Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

SYLLABUS for M. Sc. ELECTRONICS

Choice Based Credit System (Semester Pattern)

With effect from 2023-24 as per NEP 2020

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

SYLLABUS for M. Sc. ELECTRONICS

As per National Education Policy (NEP)-2020

With effect from 2023-24

Scheme of Teaching and Examination for M. Sc. ELECTRONICS (CBCS) As per NEP 2020

Structure and Credit Distribution of PG Degree Program for Two years

Choice Based Credit System (Semester Pattern)

With Effect from 2023-2024

M.Sc. ELECTRONICS SEMESTER I												
Course Category	**Code**	**Theory / Practical**	**Teaching scheme (Hours / Week)**			**Credits**	**Examination Scheme**					
							Duration in hrs.	**Max. Marks**		**Total Marks**	**Minimum Passing Marks**	
			Theory	**Practical**	**Total**			**SEE**	**CIE**		**Theory**	**Practical**
DSC	MEL 1T01	Paper 1: Fundamentals of Semiconductor Devices	4	-	4	4	3	80	20	100	40	-
DSC	MEL 1T02	Paper 2: Analog and Digital Systems	4	-	4	4	3	80	20	100	40	-
DSE	MEL 1T03	Paper 3: Electives (Choose any one) a. Network Analysis and Synthesis b. Programming in C and Embedded C c. Programming in Python and Micropython d. MATLAB e. Equivalent MOOC Course	4	-	4	4	3	80	20	100	40	-
RM	MEL 1T04	Research Methodology	4	-	4	4	3	80	20	100	40	-
DSC	MEL 1P01	Practical I: Based on Paper I	-	6	6	3	3-8*	50	50	100	-	50
DSC	MEL 1P02	Practical II: Paper II (including Research Methodology)	-	6	6	3	3-8*	50	50	100	-	50
		TOTAL	**16**	**12**	**28**	**22**	**--**	**420**	**180**	**600**	**160**	**100**

M.Sc. ELECTRONICS SEMESTER II												
Course Category	**Code**	**Theory / Practical**	**Teaching scheme (Hours / Week)**			**Credits**	**Examination Scheme**					
							Duration in hrs.	**Max. Marks**		**Total Marks**	**Minimum Passing Marks**	
			Theory	**Practical**	**Total**			**SEE**	**CIE**		**Theory**	**Practical**
DSC	MEL2T05	Paper 5: Measurements and Instrumentation	4	-	4	4	3	80	20	100	40	-
DSC	MEL2T06	Paper 6: Embedded System Design and Applications	4	-	4	4	3	80	20	100	40	-
DSE	MEL2T07	Paper 7: Electives (Choose any one) (a) Biomedical Instrumentation (b) Internet of Things (c) Equivalent MOOC course	4	-	4	4	3	80	20	100	40	-
OJT	MEL2P03	Practical 3: On Job Training/ Field Project	-	8	8	4	3-8*	50	50	100	-	50
DSC	MEL2P04	Practical 4: Measurements & Instrumentation	-	6	6	3	3-8*	50	50	100	-	50
DSC	MCH2P05	Practical 5: Embedded Systems & Applications	-	6	6	3	3-8*	50	50	100	-	50
		TOTAL	**12**	**20**	**32**	**22**	**-**	**390**	**210**	**600**	**120**	**150**

M.Sc. ELECTRONICS SEMESTER III												
Course Category	**Code**	**Theory / Practical**	**Teaching scheme (Hours / Week)**			**Credits**	**Examination Scheme**					
							Duration in hrs.	**Max. Marks**		**Total Marks**	**Minimum Passing Marks**	
			Theory	**Practical**	**Total**			**SEE**	**CIE**		**Theory**	**Practical**
DSC	MEL3T08	Paper 8: Industrial Process Control	4	-	4	4	3	80	20	100	40	-
DSC	MEL3T09	Paper 9: VLSI Design	4	-	4	4	3	80	20	100	40	-
DSC	MEL3T10	Paper 10: Digital Signal Processing	4	-	4	4	3	80	20	100	40	-
DSE	MEL3T11	Paper 11: Elective (Choose any one) (a) Artificial Neural Network (b) Applied Ultrasonics (c) Fuzzy Logic (d) Equivalent MOOC course	4	-	4	4	3	80	20	100	40	-
DSE	MEL3P06	Practical 6: Based on Paper 9,10,11	-	4	4	2	3-8*	50	50	100	-	50
RP	MEL3P07	Research Project (RP)	-	8	8	4	3-8*	50	50	100	-	50
		TOTAL	**16**	**12**	**28**	**22**	**-**	**420**	**180**	**600**	**160**	**100**

