University of Pune

Two Year M.Sc. Degree Course in

Electronic Science

M.Sc. Electronic Science

(Credit and Semester based Syllabus to be implemented from Academic Year 2013-14)

1) Title of the Course:

M.Sc. Electronic Science

2) Preamble of the Syllabus:

Master of Science (M.Sc.) in Electronic science is a post graduation course of University of Pune. The credit system to be implemented through this curriculum, would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities.

The students pursuing this course would have to develop in depth understanding various aspects of the subject. The working principles, design guidelines and experimental skills associated with different semiconductor devices and circuits, underlying mathematical and analysis techniques, electromagnetic and instrumentation principles, design methodologies for digital and embedded systems, communication electronics and control systems and various applications of electronic devices, circuits and systems are among such important aspects.

3) Introduction:

Salient Features of the Credit System:

1. Master's degree course in Electronic Science would be of 100 credits, where one credit course of theory will be of one clock hour per week running for 15 weeks and one credit for practical course will consist of 15 of laboratory exercise including the revision and setting up the practical. Thus, each credit will be equivalent to 15 hours.
2. Student will have to take admission in Electronic Science Department and complete 75 credits incorporated in the syllabus structure of Electronic Science. The remaining 25 credits shall be chosen from courses offered by the Electronic Science Department or other Departments of the University/College with credit system structure.
3. Except practical credits wherever applicable, students may be allowed to complete less courses per semester on the condition they complete the degree in maximum of four years. This facility will be available subject to the availability of concerned courses in a given semester and with a maximum variation of 25 credits (in case of fresh credits) per semester.
4. Every student shall complete 100 credits in a minimum of four semesters. All Semesters will have 25 credits each.
5. The student will be declared as failed if s/he does not pass in all credits within a total period of four years. After that such students will have to seek fresh admission as per admission rules prevailing at that time.
6. Academic calendar showing dates of commencement and end of teaching, internal assessment tests and term end examination will be prepared and duly notified before commencement of each semester every year.
7. Project course should not be greater than 10% of the total credits of the degree course. Project course is equivalent to 10 credits.

Instructions for the Students

The students seeking admission to M.Sc. Electronic Science course is hereby informed that they are supposed to adhere to the following rules:

1. A minimum of 75 % attendance for lectures / practical is the pre-requisite for grant of term.
2. There shall be tutorial / practical / surprise test / home assignment / referencing of research papers / seminar / industrial visits / training course as a part of internal assessment in each semester. The students are supposed to attend all the tests. The students should note that re-test will not be given to the student absent for the test/s.
3. The students opting for dissertation course shall follow the rules framed for the same.
4. Industrial / Institute - Visit and or Industrial Workshops / Laboratory Workshops / Training Programme is a compulsory component of the syllabus. The students are supposed to attend all the Industrial Workshops / Laboratory Workshops / Training Programme organized by the department. The students shall attend these programmes at their own cost.

4) Eligibility:

The candidate should have a B.Sc. degree with Electronic Science as principal subject **OR** B.Sc. (General) degree with Electronic Science (Electronics) as one of the subsidiary subjects.

Admission: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune.
Reservation and relaxation will be as per the government rules.

5) Examination

[A] Pattern of Examination

Evaluation of Students:

1) The In-semester and End-Semester examinations will be of 50 marks each.
2) Student has to obtain 40% marks in the combined examination of In-Semester and End-Semester assessment with minimum passing of 30% passing in both assessments separately.
3) A student cannot register for third semester if s/he fails to complete the 50% credits of the total expected within two semesters.
4) Internal marks will not change. Student cannot repeat internal assessment. If student misses internal assessment examination, s/he will have second chance with the permission of the concerned teacher. But it will not be right of the student. It will be the discretion of the concerned teacher and internal departmental assessment committee. In case s/he wants to repeat Internal, s/he can do so only by registering for the said courses during $5^{th}/6^{th}$ semester whichever is applicable.
5) There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.
6) Internal assessment answer scripts may be shown to the concerned student but not end semester answer script.

i. **In-semester Examination**: Internal assessment for each course would be continuous and dates for each tutorials/practical tests will be pre-notified in the time table for teaching or placed separately as a part of time table. Department / College Internal Assessment Committee will coordinate this activity

a) **Theory Courses**: Conducting written tests should not be encouraged. More focus should be on non-written tests. Students should be encouraged to conduct various academic activities. A teacher must select a variety of the procedures for internal assessment suggested as follows.

a) Mid-term test
b) On-line test
c) Computer based examination
d) Open book test (concerned teacher will decide the allowed books)
e) Tutorial
f) Surprise test
g) Oral
h) Assignments
i) Review of research paper
j) Seminar presentation
k) Journal / Lecture / Library notes

Student has to preserve the documentation of the internal assessment except midterm test answer script. It is the responsibility of the student to preserve the documents.

b) **Practical Courses**: It is a continuous evaluation process. Practical courses will be evaluated on the basis of the following

1. Performance assessment of each experiment on the basis of attendance, punctuality, journal completion, practical skills, results, oral and analysis.
2. Test on practical may be conducted before the end-semester examination.
3. Assessment of each experiment shall be done for each practical weekly.
4. Assessment of the Activity will be based on any one of the following per practical course.
   i. Special training programs (on C / MATLAB / LABVIEW / ORCAD / DSP / Image processing / RTOS / Special processor board etc.)
   ii. Mini-project (hardware, software or system design based)
   iii. Industrial / Institution Visit
   iv. Market survey (Analysis of existing products, scope for new product)
   v. Techno-commercial analysis of laboratory equipment (technical specification comparison, cost analysis, taxation, logistics etc.)

