016)

Department of Electronics
Saurashtra University Campus
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SAURASHTRA UNIVERSITY

DEPARTMENT OF ELECTRONICS

M.Sc. (ECI) SYLLABUS

SEMESTER I

SEMESTER I **(24 Credits)**

Paper 1: Foundation of science and Mathematics	**(4 Credits)**
Paper 2: Foundation of Electronics	**(4 Credits)**
Paper 3: Fundamental of Digital Electronics	**(4 Credits)**
Paper 4: Introduction to electronics devices and circuits	**(4 Credits)**
Practicals	**(8 Credits)**

M.Sc. (ECI)
Semester – I
Paper: 1- Foundation of Science and Mathematics

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Motion:

- **Very brief explanation of displacement, distance, speed, velocity, acceleration, force, gravity, inertia, linear momentum.**
  --Rest—Motion—Rest and Motion as Relative terms—Scalar and Vector quantities—Common terms related to moving bodies—Displacement-Time graphs—Velocity-Time graphs—Acceleration-Time graphs—motion equation —Force in Our life-Effects of force
- **Vectors, Scalars and elementary calculus:**
  --Scalar quantities—Vector quantities—The need for vectors—Representation of vectors—Types of vectors—Parallelogram law of vectors—Polygon law of vectors—Subtraction of the vectors—Properties of vector addition—Null vector or Zero vector—Unit vector—Rectangular components of a vector—Multiplication of a vector by a real number—Multiplication of a vector by a scalar—Components of a vector in terms of unit vectors $\hat{\imath}, \hat{\jmath}, and\ \hat{k}$ vectors in 3 dimensions—Magnitude and direction of $\vec{r}$—Direction Cosines of a vector—Multiplication of vectors.
- **Laws of motion.**
  What causes motion?—Gallio's work—Newton's first law of motion or the law of inertia—momentum—Newton's second law—units of force—rectangular components of force—equation of force—mass and weight—inertial mass—impulse—impulsive force—Newton's third law of motion—free body diagram—motion of connected bodies—to find the tension T—Laws of conservation of momentum--
- **Work, energy and power.**
  --Definition of work—Units of work—Positive and negative work—Sign of work—Graphical method-Work done by a constant force—work done by a varying force—Graphical method-work done by varying force—Conservative force—Central force—Work done to lift a body—Energy—Kinetic energy—Work-energy concept—Potential energy—Definition of potential energy—Gravitational potential energy-P.E. due to position—To show that gravitational P.E. is independent of the path followed—Elastic-P.E. due to configuration—Conversion of P.E. and K.E. in the case of a spring—Power—Unit and dimensional formula.

- **Projectile motion and relative velocity in two dimension**

  --Two dimensional motion—Displacement, velocity and acceleration in two dimensional motion—Acceleration—Projectile—The horizontal and vertical motion of a projectile—Projectile fired horizontally from a height—Instantaneous velocity of the projectile—Derivation of expression for maximum height, time of flight and range of a body projected at an angle with the horizontal—Instantaneous Velocity—PROJECTILE MOTION-Range and time of flight on an inclined plane—Relative velocity in two dimensional motion.

Unit 2: Rotational Motion:

- **Circular motion.**

  --Motion in a circular path—Angular variables—Angular velocity—Linear displacement in terms of angular displacement—Relation connecting linear velocity and angular velocity—Angular acceleration—Expression for centripetal acceleration—Centripetal force—Fictitious force-Centrifugal force—Examples to illustrate centrifugal force(Fictitious force)—Motion of a Car on a level road—Car on a banked circular road—Motion of a cyclist along a curved path—Banking of rails—Motion in a horizontal circle—Motion of a body in a vertical circle—Conical pendulum.