M.Sc. ELECTRONICS SEMESTER IV													
Course Category	**Code**	**Theory / Practical**	**Teaching scheme (Hours / Week)**			**Credits**	**Examination Scheme**					
							Duration in hrs.	**Max. Marks**		**Total Marks**	**Minimum Passing Marks**	
			Theory	**Practical**	**Total**			**SEE**	**CIE**		**Theory**	**Practical**
DSC	MEL4T12	Paper 12: Electromagnetic Fields and Antenna	4	-	4	4	3	80	20	100	40	-
DSC	MEL4T13	Paper 13: Digital Communication	4	-	4	4	3	80	20	100	40	-
DSC	MEL4T14	Paper 14: Microwave Communication	4	-	4	4	3	80	20	100	40	-
DSE	MEL4T15	Paper 15: Elective (Choose any one) (a) Satellite Communication (b) Mobile Communication (c) Optical Communication (d) Equivalent MOOC course	4	-	4	4	3	80	20	100	40	-
RP	MEL4P08	Research Project (RP)	-	12	12	6	3-8*	100	100	200	-	100
		TOTAL	**16**	**12**	**28**	**22**	**-**	**420**	**180**	**600**	**160**	**100**

Abbreviations:

DSC: Discipline Specific Course

DSE: Discipline Specific Elective

SEE: Semester End Examination

CIE: Continuous Internal Evaluation

OJT: On the Job Training (Apprenticeship)

FP: Field Project

RM: Research Methodology

RP: Research Project

M. Sc. Semester I (Electronics)

Paper I (MEL1T01): Fundamentals of Semiconductor Devices

Marks: 100 **Duration: 60 Hrs**

Course Objective:

To provide basic knowledge and concepts of Semiconductor materials and devices

Course Outcomes:

On successful completion of this subject, student should be able to

- Understand semiconductor devices and their operations
- Distinguish among various types of semiconductor devices based on their phenomena
- Understand the importance of optoelectronic devices in the world of visualization
- Study basic concepts of inorganic and organic semiconductor materials for electronic device application in modern electronic industry
- Emphasis on nano-electronic applications such as Schottky barrier transistors, flexible Electronics
- Gain the basic understanding of VLSI and display devices

Unit I: Inorganic and Organic Semiconductors

Valence bond model of semiconductor- intrinsic and extrinsic semiconductors, the energy band model; carrier transport, mobility, drift- diffusivity, p-n junction; the diode equation, I-V characteristics, temperature dependence, electrical breakdown in p-n junctions

Unit II: Majority Carrier Devices

Transistor action, the Ebers-Moll equations, CB, CE, CC configurations and characteristics, high frequency performance of transistor, alpha and beta cut-off frequencies, Metal-semiconductor contacts, the Schottky effect, JFET and MESFET, I-V and C-V characteristics, HEMT and Band diagrams

Unit III: MOS Structures

Semiconductor surfaces; ideal and non-ideal MOS capacitor band diagrams and CVs; effect of oxide charges, defects and interface states. MOSFET: Structures and Device Characteristics, short-channel effects, charge coupled devices (CCDs), application to VLSI

Unit IV: Optoelectronic Devices

Photovoltaic effect, the p-n junction solar cell, I-V characteristics, photo-detectors: photoconductor, photodiode, avalanche photodiode;

LEDs: radiative and non-radiative transitions; semiconductor LASERS, population inversion

Books:

1. Physics of Semiconductor Devices: S. M. Sze, Wiley eastern Publ.
2. Operation and modeling of the MOS transistor: Yannis P. Tsividis, Mc Graw-HILL International Edition

References:

1. Introduction to Semiconductor Materials and Devices: M. S. Tyagi, Wiley India Ltd, New Delhi
2. Solid State Electronic Devices: Ben G. Streetman

M. Sc. Semester I (Electronics)

Paper II (MEL1T02): Analog and Digital Systems

Marks: 100 **Duration: 60 Hrs**

Course Objective:

The course offers students to develop the ability to design and analyze MOS based VLSI circuits and analyze their performance. To understand analysis, designing and reduction techniques for sequential circuits by using Algorithmic state machine and asynchronous sequential circuit design by using transition table. Also, course explains concept of fault diagnosis; VHDL programming language and digital designing tools like FPGA, ASIC.

Course Outcomes:

On successful completion of this subject, student should be able to

- Learn to design analog and digital systems, from specifications and simulation to construction and debugging.
- Learn techniques and tools for programmable logic design.
- Understand the limitations and difficulties in modern analog and digital design aspects, including wiring constraints, high-speed etc.
- Design, construct, test and debug a moderate-scale digital circuits
- Be Familiar with the state-of-the-art system on chip (SoC) design methods using FPGAs and ASIC design chips.