The student strength of practical batch should be eight. Note that one practical session is of 4 hour duration of one practical batch.

5. Assessment of Project Like Experiment (PLE) shall be carried out every fortnight for continuous assessment and log book shall be verified. . Evaluation will be on the basis of weekly progress of project work, progress report, referencing, oral, results and documentation.

Project Course: Project will be evaluated by In-Charge of project batch in concern with project guide. Assessment will be done weekly in the respective

batch. Evaluation will be on the basis of weekly progress of project work, progress report, referencing, oral, results and documentation.

ii. **End-Semester Examination**: End-Semester examination for 50 marks per course would be held about two weeks after completion of teaching for the semester. Paper setting and assessment for a particular course would be the responsibility of the course In-charge, and these activities would be coordinated by the Department Examination Committee. The Department Examination committee would undertake preparation of the result-sheets for the student

[B] Standard of Passing

Student has to obtain 40% marks in the combined examination of In-Semester and End-Semester assessment with minimum passing of 30% passing in both assessments separately.

[C] ATKT Rules

A student cannot register for third semester if s/he fails to complete the 50% credits of the total credits expected to be ordinarily completed within two semesters.

[D] Award of Class

Grades will be awarded from grade point average (GPA) of the credits.

GPA Rules:

1. The formula for GPA will be based on Weighted Average. The final GPA will not be printed unless a student passes courses equivalent to minimum 100 credit hours (Science). Total credits hours means the sum of credit hours of the courses which a student has passed.
2. A seven point grade system [guided by the Government of Maharashtra Resolution No. NGO – 1298 / [4619] / UNI 4 dt. December 11, 1999 and University regulations] will be followed. The corresponding grade table is attached herewith.
3. If the GPA is higher than the indicated upper limit in the third decimal digit then the student be awarded higher final grade (e.g. a student getting GPA of 4.492 may be awarded ‘A’)
4. For Semester I, II, III examinations, only the grade points will be awarded for each subject. Final GPA along with final grade will be awarded only at the end of IV semester. There is also a provision for verification and revaluation. In case of verification, the existing rules will be applicable. The revaluation result will be adopted if there is a change of at least 10% marks and in the grade of the course.
5. After the declaration of result, for the improvement of Grade, the student can reappear for the examination of 30 credits worth theory courses.
6. Grade improvement programme will be implemented at the end of the academic year. A student can opt for grade improvement programme only after the declaration of final semester examination i.e. at the end of next academic year after passing M.Sc. (Electronic Science) examination and within two years of completion of M.Sc. (Electronic Science). A student can appear for grade improvement programme only once.

Grade and Grade Point Average		
Marks	**Obtained Grade**	**Grade Points**
100 – 75	**'O'** Outstanding	06
74 – 65	**'A'** Very Good	05
64 – 55	**'B'** Good	04
54 – 50	**'C'** Average	03
49 – 45	**'D'** Satisfactory	02
44 – 40	**'E'** Pass	01
39 and less	**'F'** Fail	00

Final Grade Points	
Grade Points	**Final Grade**
5.00 – 6.00	**O**
4.50 – 4.99	**A**
3.50 – 4.49	**B**
2.50 – 3.49	**C**
1.50 – 2.49	**D**
0.50 – 1.49	**E**
0.00 – 0.49	**F**

Common Formula for Grade Point Average (GPA):

$$\text{GPA} = \frac{\text{Total of Grade Points earned} \times \text{Credit hours for each course}}{\text{Total Credit hours}}$$

B Grade is equivalent to at least 55% of the marks

[E] External Students: There shall be no external students.

[F] Setting of Question Paper / Pattern of Question Paper

For core (compulsory) theory courses end semester question papers set by the University of Pune and centralized assessment for theory papers done as per the University instructions. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject. In case of EL1UT01 and EL1UT04 the at least 80% question paper must be on problem solving. In the rest of the theory papers at least 50% of the question paper should be on designing, problem solving. Question 1 should contain definitions, theorems, short problems based on concepts or programming or logic designs.

Theory examination will be of 2 hours duration for each theory course of 4 credits and 1½ hrs for 3 credit course. There shall be 3 questions each carrying marks as shown below. The pattern of question papers shall be:

Question 1 (10 Marks)	5 compulsory sub-questions, each of 2 marks; answerable in 2 -3 lines
Question 2 (20 Marks)	5 out of 7– short answer type questions; answerable in 8 – 10 lines (For 3 Credit course: 2 out of 3 of 4 marks and 1 compulsory of 2 marks- 10 marks)
Question 3 (10 Marks)	2 out of 3 – problem type question; answerable in numerical or analytical fashion or circuit / logic diagrams or designing

[G] Verification / Revaluation

There is also a provision for verification and revaluation. In case of verification, the existing rules will be applicable. The revaluation result will be adopted if there is a change of at least 10% marks and in the grade of the course. There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.