- **Oscillations.**

  --Periodic motion—Oscillations of a Mass supported by a spring—Displacement—Amplitude—Angular frequency—Simple harmonic motion—Definition of SHM—Differential equation of simple harmonic motion—Physical significance of ω—Energy of a harmonic oscillator—Expression for kinetic energy—Characteristics of SHM—Relation between linear SHM and Uniform circular motion-reference circle—Uniform circular motion and SHM—Displacement—Experimental demonstration—Expression for velocity of a particle executing SHM—Expression for acceleration—Graphs to show the variation of Displacement, Velocity, Acceleration—Graphical representation of SHM—Phase difference—Derivation of time period of a body executing SHM—Definition of Spring constant or Force constant—Mass on a Spring-Vertical Oscillation—Seconds pendulum—Angular SHM—Free oscillation, Natural vibration—Dumped Oscillations—Effect of Damping on the Oscillations of Mass attached to a spring—Forced harmonic oscillations—Resonance.

- **Waves**

  --Introduction—Wave—Spring-model to understand wave propagation—propagation of sound waves in Air—Characteristics of wave motion—Types of wave—Wavelength, Frequency and velocity of a wave—Formation of transverse wave—Formation of longitudinal waves—Graphical representation of harmonic wave—Expression for displacement in wave motion—Characteristics of a progressive wave—Relation connecting particle velocity and wave velocity—Differential equation of wave motion—Relation connecting elasticity of a medium and the excess pressure—Intensity of a wave

Unit 3: Trigonometry, Algebra, Differentiation and Integration:

--Angle—measurement of angle, trigonometric function—Quadrants—trigonometric formulas of compound angles—trigonometric formulas of multiple and sub-multiple angles—properties of triangle--Quadratic equation—determinants—Crammer's rule—progression—Binomial theorem—exponential and logarithmic series—logarithms--Concept of limit—differentiation—some rules of differentiation—D.C. of functionofA function—Differentiation of implicit function—The second derivative of a function—dy/dx at a point (x,y)—Definition of integration—table of standard elementary integrals--method of transformation—method of substitution—definite integral

Unit 4: Application of dy/dx, integration, geometric meaning of differentiation and integration, Introduction to graphs

--dy/dx as a rate measure—maximum and minimum value of a function—average of a varying quantity—centre of mass of a body—moment of inertia of a body—slope or gradient of a straight line—tangent of a point to a curve—geometric meaningof definite integration—graphical problems on kinematics—standard geometricalcurves—graphs of exponential, logarithmic and trigonometric functions—graphof a modulus of a function—some additional graphs

Recommended books:

1. Fundamentals of physics By RobertResnick &David Halliday Wiley Eastern limited
2. Mathematical tools for physics By Shakir Hussain, Mcg raw Hill Education (India) PVT. LTD. New Delhi.

Reference Books:

1. Concepts of physics vol-1 by H.C. Verma
2. Higher Engineering Mathematics by Dr. B.S. Grewal, 40th Edition Khanna Publication
3. Higher Engineering Mathematics by Dr. K.R. Kachot, Mahajan publishing house
4. College Physics by Openstax College Rice University

PAPER 2: Foundation of Electronics

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Voltage, current and power:

Two kinds of charges—basic properties of charges—Coulomb's law—electric field and intensity—electric field intensity due to point charge--Meaning of electric potential—relation between E and V—work done in an electrostatic field—formal definition of potential—calculation of electric potential—definition of volt and voltage--Flow of charge: current—source of current: need to maintain potential difference—definition of current--Energy and power in a circuit—definition of power

Unit 2: Resistance, capacitance and inductance:

Resistance of conductor—circular Mils —definition of resistance—temperature effects—series and parallel combination of resistances--Capacitance of a conductor—definition of capacitance--principle of a capacitor—capacitance of parallel plate capacitor—effects of dielectric and metallic slabs—capacitor in series and parallel—energy stored in a capacitor--Magnetic field—magnetic force on a moving charge—motion of a charge in a magnetic field—electron motion and combined influence of E and B—Hall effect—Oersted's experiment—law of Biot-Savart—magnetic field of a straight conductor—magnetic field due to a moving charge—magnetic field of a circular field—magnetic field due to a solenoid—Ampere's circuital theorem—magnetic force on a current carrying conductor—torque on a current loop—discovery of electromagnetic induction—laws of electromagnetic induction—method of producing induced emf—induced emf, current and charge—motional emf—mutual induction—self-induction—definition of inductor—series –parallel connection of inductors—energy stored in an inductor