Unit I: Analog System Design

Circuit Design and Analysis using PSPICE – Schematics, attributes and types of analysis in PSPICE, use of PROBE.

Design and analysis of BJT/FET differential and multistage amplifiers, current sources, current mirrors, and active loads, small signal circuit analysis

Unit II: Amplifiers and their applications

Operational Amplifiers (OPAMP)-characteristics and Applications- Integrator, Differentiator, Wave-shaping circuits, Active filters, Oscillators, Schmitt trigger circuit, Non-sinusoidal oscillators and timing circuits

Design and analysis of Signal conditioning circuits, Current to voltage, voltage to current, voltage to frequency, frequency to voltage converters, Phase Locked loop and its application circuits.

Unit III: Combinational and Sequential circuits:

Interfacing of Logic Families, open-collector, totem pole and tri state outputs, TTL-CMOS and CMOS-TTL interfacing

Combinational circuits: Simplification of logic functions using K-maps, multiplexer, DEMUX, decoders, encoders, 4x4 keyboard encoder

Sequential circuits: State diagrams, characteristic equations of different flip-flops, conversion from one type to another type of flip flops. Finite state machines (FSM), Mealy and Moore models, State assignments, design of counters with lockout prevention; asynchronous sequential circuits, ripple counters, detection and removal of races and hazards.

Unit IV: Digital System Design:

Digital System design concepts, approaches. Implementation of systems like ALU, Stop-watch, Control Unit design, Applications of FSM like shift registers, ring counter, sequence detector, sequence generator, Stepper control. Programmable logic devices: ROM, PLA, PAL, CPLD, FPGA etc.

Books:

1. Electronic circuit analysis and design: D. A. Neaman, McGraw HILL
2. Integrated Electronics: J. Millman, C. Halkias, C. Parekh, McGraw HILL
3. Digital Design: Morris Mano, Prentice Hall India, New Delhi
4. Digital System Design using VHDL: Charles H. Roth, Jaico Publishers, New Delhi
5. Fundamentals of Digital Logic with VHDL Design: Stephen Brown, TMH, New Delhi

References:

1. Modern Digital Electronics: R. P. Jain, Tata McGraw Hill, New Delhi
2. VHDL: Douglas Perry, Tata McGraw Hill, New Delhi
3. VHDL Primer: J. Bhaskar, Pearson Education, New Delhi

M. Sc. Semester I (Electronics)

Paper III (MEL1T03.a): Network Analysis and Synthesis (Elective)

Marks: 100 **Duration: 60 Hrs**

Course Objective:

To provide basic knowledge of network analysis, synthesis and applications of network theorems

Course Outcomes:

On successful completion of this subject students should be able to:

- Explore the fundamentals of Network Analysis and Synthesis
- Apply various network theorems in the circuit design
- Develop the design concepts of various analog electronic circuits
- Analyze and synthesize various networks

Unit I: Network Elements

Network elements: passive and active, linear and non-linear, unilateral and bi-lateral, time variant and time invariant, lumped and distributed;

Types of sources: independent, dependent, ideal voltage source and practical voltage source;

Kirchoff's Laws: Kirchoff's Current Law (KCL) and Kirchoff's Voltage Law (KVL); source transformation technique; Thevenin's voltage source, Norton's current source

Unit II: Network Analysis

Graph Theory and network equations: Graph of a network, trees and co-trees, twigs and links, incidence matrix, tie set matrix, cut set matrix;

Mesh analysis, mesh equations, super-mesh analysis; nodal analysis, nodal equations, super-node analysis; state variable analysis; time domain analysis

Unit III: Network Theorems and Applications

Star-delta transformations, superposition, Thevenin's, Norton's and Reciprocity theorems, maximum power transfer theorem, Tellegen's and Millman's theorem, duals and duality

Laplace transformation, properties of Laplace transforms, inverse Laplace transforms, partial fraction expansion, applications of the Laplace transform to circuit analysis, time and frequency domain response, passive filters

Unit IV: Network Functions and synthesis Techniques

One-port and two-port networks, two-port network parameters: open circuit impedance, short circuit admittance, h, Y, Z, ABCD parameters, interrelationship of different parameters

Transfer functions, signal representation, poles and zeros of network functions, time domain behavior of pole zero plot; stability of active networks, Routh Hurwitz array and R-H criteria

Practical:

Minimum 10 practicals covering network theorems and relevant examples for real time implementation and applications.