6) Structure of Course

Basic structure/pattern (Framework) of the proposed postgraduate syllabus for the two year integrated course leading to M.Sc. (Electronic Science) in the colleges affiliated to Pune University.

a) Compulsory Papers

Theory: EL1UT01, EL1UT02, EL1UT03, EL1UT04, EL2UT05, EL2UT06, EL2UT07, EL2UT08, EL3UT09, EL3UT10

Practical: EL1UP01, EL1UP02, EL1UP03, EL2UP04, EL2UP05, EL2UP06, EL3UP07, EL3UP08, EL3UP09, EL4UP10

b) Optional Papers

Theory: All elective courses are represented by code ELDT**xx**

M.Sc. Electronic Science - Course structure & Credits Distribution

Semester	Course Code	Course Title	No. of Units	No. of credits
Sem-I	EL1UT01	Mathematical Methods in Electronics and Network Analysis	04	04
	EL1UT02	Analogue Circuit Design	04	04
	EL1UT03	Digital System Design	04	04
	EL1UT04	Advanced ‘C’ Programming	03	03
	EL1UP01	Practical Course –I	12 Practical Sessions	04
	EL1UP02	Practical Course –II	12 Practical Sessions	04
	EL1UP03	Practical Course –III	Project Like Experiment	02
Sem-II	EL2UT05	Applied Electromagnetics, Microwaves and Antennas	04	04
	EL2UT06	Instrumentation and Measurement Techniques	04	04
	EL2UT07	Embedded System Design	04	04

	EL2UT08	Foundation of Semiconductor Devices	03	03
	EL2UP03	Practical Course – IV	12 Practical Sessions	04
	EL2UP04	Practical Course – V	12 Practical Sessions	04
	EL2UP04	Practical Course – VI	Project Like Experiment	02

Semester	Course Code	Course Title	No. of Units	No. of credits
Sem-III	EL3UT09	Communication Electronics	04	04
	ELDTxx	Elective Theory	04	04
	ELDTxx	Elective Theory	04	04
	ELDTxx	Elective Theory	03	03
	EL3UP07	Practical Course –VII	12 Practical Sessions	04
	EL3UP08	Practical Course –VIII	12 Practical Sessions	04
	EL3UP09	Practical Course –IX	Project Like Experiment	02
Sem-IV	EL4UT10	Control Systems	04	04
	ELDTxx	Elective Theory	04	04
	ELDTxx	Elective Theory	04	04
	ELDTxx	Elective Theory	03	03
	EL4UP10	Practical Course –X (Project)	-	10

c) Question Papers and papers etc.:

Theory
- In-Semester Examination : 40/30/20 Marks (4/3/2 Credits)
- End-Semester Examination : 40/30/20 Marks (4/3/2 Credits)

Practical
- In-Semester Examination : 40/30/20 Marks (4/3/2 Credits)
- End-Semester Examination : 40/30/20 Marks (4/3/2 Credits)

d) Medium of Instructions: English.

7) Equivalence of Previous Syllabus:

Old Course (2008 Pattern)	New Course (2013 Pattern)
EL1UT01: Foundation of Semiconductor Devices	EL2UT08: Foundation of Semiconductor Devices
EL1UT02: Analog Circuit Design and Analysis	EL1UT02: Analogue Circuit Design
EL1UT03: Instrumentation and Measurement Techniques	EL2UT06: Instrumentation and Measurement Techniques
EL1UP01: Practical course –I	EL1UP01: Practical Course –I
EL1UP02: Practical course –II	EL1UP02: Practical Course –II
EL2UT04: Applied Electromagnetics, RF and Microwave	EL2UT05: Applied Electromagnetics, Microwaves and Antennas
EL2UT05: Communication Electronics	EL3UT09: Communication Electronics
EL2UT06: Digital System Design using VHDL	EL1UT03: Digital System Design
EL2UP03: Practical course –III	EL2UP04: Practical Course –IV
EL2UP04: Practical course –IV	EL2UP05: Practical Course –V
EL3UT05: Embedded Systems	EL2UT07: Embedded System Design
EL4UT06: Control System: Theory & Application	EL4UT10: Control Systems

8) University Terms:

Dates for commencement and conclusion for the first and second terms will be declared by the University authorities. Terms can be kept by only for duly admitted students. The term shall be granted only on minimum 75 percent attendance at theory and practical course and satisfactory performance during the term.

9) Qualification of Teacher:

i. M.Sc. (Electronic Science) degree with NET / SET qualification.
ii. Recognition of Pune University as a post graduate teacher, by papers.
iii. Other criteria as per the guidelines of UGC and University of Pune.

10) Detail Syllabus with Recommended Books

M.Sc. Electronic Science
First Year
SEM-I and SEM-II

Credit and Semester based Syllabus to be implemented

From

Academic Year 2013-14

EL1UT01: Mathematical Methods in Electronics and Network Analysis

Objectives:

1. To get familiar with role of differential equations in applied electronics
2. To know about mathematical tools and techniques for network analysis
3. To learn the methods of analysis for CT and DT signals and systems
4. To learn concept of mathematical modeling of simple electrical circuits

Unit-1: Mathematical modeling of Electrical and Electronic Systems

Concept of modeling, types, mathematical modeling using differential equations, transfer function, analogous physical and electrical quantities

Unit-2: Differential Equations

Differential Equation, Ordinary Differential Equations (ODE), DE and their occurrences in real life problems, linear differential equation with constant coefficients, partial DE, Introduction to coordinate systems (rectangular, cylindrical and spherical), method of separation of variables, General outline for solution of wave equation in cartesian and cylindrical coordinate system, Bessel DE and zeros of Bessel function and their significance, solution of Laplace equation in spherical coordinate system

Unit-3: Electronic Signals and Mathematical Tools for Circuit Analysis

Signals: periodic, aperiodic, Continuous Time (CT) and Discrete Time (DT), special electronic signals (impulse, unit step, sinusoidal, ramp, square wave, staircase)
Laplace Transform (LT): definition, LT of standard electronic signals, inverse LT, methods of ILT (partial fraction method), properties of LT (shifting, linear, scaling), initial and final value theorem, LT of derivatives and Integrals, solution of DE using LT, concept of Transient and steady state response
Z-Transform (ZT): definition, inverse ZT (partial fraction and residue method), ZT of standard electronic signals, properties, difference equation and solutions using ZT