Unit 3: Basic laws, DC sources and AC sources:

Basics of circuit—Ohm's law—Kirchhoff's laws—resistive networks: series and parallel connection—voltage divider rule and current divider rule--Ideal sources: voltage and current—practical sources: voltage and current—constant voltage source and constant current source—series and parallel combination of sources—dependent sources--Generation of AC voltage—voltage and current conventions for AC—frequency, period, amplitude and peak value—angular and graphic relationships for sine waves—voltages and currents as function of time—introduction to phasors—AC waveforms and average value—AC voltage and current measurement

Unit 4: Introduction to PSpice:

Description of PSpice—types of PSpice—types of analysis—description of simulation software tools—Pspiceplateforms—Pspice schematic versus OrCAD capture—limitations of PSpice—Pspice resources—input files—element values—nodes—circuit elements—sources—types of analysis—output variables—Pspice output commands—format of circuit files—format of output files—examples of PSpice simulations—OrCAD capture—Importing Microsim schematic in OrCAD—Installing the OrCAD software—overview—the circuit analysis process—drawing the circuit—copying and capturing schematics

Recommended books:

1. Circuit analysis: Theory and practice
   Allan H. Robbins and Wilhelm C. Miller
   CENGAGE LEARNING (Fifth Edition)
2. Introduction to PSpice using OrCAD for circuits and electronics
   Muhammad H. RashidPHI Learning PVT Ltd.
   Delhi

Reference Books:

1. Circuits by A. Bruce Carlson
   Cengage Learning publication (Indian Edition)
2. Circuits and Networks: Analysis & Synthesis by A. Sudhakar, Shyammohan S. Palli
   Tata McGraw-Hill Publication Company Ltd. Third Edition
3. Introduction to Circuit Analysis and Design by Tildon Glisson, Jr.
   Springer Publication, International Edition
4. Basic Circuit Analysis by Dr. Cunningham & J.A. Stuller.
   Jasic Publishing House

Paper 3: Fundamental of Digital Electronics

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Number system, codes and digital arithmetic:

Introduction to number systems—decimal number system—binary number system—number systems-some terms—number representation in binary—finding decimal equivalent—decimal-to-binary conversion—decimal-to-octal conversion—decimal-to-hexadecimal conversion—binary-octal and octal-binary conversion—hex-binary and binary-hex conversion—hex-octal and octal-hex conversion—the four axioms—floating point numbers—binary coded decimal—higher density BCD encoding—packed and unpacked BCD numbers—excess-3 code—gray code—alphanumeric codes—seven segment display code—error detection and correction codes—Basic rules of binary addition and subtraction—addition of larger bit binary numbers—subtraction of larger bit binary numbers—BCD addition and subtraction in Excess-3 code—binary multiplication—binary division—floating point arithmetic

Unit 2: Logic gates and IC families:

AND gate—diode AND gate—transistor AND gate—OR gate—diode OR gate—transistor OR gate—disadvantages of diode gates—multi-inputs(Fan-in)—NOT gate(INVERTER)-complementation, double inversion, IC inverters—loading effects(Fan-out)-buffer/drivers—representation of binary numbers as electrical signals-positive and negative logic in dc and ac systems—positive and negative gates—NAND gate-NAND as inverter—NOR gate-NOR gate as inverter—bubbled gates-significance, bubbled NAND , bubbled NOR—NAND and NOR as universal gates-AND, OR and NOT realization—XOR and XNOR gates—concise account of logic gates—digital ICs—levels of integration—digital IC(logic) families-bipolar families, MOS families—characteristics of digital ICs-voltage and current parameters, noise immunity, speed/propagation delay, power dissipation, fan in/ fan out, operating temperature—DTL AND gate—DTL NAND gate—DTL NAND gate with load circuit analysis, current sinking, noise, wired-AND connection—RTL NOR gate-current sourcing, RTL characteristics—TTL—TTL basic NAND gate—standard TTL NAND gate with totempole output-low-state operation, high-state operation, loading considerations, output circuits, totempole output, open collector output, tristate output, wired-ANDing—TTL series 7400 and 5400-high speed TTL, low power TTL, Schottky TTL, low power Schottky TTL, advanced Schottky TTL, advanced low-power Schottky TTL, Fast TTL—DCTL NOR gate-high and low state operations, disadvantages—ECL—ECL basicaciruit—ECL OR/NOR gate-circuit operation, wired-OR connection, characteristics—I^2L NOR gate-current injector, circuit operation—tristate logic—tristate buffers-inverting and non-inverting buffers—MOS-logic families-NMOS inverter, CMOS inverter—dynamic MOS inverter-rationed dynamic inverter, ratio less dynamic inveter—NMOS-NAND and NMOS- NOR gates—CMOS-NAND and CMOS NOR gates—CMOS transmission gate—CMOS series—MOS logic characteristics—BiCMOS logic—comparison of logic families—IC gates