Books:

1. *Network Analysis*: M. E. Van Valkenberg, PHI, New Delhi
2. *Circuits and Networks: Analysis and Synthesis*: A. Sudhakar and S. P. Shyammohan, Tata McGraw Hill, New Delhi
3. *Networks and Systems:* D. Roy Choudhuri, New Age International (P) Limited, Publishers, New Delhi

Semester I M. Sc. (Electronics)

Paper III (MEL1T03.b): Programming in C and Embedded C (Elective)

Marks: 100 **Duration:60 Hrs**

Course Objective:

- To impart adequate knowledge of C programming language and problem-solving techniques
- To pursue advance structured and procedural programming understating
- To improve C programming skills
- To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types

Course Outcomes:

On successful completion of this subject, student should be able to

- Explore the fundamentals of C language
- Apply the concepts of control structures, arrays, functions and file handling for effective programming
- Develop programming skills by writing various C programs
- Desing various applications based on C programming.
- Develop embedded C programming concepts to be used in the designing of the embedded system.

Unit I: Basics of C programming and Control structure

Basics of programming: Structure of a C program, C character set, constants, variables and keywords, C operators and hierarchy, Input-Output statements in C (Formatted and Unformatted), tools for programming in C – data types, data storage, data access, operators, associativity of operators, operator precedence,

Decision control structures: if, if-else, nested if, nested if-else, else-if ladder, switch-case; Loop control structures: while, do-while, for loop, Break statement, Continue statement.

Unit II: Arrays, functions, Structures and Unions

Arrays and strings; One- dimensional, two dimensional and multidimensional array, various string operations;

Function definition and prototyping, types of functions, type of arguments, recursion, passing arrays to functions, passing structures to functions, storage class in C;

Structure and union: structure variable, accessing structure member, arrays of structure, union, bit fields

Unit III: Pointers and file handling

Pointers: declaration of pointers, chain of pointers, pointer expression, pointer arrays, pointer to array, pointer to function;

File handling in C- File opening modes, Text and Binary files, High level and Low-level operations on files; Linked list.

Unit IV: Embedded C

Introduction and structure of embedded C, Difference between C and Embedded C, development tools and environment for embedded c, Variables, Types and Debugging, Operators and Hardware Manipulation, IDE for embedded C.

Practicals:

Minimum 20 practicals covering file handling for various data types, sorting and searching, printer port access for input-output, serial port access, interfacing of character display (5x7)

Books:

1. Programming in ANSI C: E. Balaguruswamy, TMH, New Delhi
2. Let Us C: Yashwant Kanetkar, BPB Publications, New Delhi
3. C Programming: Gottfried, Schaum Outline Series, MGH
4. Programming Languages: Concepts and Constructs: Ravi Sethi, Addison Wesley Publishers
5. Mastering C++: K R Venugopal Tata McGraw-Hill , New Delhi

Reference:

1. The ANSI 'C' Language: Kernighan and Ritchie, PHI, New Delhi, 1996
2. Object Oriented Programming with C++: E. Balagurusamy, McGraw Hill

Semester I M. Sc. (Electronics)

Paper III (MEL1T03.c): Programming in Python and MicroPython (Elective)

Marks: 100 **Duration:60 Hrs**

Course Objective:

- To impart adequate knowledge of python programming language and problem-solving techniques
- To pursue advance structured and procedural programming understating
- To improve python programming skills
- To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types

Course Outcomes:

On successful completion of this subject, student should be able to

- Explore the fundamentals of python language
- Apply the concepts of control structures, arrays, functions and file handling for effective programming
- Develop programming skills by writing various python programs
- Desing various applications based on python programming.
- Develop micorpyhton programming concepts to be used in the designing of the embedded system, IoT.

Unit I: Introduction

Installing Python in Windows/Linux/Mac OS, Using Python interpreter, execute a Script, Structuring with Indentation, Editors

Data types and Variables: Variables, Variables v/s identifiers, Naming convention of variables, Keywords,

Data Structure: List, Tuples, Sets, Dictionaries

Input and Output: Input function, Input with raw_input(), Output with old string format, Python format function

Unit II: Control Flow and Functions

If/Else Statements, For and while Statements, Range () function, Break and continue statements, Else clauses on Loops.

Functions: Defining Function, Default Argument, Keyword Argument, Arbitrary Arguments List

Unit III: File Handling

Reading from the file, Writing to the file, Methods of file objects

Error And Expectation: Syntax Errors, Exceptions, Handling Exceptions (try, except)

Module: Creating Modules, import a module, Import the names, Executing modules as scripts

Unit IV: MicroPython

Introduction to MicroPython, difference between Python and MicroPython, Why MicroPyhton, MicroPython IDE, Libraries, Simple pin operations, LED Blinking, Toggling the LED, Timers and Delay, Pins and GPIO, PWM, ADC, SPI bus, 12C bus, Sensors, Display, Motors, MicroPython Program examples.