Concept of transfer function of CT and DT systems, Laplace transformation of electrical circuits, two port network functions, time and frequency domain response

of systems using transfer function, poles and zeros of transfer function and their significance, applications to simple passive filters such as Low Pass (LP), High Pass (HP), Butterworth filters, stability criterion, Routh-Hurwitz criterion, synthesis of transfer function using poles and zeros

Unit-4: Network Analysis

Network Topology (nodes, tree, graph, branch, mesh, and loop)
Network Theorems and Applications to DC and AC Circuits: Thevenin's, Norton's, superposition, maximum power transfer – theorems
Mesh, loop and nodal analysis of circuits, T and π networks, state variable method with simple examples

Text / Reference Books:

1. Advanced Engineering Mathematics, E. Kreyzig, John Wiley and Sons.
2. Network Analysis, G. K. Mittal, Khanna Publication.
3. Circuits and Networks Analysis and Synthesis, A. Sudhakar, Shyam Mohan and S. Pilli, TMH.
4. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanpriya, McGraw Hill.
5. Network Analysis, M. E. Van Valkenberg, PHI.
6. Network and Systems, Roy Choudhary, Wiley Eastern.
7. Microwave Devices and Circuits, Samuel Y. Liao, 3rd Edition, PHI, 2002.

EL1UT02: Analogue Circuit Design

Objectives:

1. To learn the characteristics and working of electronic devices
2. To study the various device models
3. To study the wideband and narrowband amplifiers using BJT
4. To develop skills in analysis and design of analog circuits
5. To study the designs of opamp applications

Unit-1: Basic Semiconductor Devices

Practical diode characteristics (static and dynamic resistance), temperature effects, switching characteristics, diode breakdown, diode applications in wave shaping circuits
BJT construction and biasing, Operation, CC, CB and CB configurations
Construction of JFET, types and its operation, parameters of JFET, JFET characteristics, comparison of BJT and JFET, JFET amplifiers
MOSFET, depletion and enhancement, biasing of MOSFET, applications

Unit-2: Frequency Response of Amplifiers

BJT models and modeling parameters, equivalent circuits for CE, CB and CC configurations, single stage amplifier, small signal analysis, distortion
Design of single stage RC-coupled amplifier with frequency response (f_1 and f_2)
Frequency Response: Low and High frequency equivalent circuit, bode plots, Miller effect, square wave testing, frequency response of multistage amplifiers, different coupling schemes and gain of multistage amplifiers

Unit-3: Tuned Amplifier and Oscillators

Tuned amplifier design, multistage tuned amplifiers: synchronous and stagger tuning cascade configuration, large signal tuned amplifier
Oscillators: design and analysis of LC and RC oscillators, Hartley, Colpitt's, Miller oscillators, phase shift and Wien-bridge oscillators, crystal oscillators and applications

Unit-4: Operational Amplifiers and their Applications

Practical consideration in opamp based circuit design, opamp parameters such as dc and low frequency parameters and their significance in design of opamp, closed loop stability analysis and frequency compensation.
Inverting and non-inverting amplifiers with design aspects such as input and output impedance, common mode errors and limitations, bandwidth, etc.
Bridge and instrumentation amplifier
Practical design aspect of integrator and differentiators, such as offset error and stability, bandwidth considerations.
Concept and applications of PLL.
Active Filters: transfer functions poles and zeros, Design of active filters - LPF, HPF, BPF and BRF (first and higher orders), Butterworth and Chebyshev filters.

Text / Reference Books:

1. Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar, 3rd Edn, McGraw Hill.
2. Electronic Devices and Circuit Theory, Robert Boylestead, Louis Nashelsky, PHI.
3. Design with Operational Amplifiers and Linear IC, Sergio Franco, 3rd Edn, TMH.
4. Electronic Principles, Malvino and Bates, McGraw Hill.
5. Operational amplifier, G.B.Clayton, Elsevier Sci. Tech.
6. Microelectronic Circuits: Analysis and Design, Mohammad H. Rashid, PWS Publishing Company.
7. Pulse, Digital Switching Circuits, Millman Taub, TMH.
8. Electronic devices, Allen Motershed, PHI.
9. Integrated electronics, Millman Halkies, McGraw Hill.

EL1UT03: Digital System Design

Objectives:

1. To understand sequential and combinational logic design techniques
2. To introduce VERILOG
3. To learn various digital circuits using VERILOG
4. To learn PLD, CPLD, FPGA and their applications

Unit-1: HDL for Digital System Design

VERILOG: design flow, EDA tools, data types, modules and ports, operators, gate-level modeling, data flow modeling , behavioral modeling, tasks and functions, timing and delays, test bench, types of test bench, comparison between VERILOG and VHDL language

Unit-2: Combinational Logic

Introduction to combinational circuits, realization of basic combinational functions **-** magnitude comparator, code converters, multiplexers, demultiplexers, multiplexed display, encoder and decoders, priority encoders, parity generator/checker, arithmetic circuits (adder, subtractor, binary multiplier), parallel adder, look ahead carry generator
VERILOG models and simulation of above combinational circuits

Unit-3: Sequential Logic Design and Circuits

Introduction to sequential circuits
Flip Flops: types, state table, transition table, excitation tables, timing waveforms, clock generators
Counters: synchronous, asynchronous, design of counters, up/down counter
Shift Registers: ring counter, Johnson counter
Finite State Machine (FSM) Design: Mealy and Moore state machines
VERILOG Models and Simulation of above Sequential Circuits and FSMs: stepper motor controller, traffic light control, washing machine control, parking controller, coffee vending machine, LCD controller