Unit 3: Boolean algebra and simplification techniques:

Introduction to Boolean algebra: variables, literals, and terms in Boolean expressions, equivalent and complement of Boolean expressions, dual of Boolean expression—Postulates of Boolean algebra—theorems of Boolean algebra: Operations with 0 and 1(Theorems 1 and 2), Idempotent or identity laws(Theorem 3), complementation law(Theorem 4), commutative law(Theorem 5), associative laws(Theorem 6), distributive laws(Theorem 7), Theorem 8, theorem 9, Absorption law or redundancy law(Theorem 10), Theorem 11, consensus theorem (Theorem 12), DeMorgan's theorem(Theorem 13), Transposition theorem(Theorem 14), Theorem 15, Theorem 16, Involution theorem (Theorem 17) --simplification techniques: sum-of-product Boolean expressions, product-of-sums expressions, expanded forms of Boolean expression, canonical form of Boolean expression, $\sum$ and π nomenclature—Quine-Mccluskey tabular method—Karnaugh

map method: construction ofKarnaugh map, Karnaugh maps for Boolean expression with larger number of variables, Karnaugh maps for multi-output functions

Unit 4: Arithmetic and combinational logic circuits:

Combinational circuits—implementing combinational logic—Arithmetic circuits-Basic building blocks: Half-adders, full-adders, Half-subtractor, Full-subtractor, controlled inverter—Adder-subtractor—BCD adder—carry propagation-look ahead carry generator—arithmetic logic unit—multipliers—magnitude comparator—application-relevant information--Multiplexer: inside the multiplexer, implementing Boolean functions with multiplexers, multiplexer for parallel-to-serial data conversion, cascading multiplexer circuits—encoders: priority encoder—de-multiplexers and decoders, cascading decoder circuits—parity generation and checking—application-relevant information

Recommended books:

1. Digital electronics: Principles and integrated circuits
   Anil K. Maini
   Wiley India Pvt. Ltd.
   1st Edition
2. Digital principles and circuits
   Dr. C.B. Agrawal
   Himalaya Publishing House
   1st Edition

Reference books:

1. Digital Design by M. Morris Mano Third edition
Prentice Hall publisher

2. Fundamentals of Digital Electronics by Prof. Barry Paton Delhousie University
March 1998 Edition, National Instrument Corporation

3. "Modern Digital Electronics" by R.P. Jain
TMH Publication

4. Digital Design Principal & Practices by John F. Wakerly
Prentice Hall Publication 3rd Edition

Paper 4: Introduction to Electronic devices and Circuits

Credit: 04

Total Marks: 100 (70 External+30 Internal)

Total Hours requires: 60 Hrs.