Books:

1. Python Essential Reference: David M. Beazley, Pearson Education, New Delhi
2. Core Python Programming: Wesley J. Chun, Pearson Education, New Delhi
3. Python Tutorial Release 2.6.1 by Guido van Rossum and Fred L. Drake Jr., http://www.altaway.com/resources/python/tutorial.pdf
4. Numpy Reference Guide, http://www.docs.scipy.org/doc/numpy/numpy-ref.pdf
5. Matplotlib, http://matplotlib.sf.ne/Matplotlib.pdf
6. Numerical Methods in Engineering with Python: Jaan Kiusalaas,
7. Computation and Programming using Python with Application to Understanding Data: John V. Guttag, MIT Press Cambridge, Massachusetts USA

Semester I M. Sc. (Electronics)

Paper III (MEL1T03.d): MATLAB (Elective)

Marks: 100 Duration:60 Hrs

Course Objectives:

- To impart adequate knowledge of MATLAB programming and problem-solving techniques
- To pursue advance structured and procedural programming understating
- To improve MATLAB programming skills
- To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types

Course Outcomes:

On successful completion of this subject, student should be able to

- Explore the fundamentals of MATLAB
- Apply the concepts of basic MATLAB programming, arrays, functions, file handling and data plotting for effective programming
- Develop programming skills by writing various MATLAB programs
- Desing various applications based on MATLAB.

Unit I: Introduction to MATLAB

MATLAB Interactive Sessions, Menus and the toolbar, Computing with MATLAB, Script files and the Editor Debugger, MATLAB Help System, Programming in MATLAB

Arrays: Multidimensional Arrays, Element by Element Operations, Polynomial Operations Using Arrays, Cell Arrays, Structure Arrays

Unit II: Functions & Files

Elementary Mathematical Functions, User Defined Functions, Advanced Function Programming, Working with Data Files

Programming Techniques: Program Design and Development, Relational Operators and Logical Variables, Logical Operators and Functions, Conditional Statements, Loops, The Switch Structure, Debugging MATLAB Programs

Unit III: Plotting

XY- plotting functions, Subplots and Overlay plots, Special Plot types, Interactive plotting, Function Discovery, Regression, 3-D plots

Linear Algebraic Equations: Elementary Solution Methods, Matrix Methods for (LE), Cramer's Method, Undetermined Systems, Order Systems.

Probability and Statistics: Interpolation, Statistics, Histogram and probability, The Normal Distribution, Random number Generation, Interpolation

Unit IV: Simulink

Introduction to Simulink, Simulink Fundamentals, Circuit simulations in Simulink Simulink Fundamentals for Automotive Applications, Signal Processing with Simulink, Control System Design with Simulink.

Books:

1. MATLAB Handbook with Applications to Mathematics, Science, Engineering, and Finance, Jose Miguel David Baez-Lopez, David Alfredo Baez Villegas, CRC Press, 2019

2. Beginning MATLAB and Simulink: From Beginner to Pro 2nd Edition by Sulaymon Eshkabilov, APress, 2022.

3. Programming with MATLAB for Scientists: A Beginner's Introduction by Eugeniy E. Mikhailov, CRC press, 2018

M.Sc. Semester-I (Electronics Science)

Paper IV (MELT104) RESEARCH METHODOLOGY

Marks: 100 Duration: 60Hrs

Course Objectives

The main objective of this course is to introduce the basic concepts in research methodologyin Electronic Science. This course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project. This will also enable the students to prepare report writing and framing Research proposals.

Course Outcomes

- Students who complete this course will be able to understand and comprehend the basics in research methodology and applying them in research/project work.
- This course will help them to select an appropriate research design.
- With the help of this course, students will be able to take up and implement a researchproject/ study.
- The course will also enable them to collect the data, edit it properly and analyze it accordingly. Thus, it will facilitate students' prosperity in higher education.
- The students will develop skills in qualitative and quantitative data analysis and presentation.
- Students will be able to demonstrate the ability to choose methods appropriate toresearch objectives.

Unit I: Basics in Electronic Science Research

Foundations of Research:

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process

Problem Identification & Formulation:

Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance

Research Design:

Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, typesand uses. Experimental Design: Concept of Independent & Dependent variables.

Unit II: Research Design

Qualitative and Quantitative Research:

Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

Measurement:

Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.

Sampling:

Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample

– Practical considerations in sampling and sample size.

Unit III: Data Collection, Analysis and Interpretation

Data Analysis:

Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

Interpretation of Data and Paper Writing:

- Layout of a Research Paper, Journals in Electronic Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

- Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Electronic Science Discipline.