Unit-4: PLDs and Memories

Need of PLD, antifuse, architecture of simple PLD (SPLD)-PAL, PLA, Complex Programmable Logic Device (CPLD) and Field Programmable Logic Devices (FPGA) CPLD/FPGA based system design applications - typical combinational and sequential system implementation, estimation of uses of blocks, links, LUTs, etc.
Memories: types, data storage principle, control inputs, and timings, applications, Random Access Memories (RAM), Static Ram (SRAM), standard architecture, 6 transistor cell diagram, sense amplifier, address decoders, timings, Dynamic RAM (DRAM), different DRAM cells, refresh circuits, timings, role of memories in PLD

Text / Reference Books:

1. Verilog HDL; A Guide to Digital Design and Synthesis, Samir Palnitkar, Pearson Education, 2nd edition, 2003.
2. Verilog HDL synthesis; A Practical Primer, J. Bhaskar, Star Galaxy Publishing, 1998.
3. Digital System Design with VERILOG Design, Stephen Brown, Zvonko Vranesic, TMH, 2nd Edn, 2007.
4. Digital design; Principles Practices, Wakerly, PHI.
5. Modern Digital Electronics, R.P Jain, McGraw Hill.
6. Digital systems; Principles and Applications, Tocci, Pearson Education.
7. Digital Logic and Computer Design, Morris Mano, PHI.

EL1UT04: Advanced 'C' Programming

Objectives:

1. To understand basic concepts of C programming language.
2. To learn various advanced features, graphics and interfacing
3. To learn concepts of object oriented programming in C++

Unit-1: Basics of C

C fundamentals: Introduction of high-level programming language, operators and its precedence, various data types in C, storage classes in C.
Control statements: Decision–making and forming loop in programs.
Arrays & pointers: handling character, arrays in C, pointers in C, advanced pointers, structure and union.
Functions: user defined function, pointer to functions.

Unit-2: Advanced Features and Interfacing

Miscellaneous and advanced features: command line argument, dynamic memory allocation, Data files in C, file handling in C.
Graphics in C: graphics-video modes, video adapters, drawing various object on screen.
Interfacing: interfacing to external hardware, via serial/parallel port using C, applying C to electronic circuit problems.

Unit-3: Introduction to C++

Introduction to object –oriented programming and C++, characteristics, objects, classes, inheritance, polymorphism, overloading.

Text / Reference Books:

1. Computer programming in C, V. Rajaraman, Pearson Education, 2nd edition, 2003.
2. The C programming language, Dennis Ritchie, Pearson Education, 2nd edition, 2003.
3. Graphics programming in C, Roger T. Stevens, BPB Publications.
4. Object oriented programming in C++, Robert Lafore, Galgotia Publications.
5. Programming with C++, John Hubbard, Schaum Outline Series, Tata McGraw Hill.
6. Programming with C, Byron S. Gottfried, Schaum Outline Series, Tata McGraw Hill.
7. Programming in C, Stephen G. Kochan. CBS.

EL2UT05: Applied Electromagnetics, Microwaves and Antennas

Objectives:

1. To introduce to students the concepts of electromagnetics
2. To understand the theory of transmission lines and wave guides
3. To study various parameters of antennas
4. To study various methods of generation of microwaves

Prerequisite: Physical quantities as vectors, concept of gradient, curl, and divergence, concept of rotation operator, covariant and contra-variant vectors, line, surface and volume – integrals, Gauss and Stokes theorem complex plane, polar form of complex number, complex functions, Cauchy-Riemann conditions, orthogonal functions and relation with Laplace equation

Unit-1: Electromagnetic Waves

Review of Maxwell's equations and their meaning, continuity equation, electric and magnetic wave equations in time domain and frequency domain, wave propagation in conducting and non-conducting media, skin depth and high frequency propagation, boundary conditions at the interface between two mediums, Poynting theorem and its applications

Unit-2: Transmission Lines

Types of transmission lines, microstrip lines, two wire transmission line, transmission line equations for voltages and currents, inductance and capacitance per unit length of two wire and coaxial cable transmission line, characteristic impedance, propagation constants, attenuation and phase constants, phase velocity, reflection and transmission coefficients, SWR, line impedance, normalized impedance and admittance, Smith chart construction and applications, single stub and double stub matching, applications to reflection of EM-waves at interfaces for normal incidence

Unit-3: Waveguides and Components

Concept of waveguides, frequency range, relation to transmission lines
Rectangular Waveguides: TM and TE Modes, concept of cut-off frequency, guide impedance, phase velocity, guide wavelength for TE and TM modes, Applications to TE mode in rectangular waveguide, power losses in rectangular waveguide
Circular waveguide introduction only
Optical Fiber: principles of operation and construction, difference between conducting circular waveguide and fiber
Different methods of excitation of TE and TM modes in waveguides
Cavity Resonators, Q factor of cavity resonators

Unit-4: Electromagnetic Radiation

Potentials of electromagnetic fields, retarded potential, radiation from oscillating dipole, concept of near zone and radiation zone, radiation resistance, role of antenna in exciting different TE, TM modes in wave guides
Antenna Parameters: gain, directivity, power, aperture, Friis equation, radiation pattern

Application Areas: antenna temperature, Signal to Noise Ratio (SNR), remote sensing, RADAR equation
Antennas Types: λ/2 antenna, antenna arrays, horn antennas, parabolic dish antennas, End fire antenna – Yagi Uda, patch antenna, microstrip antennas
EMI and EMC
Generation of Microwaves: principle, physical structure and working of - Gunn effect diodes, magnetron oscillator, reflex Klystron oscillator

Note: In the case of antennas and microwave devices, mathematical analysis of equivalent circuits and processes is not expected.