Unit 1: Semiconductor physics:

Semiconductor materials—elemental semiconductor materials—compound semiconductor materials crystalline structure—energy band theory of crystals—energy bands in solids—conduction in solids—drift and diffusion currents—atomic bonds—Fermi-Dirac energy distribution—intrinsic semiconductors—extrinsic semiconductors—mass action law—charge densities in an extrinsic semiconductor—relaxation time, collision time and mean free path—conductivity of metals—conductivity of semiconductors—carrier concentration in an intrinsic semiconductor—Fermi level in extrinsic semiconductor—carrier life time—continuation equation—hall effect—basic structure of P-N junction—P-N junction as a diode—zero applied bias—reverse applied bias—metal semiconductor junctions

Unit 2: Junction diodes, Zener, other two terminal devices and rectifiers:

Fabrication techniques—diode failure modes and Ohmmeter check—junction break down—Ideal diode—current components in a P-N diode—quantitative theory of P-N diode currents—temperature dependence of P-N diodes—diode resistance—real diode—DC load line—transition and diffusion capacitances—equivalent circuit of a diode—P-N diode switching times—switching diodes—P-N diode applications—diode data sheets--Zener diodes—zedner diode applications—tunnel diode—PIN diode—varactor diode—point contact diode—step recovery diode—fast-recovery diode—Schottky diode—backward diode—power diode—varistors or voltage dependent resistors(VDRs)—thermistors--Half-wave rectifiers—full-wave rectifiers—three-phase rectifiers—filter circuits—bleeder resistor—voltage regulation—rectifier specifications—voltage multipliers

Unit 3: Bipolar junction transistors and field effect transistors:

transistor terminals—transistor action—transistor biasing—important point regarding working of transistors—transistor current components—current amplification factors—relationship between α and β—base spreading resistance—Ebers-Moll model—transistor circuit configurations—common base configuration—early effect and base-width modulation—common emitter configuration—common collector configuration—comparison of characteristics of transistors in different configurations—transistor as an amplifier—transistor load lines—standard notations for voltages and currents—transistor fabrication—transistor maximum ratings—numbering system for semiconductor devices—transistor data sheets—transistor packaging—transistor lead identification and testing—transistor as diode—thermal run-away and heat sink—transistor approximation—DC equivalent circuits—different methods of drawing transistor circuits—Beta rule—importance of collector-emitter voltage, V_{CE}—Junction field effect transistors—characteristics of JFETs—merits and demerits of JFETs—practical FET structure—FET configurations—JFET temperature effects—JFET as an amplifier—JFET parameters—JFET data sheets—DC load line and bias point—FET biasing—FET small signal models—common source JFET amplifier—common drain JFET amplifier—common gate JFET amplifier—applications of FETs—FET as a voltage variable resistor(VVR)—Metal-insulator-semiconductor Field effect transistor(MISFETs)—depletion-enhancement MOSFETs(DE-MOSFETs)—MOSFET small signal model—enhancement only MOSFETs(E-MOSFETs)—MOSFET resistor—MOS capacitor—Dual-gate MOSFET—power MOSFETs(or V-FETs)—complementary MOSFET or CMOS—MOSFET handling—testing FETs—comparison of N-channel FETs with P-channel FETs—comparison of JFETs and MOSFETs—comparison between NMOS and PMOS

Unit 4: Hybrid parameters, transistor biasing and stabilization:

Two-port devices and the Hybrid model—transistor hybrid model—experimental determination of hybrid parameters—determination of h-parameters from static characteristics—variations of Hybrid-parameters of a transistor—typical vales of h-parameters for a transistors—conversion of hybrid parameters in transistor three configurations—transistor amplifier circuit performance in h-parameter—limitation of h-parameters—transistor amplifier configuration comparison—physical model of a

CB transistor--Transistor biasing—selection of operating point—bias stabilization—stability factor—transistor biasing circuits—guidelines for design of transistor biasing circuits—bias compensation—thermal resistance—condition for thermal stability

Recommended books:

1. Electronic devices and circuits
   J.B.Gupta
   S.K.Kataria& Sons
   Delhi

Reference books:

1. Electronic devices and circuit theory
Robert L. Boylestad and Louis Nashelky
Pearson

2. Electronic Devices: Electron Flow Version ninth edition
By Thomas L. Floyd
Pearson Publication

3. Electronic Devices & Application NII, PHI

4. Complete Guide to Semiconductor Devices by Kwok N.G.
TMH Publication