Use of tools / techniques for Research:

Methods to search required information effectively, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Unit IV: Thesis writing, results and ethics, Reasoning

Reporting and Thesis writing:

Structure and components of scientific reports - Types of report - Technical reports and thesis - Significance - Different steps in the preparation - Layout, Structure and Language of typical reports - Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation - Planning - Preparation - Practice - Making presentation - Use of visual aids - Importance of effectivecommunication

Application of results and ethics:

Environmental impacts - Ethical issues - ethical committees - Commercialization - Copy right - royalty - Intellectual property rights and patent law - Trade related aspects of intellectual property Rights - Reproduction of published material - Plagiarism - citation and acknowledgement - citation and acknowledgement - Reproducibility and accountability.

Reasoning and Mental-ability:

Analogy, Classification, Series, Coding-Decoding, Direction Sense, Representation Through Venn Diagrams, Mathematical Operations, Arithmetical Reasoning, Inserting the Missing Character, Number, Ranking and Time Sequence Test, Eligibility Test**,** Representation through Venn-diagrams, Number & symbols ordering, Comprehension questions, Statement & assumptions, Statement & conclusions, Statement & actions.

Books Recommended: -

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C. R. Kothari
4. Select references from the Internet

REFERENCES

1) Garg B. L., Karadia, R., Agarwal, F. and Agarwal, U. K., 2002. An introduction to ResearchMethodology, RBSA Publishers.
2) Kothati C.R., 1990. Research Methodology: Methods and Techniques. New AgeInternational. 418p.
3) Sinha S. C. and Dhiman, A. K., 2002. Research Methodology, Ess Publications.
4) Trochim W. M. K., 2005. Research Methods: the concise knowledge base, Atomic DogPublishing. 270p
5) Wadehra B. L. 2000. Law relating to patents, trademarks, copyright designs andgeographical indications. Universal Law Publishing.

Semester II M. Sc. (Electronics)

Paper V (MEL2T05): Measurements and Instrumentation

Marks: 100 **Duration:60 Hrs**

Course Objectives:

To impart knowledge on the following Topics

- Basic functional elements of instrumentation
- Fundamentals of electrical and electronic instruments
- Comparison between various measurement techniques
- Various storage and display devices
- Various transducers and the data acquisition systems
- Virtual Instrumentation and its designing concepts

Course Outcomes:

On successful completion of this subject, student should be able to

- Acquire knowledge on Basic functional elements of instrumentation
- Understand the concepts of Fundamentals of electrical and electronic instrument
- Comprehend various measurement techniques
- Acquire knowledge on Various storage and display devices
- Understand the concepts Various transducers and the data acquisition systems
- Model and analyse electrical and electronic Instruments and understand the operational features of display Devices and Data Acquisition System.
- Assess and apply graphical programming structures and data types to display and log data.
- Generate data acquisition applications that utilize GUIs and Virtual Instruments.

Unit I: Introduction

Functional elements of an instrument – Static and dynamic characteristics: Accuracy, Precision, Sensitivity, Dead Zone, Hysteresis, Threshold, Resolution, Loading Effects, Errors in measurement, Statistical evaluation of measurement data – Standards and calibration, failures and causes of failures and maintainability

Unit II: Transducers and data acquisition systems

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart Sensors-Thermal Imagers

Unit III: Virtual Instrumentation

Definition of VI, architecture of VI, graphical programming, advantages of Lab VIEW, palettes, sub VI, express VI, data flow program, modular programming

Introduction to LabVIEW: For and WHILE loops, feedback nodes, local and global variables, arrays, array functions, polymorphism, cluster operations, conversion between arrays and clusters, case and sequence structures, formula nodes, strings and file I/o, charts and graphs

Unit IV: Instrument Control and Processing Toolkits

Instrument I/o Assistant, VISA, instrument drivers, serial port communications with GPIB, RS-232, USB, firewire, Ethernet and IEEE-1394 controllers, Control design and simulation tools, PID control, digital filter design and modulation tool kits, simulation of ECG signal, motion control systems, prototyping with Motion Assistant

TEXT BOOKS:

1. A Course in Electrical & Electronic Measurements & Instrumentation: A. K. Sawhney, Dhanpat Rai and Co. 2010

2. A Course in Electronic and Electrical Measurements: J. B. Gupta, S. K. Kataria & Sons Publishers, Delhi, 2013

3. Measurement Systems – Applications and Design: Doebelin E.O. and Manik D.N., Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007