Text / Reference Books:

1. Microwave Devices and Circuits, Samuel Y. Liao, PHI, 3rd Edition, 2002.
2. Principles of Electromagnetics, N. Sadiku, Oxford University Press.
3. Electromagnetics with Applications, Kraus and Fleiseh, McGraw Hill, 5th Edn, 1999.
4. Electromagnetics, J.D. Kraus, 4th Edn, McGraw Hill, 1992.

EL2UT06: Instrumentation and Measurement Techniques

Objectives:

1. To understand the configurations and functional descriptions of measuring instruments
2. To understand the basic performance characteristics of instruments
3. To understand the working principles of various types of sensors and transducers and their use in measuring systems
4. To study the techniques involved in various types of instruments
5. To understand the relevance of electronics with other disciplines

Unit-1: Introduction to Measurement and Measurement Systems

Definition and significance of measurement, classification of instruments and types of measurement applications, elements of an instrument / measurement system, active and passive transducers, analog and digital modes of operation, null and deflection methods, input-output configuration of instruments and measurement systems, methods of correction of instruments and measurement systems
Generalized performance characteristics of instruments: static characteristics and static calibration, meaning of static calibration, true value, basic statistics, least–squares calibration curves, calibration accuracy versus installed accuracy, combination of components errors in overall system accuracy calculations, theory validation by experimental testing

Unit-2: Static Dynamic Characteristic of Measurement System

Static sensitivity, linearity, threshold, noise floor, resolution, hysteresis and dead space, scale readability, span, generalized static stiffness and input impedance, loading effect
Dynamic characteristics: generalized mathematical model of measurement system, operational transfer function, sinusoidal transfer function, zero-order instrument, first order instrument, second order instruments, step response, ramp response, frequency response of first -order instruments and second order instruments
Errors in measurement: Types of Errors - gross, systematic, environmental errors, systemic errors, computational error, personal error etc.

Unit-3: Motion Measurement

Methods of transduction, primary sensing elements and transducers, electrical transducers, classification of transducers
Motion and dimensional measurement: fundamental standards, relative displacement- translational and rotational, calibration, resistive potentiometers, resistance strain gauge, differential transformers, variable–inductance and variable–reluctance pickups, eddy current, non contacting transducers, capacitance pickups, piezoelectric transducers, digital displacement transducers (translational and rotary encoders), ultrasonic transducers, detailed discussion of strain gauges, LVDT and synchros
Relative velocity: translational and rotational, calibration, average velocity from measured Δx and Δt, tachometer encoder methods, laser based methods, stroboscopic methods, translational–velocity transducers (moving coil and moving magnet pickups)

Relative acceleration measurements: seismic (absolute) displacement pickups, seismic (absolute) velocity pickups, seismic (absolute) acceleration pickups (accelerometers)

Unit-4: Process Parameter Measurements

Force, Torque and Shaft power: standards and calibration, basic methods of, bonded strain gauge, differential transformer, piezoelectric, variable reluctance/ FM oscillator digital system, torque measurement on rotating shafts
Pressure and Sound Measurement: standards and calibration, dead weight gauges and manometers, low pressure measurement - Mcleod gauge, Knudsen gauge, viscosity, thermal conductivity, ionization, sound level meter, microphone, capacitor microphone
Flow measurement: Pitot-static tube, Yaw tube, hot wire and hot film anemometers, Laser Doppler anemometer, Gross Volume Flow Rate- rotameter, turbine, ultrasonic flow meter, electromagnetic flow meters
Temperature and Heat Measurement Transducers: standards and calibration, bimetallic thermometers, liquid in glass thermometers, pressure thermometers, RTD, thermocouples, thermistors, semiconductor based temperature sensors, detailed discussion on basics of thermocouples, laws of thermocouples, cold junction compensation; thermistor types, materials used, application circuits, LM35
Radiation Fundamentals: detectors, optical pyrometers, IR imaging systems, heat flux sensing- slug type sensors, Gorden gauge

Text / Reference Books:

1. Measurement Systems, Applications and Design, Ernest O. Doeblin and Dhanesh N. Manik, 5th Edition, Tata McGraw Hill.
2. A Course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney, Dhanpat Rai & Co.
3. Electronic Instrumentation, Kalsi, TMH.
4. Modern Electronic Instrumentation and Measurements Techniques, Cooper and Helfrick, PHI.

EL2UT07: Embedded System Design

Objectives:

1. To understand the basics of embedded system
2. To understand the architecture, assembly language and interfacing of different 8-bit microcontrollers
3. To learn embedded C programming
4. To learn software techniques to embed codes in to the systems
5. To learn communication standards and protocols

Unit-1: Introduction to Embedded System

Embedded System: components, examples, development cycle of embedded system, embedded System Development Environment - algorithm, flow chart, IDE, ICE, programmer
Processor Architectures: Harvard architecture, Von-Neumann architecture, RISC and CISC

Unit-2: Bus Standards and Communication

Communication Protocols: I2C bus- specification, general characteristics, bus signals, address mechanism,
Serial Peripheral Interface (SPI): specifications, master slave configuration,
Bus Standards- RS 232, RS 485, USB, Bluetooth, Zigbee
Controller Area Network (CAN): specifications, basic concepts, frame types, bus signals, error handling and addressing

Unit-3: AVR Microcontroller

Architecture (Atmega16), instruction set, addressing modes, memory organization, timers, I/O, ADC, interrupts, serial communication
Design of General Purpose Target Board: reset, oscillator circuit, derivatives of AVR
Basic Assembly Programs: arithmetic, logical, code converter, block data transfer, I/O programming
C Programs: ADC, timer, I/O ports, interrupts, Inter-Integrated Circuit (I2C), serial communication, PWM.
Real world interfacing with the microcontrollers and programming in C: DAC, LED, SSD, dot matrix display, and LCD displays (text and graphic), keyboard and motors (DC, stepper, and servo), I2C and SPI based RTC, EEPROM, DAC and ADC, coding assembly in C and code optimization

Unit-4: PIC Microcontroller

Architecture (PIC18F4550, 18F458), instruction set, addressing modes, memory organization, timers, I/O, ADC, interrupts, serial communication
Design of General Purpose Target Board: reset, oscillator circuit, derivatives of PIC
Basic Assembly Programs: arithmetic, logical, code converter, block data transfer, I/O programming
C Programs: ADC, timer, I/O ports, interrupts, I2C, serial communication, PWM
Real world interfacing with the microcontrollers and programming in C: DAC, LED, SSD, dot matrix display, and LCD displays (text and graphic), keyboard and motors

(DC, stepper, and servo), I2C and SPI based RTC, EEPROM, DAC and ADC, coding assembly in C and code optimization

Text / Reference Books:

1. AVR Microcontroller and Embedded Systems using Assembly and C, Mazidi and Naimi, Pearson education, 2011.
2. Embedded C Programming and the Atmel AVR, Barnett, Larry D. O'Cull and Sarah A. Cox, Delmar, Cengage Learning, 2007.
3. PIC Microcontroller and Embedded Systems, Mazidi, Mckinlay and Causey, Pearson Education.
4. C Programming for Embedded Systems, Kirk Zurell, Pearson Education.
5. Programming in C, Stephen Kochan, Hayden Books/Macmillan.

EL2UT08: Foundation of Semiconductor Devices

Objectives:

1. To introduce crystal structure with reference to semiconductors
2. To introduce quantum and statistical mechanics
3. To understand the characteristics of semiconductor devices
4. To introduce theory of diode, transistor and FETs

Unit-1: Theory of solids, quantum and statistical mechanics

Crystal structure of solids: Semiconductor materials, types of solids, basics of crystallography, space lattice atomic bonding, unit cell, Miller indices imperfections and impurities in solids, methods for semiconductor crystal growth.
Introduction to Quantum Mechanics: Principles of quantum mechanics, Schrodinger wave equation, and Applications of Schrodinger's wave equation for bound state potential problems.
Introduction to quantum theory of solids: Allowed & forbidden energy bands, electrical conduction in solids, extensions to three dimensions, density of states, Statistical mechanics: Statistical laws, Fermi-Dirac probability function, the distribution function and the Fermi energy

Unit-2: Physics of semiconductors

Semiconductor in equilibrium: Charge carriers in semiconductors, dopant atoms and energy levels, extrinsic semiconductors, Statistics of donors and acceptors, charge neutrality, position of Fermi energy level.
Carrier transport phenomena: charge, effective mass, state & carrier distributions ,Carrier drift, carrier diffusion, graded impurity distribution, resistivity, Hall effect.
Non-equilibrium excess carriers in semiconductors: Carrier generation and recombination, characteristics of excess carriers, ambipolar transport, quasi-Fermi energy levels, excess carrier lifetime, surface effects

Unit-3: Basics of Semiconductor Devices

Diode: Junction terminologies, Poisson's equation, built-in potential, depletion approximation, diode equation, Qualitative and Quantitative analysis, Reverse-bias breakdown, avalanching, zener process, C-V characteristics, Transient response .
BJT: Terminology, electrostatics and performance parameters, Eber-Moll model, Two port model, hybrid – pi model, device models in spice , Modern BJT structures – polysilicon emitter BJT, Heterojunction bipolar transistor (HBT)
FETs: JFET and MESFET - Junction terminologies, characteristics, ac response, spice models
MOSFET: Fundamentals, Capacitance- voltage characteristics, I-V characteristics, Qualitative Theory of Operation, I_D - V_D Relationship, ac response, spice models.

Text / Reference Books:

1. Semiconductor Physics and Devices Basic Principles, Donald A. Neamen, TMH, 3rd Edition (2003)
2. Semiconductor Device fundamentals, Robert F. Pierret, Pearson Education
3. Solid State Electronics Devices, Streetman, PHI, 5th Edition, (2006)

EL1UP01: Practical Course –I

Group A: Analog Circuit Design → 7

Group B: Digital Electronics (hardware) → 3

Group C: Activity → 2

Note that for Group C: Activity, please refer Section 5) Examination of this document.

[A] Practical based on Circuit Design

1. Bootstrap ramp generator for delay triggering
2. Blocking oscillator
3. Tuned amplifier small signal / large signal for IF
4. Transistor based microphone amplifier
5. Voltage controlled current source / sink and current mirror and doubler
6. Comparator and Schmitt trigger with single supply operation
7. Second order Butterworth filters (BP and BR)
8. Waveform generation: quadrature oscillator, Bubba oscillator
9. V to f and f to V using commercially available IC
10. Instrumentation amplifier for a given gain
11. Low current negative power supply using IC555 / dual power supply using single battery
12. PLL characteristics and demonstrate any one application (IC565/CD4046)

[B] Practical based on Digital Design

1. Two digit combinational lock
2. Keyboard encoder with latches
3. Traffic light controller
4. Multiplexed display (Bank token / two digit counter)
5. Bidirectional stepper motor control (Sequence Generator)
6. One digit BCD adder and 8-bit adder / subtractor
7. Object counter (use of MMV, counter)
8. Binary-Gray and Gray-Binary code converter

EL1UP02: Practical Course –II

Group A: VEILOG programming, CPLD/FPGA → 6

Group B: Mathematical Methods for Electronics (C/MATLAB/PSICE) → 4

Group C: Activity → 2

Note that for Group C: Activity, please refer Section 5) Examination of this document.