4. Virtual Instrumentation using Lab VIEW: Jovitha Jerome, PHI Learning Pvt. Ltd., New Delhi

5. Virtual Instrumentation using Lab VIEW: Sanjay Gupta and Joseph John, TMH, New Delhi

REFERENCES:

1. Electronic Instrumentation: H.S. Kalsi, McGraw Hill, III Edition, 2010

2. Transducers and Instrumentation: D.V.S. Murthy, Prentice Hall of India Pvt Ltd, New Delhi, 2015

3. Electronic Instrumentation & Measurements: David Bell, Oxford University Press,2013

4. Electrical Measurements: Martin Reissland, New Age International, Pvt Ltd., Delhi, 2001

5. Principles of Measurements and Instrumentation: Alan. S. Morris, 2nd Edition, Prentice Hall of India, 2003

Semester II M. Sc. (Electronics)

Paper VI (MEL2T06): Embedded System Design & Applications

Marks: 100 **Duration: 60 Hrs**

Course Objective

To explore the concepts, design and interfacing of microcontroller-based embedded systems.

Course Outcomes

After successful completion of the course the students will be able to:

- Explore the fundamentals of microcontrollers and assembly language programming.
- Understand the general concepts of embedded systems.
- Interface various I/O devices with the microcontroller.
- Deal with the advanced microcontrollers.
- Design and develop the embedded systems based projects.

Unit I: Introduction

Introduction to embedded systems, classifications, processor in the system. 8051 Microcontroller: architecture, features, basic assembly language programming concepts, instruction set, addressing modes.

Interfacing: Interfacing with 8051 Microcontroller: keyboard, displays, ADC, DAC, RTC, stepper motor, dc motor, relay, opto-coupler.

Unit II: ARM controllers

ARM Architecture, organization and implementation, 3-stage pipeline, 5-stage pipeline, instruction set, thumb instruction set, thumb implementation, thumb applications, programming, memory interface, memory hierarchy and management, co-processor interface

Unit III: ARM Cortex

ARM Cortex M3/M4 Microcontroller: memory and bus Architecture, power control, reset and clock control; Peripherals: GPIOs, system configuration controller, NVIC, ADC, Comparators, General Purpose Timers, USART.

Unit IV Communication protocols and development tools

Serial communication protocols: RS232, Serial Peripheral Interface (SPI), Inter-Integrated Circuit (I2C), USB.

Development & Debugging Tools: Software and Hardware tools like JTAG, boundary scan test architecture, cross assembler, compiler, debugger, simulator, In Circuit Emulator (ICE), logic analyzer

Books:

1. The 8051 Microcontroller: Kenneth Ayala, Thomson Delmar Learning, New Delhi
2. 8051 Microcontroller and Embedded Systems: Mazidi & Mazidi, Pearson Publishers, New Delhi
3. "ARM System-On-Chip Architecture", Steve Furber, 2nd Edition, Pearson Education
4. The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, Second Edition, Elsevier Inc. 2010
5. The Definitive Guide to the ARM Cortex-M0 and M0+, Joseph Yiu, Second Edition, Elsevier Inc. 2010
6. Embedded/Real Time Systems Concepts, Design and Programming Black Book, Prasad, KVK

References:

1. David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England; Morgan Kaufmann Publishers
2. Cortex-M series-ARM Reference Manual
3. Cortex-M3 Technical Reference Manual (TRM)
4. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide -Designing and Optimizing System Software", 2006, Elsevier

M. Sc. Semester II (Electronics)

Paper VII (MEL2T07.a): Biomedical Instrumentation(Elective)

Marks: 100 **Duration:60 Hrs**

Course Objective:

- To understand the generation of bio-potential signals
- To learn different transducers, sensors and smart sensors for measurement of physiological parameters
- To understand biomedical Instruments imaging system and processing of bioelectric signals & image reconstruction techniques
- To design simple biomedical instruments

Course Outcomes:

After successful completion of the course, the students will be able to:

- Gain knowledge of bio potential signals and understand the principle of various transducers & sensors
- Knowledge about various instruments their uses and signal processing.
- Knowledge of various imaging systems and image re-construction techniques
- Design of simple biomedical instruments as a part of skill development

Unit I: Basic Principles of Biomedical Electronics

Role of technology in medicine, origin of bio-electrical signals, distribution of potentials in different parts of body, biometrics, basic medical instrumentation system, transducers for data acquisition, smart Sensors, chemical sensors, preamplifiers, main amplifiers and driver stage, direct writing recorder

Unit II: Patient Safety and Biomedical Instruments

Sources noise in low level measurement, biomedical signal analysis and processing techniques : FT, FFT, wavelet transform digital signal processing, electric shock hazards: gross shock, micro current shocks, leakage current & types of leakage currents, ECG, EMG, EEG