[A] Practical Based on VERILOG Programming and Implementation on CPLD or FPGA

1. Combinational Logic
    a. Parity Generator and checker
    b. Hamming Code Generator
    c. Manchester code Generator
2. Sequential Logic
    a. Up-down bit binary counter (minimum 4-bit)
    b. Universal shift register
3. Four bit ALU design (structural modelling)
4. Keyboard Scanning
5. Designing of Traffic light Controller
6. Implementation of 8 bit multiplexer
7. LCD controller
8. Code Converter (BCD to seven Segment)
9. Practical based on state machine (Stepper sequence generator/Vending Machine/ Washing Machine)
10. Barrel shifter

[B] Practical based on C / MATLAB / PSPICE

1. Phase and frequency response from transfer function of a CT system: Low Pass and High Pass
2. Phase and frequency response from transfer function of a DT system: Low Pass and High Pass
3. Transient and steady state response of CT system: LCR series circuit with different inputs
4. Simulation of transfer function using poles and zeros
5. Synthesis of periodic waveform from Fourier coefficients
6. Solution of differential equation with given boundary conditions
7. Analysis of a given dc electrical circuit
8. Effect of locations of poles and zeros on the transfer function and corresponding frequency response

EL1UP03: Practical Course –III (PLE)

Candidate should carry out a Project Like Experiment (PLE). PLE is a small project equivalent to 5 practical experiments. A project report should be submitted to the department. Log book of the continuous progress of the work should be maintained by candidate.

EL2UP04: Practical Course –IV

Group A: Instrumentation → 7

Group B: Electromagnetics, Microwave → 3

Group C: Activity → 2

Note that for Group C: Activity, please refer Section 5) Examination of this document.

[A] Practical based on Instrumentation and Measurement System

1. Design build and test rms to dc converter for voltage measurement of ac signal
2. Displacement measurement using LVDT, signal conditioning and DPM
3. Temperature measurement using PT100, signal conditioning and DPM
4. Temperature measurement using thermocouple with cold junction compensation
5. Design build and test IR transmitter and receiver (TSOP1738 or similar) for object detection
6. To build and test current telemetry (4 to 20 mA)
7. Ultrasonic transmitter and receiver, distance measurement
8. Pressure measurement using strain gauge
9. RPM measurement using various methods
10. Design and calibrate light intensity meter using photodiode or LDR and the necessary signal conditioning and display.
11. Use of strain gauge to measure stress on a cantilever made of material known quantity
12. Hot wire anemometer

[B] Practical based on Electromagnetics, Microwaves, Antennas

1. To study the characteristics of Klystron tube
2. To determine the standing wave ratio and reflection coefficient of a given waveguide
3. To plot directivity pattern of a given antenna
4. To determine a characteristics of a microstrip transmission line
5. Design and test Yagi-Uda antenna with power reflectors
6. Measurement of primary-secondary coupling factor of a given transformer using LCR meter (calculation of transformer model parameters expected)

EL2UP05: Practical Course –V

Group A: Microcontrollers → 7

Group B: Electromagnetics (C/MATLAB) → 3

Group C: Activity → 2

Note that for Group C: Activity please refer section 5) Examination of this document.

[A] Practical on AVR/PIC Interfacing Students should design of target board of AVR / PIC

Practical on AVR (3/4)

1. Interfacing of LED array to generate different sequences, use of timer for delay generation
2. Matrix Keyboard interface with LCD
3. DAC interfacing (sine, staircase, triangular, square wave) use of timer
4. Use of ADC
5. DC motor control using PWM / Intensity control of LED – with CCP
6. Serial EEPROM / EEPROM interface using SPI protocol
7. Real time clock (RTC)
8. Stepper motor Interfacing
9. Dot matrix rolling display

Practical on PIC (3/4)

Any four Practical on PIC Interfacing

1. Two-digit 7-segment display(multiplexed) interfacing
2. LCD / keyboard Interfacing
3. Bidirectional stepper motor interfacing
4. Real Time Clock display on LCD / HyperTerminal (I2C)
5. Use of internal EEPROM
6. DAC interfacing (square wave, staircase, triangular, sine) use of timer for
7. On-off controller with hysteresis (ADC)
8. Two digit frequency counter or event counter using timer / interrupt
9. Matrix keyboard / Touch screen
10. Graphic LCD interfacing
11. Zigbee communication
12. DC motor control using PWM / intensity control of LED

[B] Practical on Electromagnetics (C / MATLAB)

1. To plot Equipotential contours and field lines for given charge distribution
2. Use of Smith chart for transmission line pattern and verify using C
3. Use of MATLAB for potential distribution in a region bound by two conductors
4. Use of MATLAB for directivity pattern for simple antennas

EL2UP06: Practical Course –VI (PLE)

Candidate should carry out a Project Like Experiment (PLE). PLE is a small project equivalent to 5 practical experiments. A project report should be submitted to the department. Log book of the continuous progress of the work should be maintained by candidate.