Unit III: Imaging Techniques:

Need for imaging human body, Imaging techniques: X-ray tomography, image reconstruction techniques: convolution and iterative; MRI and principle of NMR imaging system, basic MRI components, image reconstructionon techniques: sequential point, sequential line, sequential plane; ultrasonic imaging: basic pulse echo apparatus, imaging modes: A and B scan modes, foetal Doppler ultrasonic imaging, foetal ECG; patient monitoring systems, ventilators

Unit IV: Therapeutic Equipments

Cardiac pacemaker, cardiac defibrillator, surgical diathermy, LASER application, design of temperature measurement system, pulse-oximeter using photoelectric pulse transducer, short range medical telemetry system and infusion pump system; telemedicine, design of personal biomedical parameters monitoring system using IoT

Books:

1. Handbook of Biomedical Instrumentation: R. S. Khandpur, TMH, New Delhi
2. Biomedical Instrumentation: Leslie Cromwell, PHI Publication, New Delhi
3. Biomedical Engineering System: Leslie Cromwell, PHI Publication, New Delhi
4. Biomedical Phenomenon: Robert Plonsay, John Wiley & Sons
5. Introduction to Biomedical Equipment Technology: J. J. Carr and J. M. Brown, Pearson Education Asia Publication, Singapore
6. Computers in Medicine: R. D. Lele, THM, New Delhi
7. Biomedical Signal Processing: D. C. Reddy, MGH
8. Bio-electro-magnetism: Principles and Applications of Bioelectric and Biomagnetic Fields: Malmivno J. and Plonsay R., Oxford University, Press, New York, 1995

Semester II M. Sc. (Electronics)

Paper VII (MEL2T07.b): Internet of Things (Elective)

Marks: 100 **Duration: 60 Hrs**

Course Objectives:

- To understand the basics and fundamentals of latest technology of Internet of Things (IoT)
- To provide basic knowledge, concepts and use of wireless sensor networks
- To provide knowledge of various protocols used for designing WSN
- To provide basic knowledge about different operating systems used for WSN

Course Outcomes:

Students after successful completion of the course will be able to:

- Understand the concepts of Internet of Things
- Analyze basic protocols in wireless sensor network
- Design IoT applications in different domain and be able to analyze their performance
- Implement basic IoT (and/or WSN) applications on embedded platform
- Understand and explain common wireless sensor node architectures.
- Carry out simple analysis and planning of WSNs.
- Demonstrate knowledge of MAC protocols developed for WSN.
- Demonstrate knowledge of routing protocols developed for WSN.

Unit I: Introduction to IoT and WSN

Definition of IoT, characteristics of IoT and WSN, physical design of IoT, logical design of IoT, functional blocks of IoT, standards considerations, Machine to Machine, Difference between IoT and M2M, Software defined Network.

WSN vs Adhoc Networks – Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage, profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Unit II: Network & Communication aspects:

Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts – Contention based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol, (TRAMA) - The IEEE 802.15.4 MAC protocol, survey routing protocols, sensor deployment & node discovery, data aggregation & dissemination. Design challenges, development challenges, security challenges, other challenges, protocols- BACNet protocol, modbus

Unit III: Routing and Data Gathering Protocols:

Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping, Data centric Routing, SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing, Rumor Routing, COUGAR, ACQUIRE, Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation – data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

Unit IV: Security and Web/ Cloud of Things and tools

IoT Security: Vulnerabilities of IoT, security requirements, challenges for secure IoT, threat modelling, key elements of IoT security Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Introduction to different IoT tools, developing applications through IoT tools, developing, sensor based application through embedded system platform, Implementing IoT concepts with python.

Practicals:

Minimum 15 practicals on interfacing Arduino/node MCU/ESP8266 with sensors and actuators, controlling and monitoring.

Books:

1. Internet of Things: A Hands-On Approach: Arshdeep Bahga,, Vijay Madisetti,
University Press, Mumbai
2. Fundamentals of Wireless Sensor Networks: Theory & Practice, Waltenegus
Dargie, Christian Poellabauer
3. Wireless Sensor Networks : Technology, Protocols, and Applications, Kazem Sohraby, Daniel Minoli and Taieb Znati, John Wiley & Sons, 2007
4. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig, John Wiley & Sons, Ltd, 2005.
5. A survey of Routing Protocols in Wireless Sensor Networks, K. Akkaya and M. Younis, Elsevier Ad Hoc Network Journal, 3(3), 325—349
6. TinyOS Programming, Philip Levis,
7. Wireless Sensor Network Designs, Anna Ha´c, John Wiley & Sons Ltd.

M. Sc. Semester III (Electronics)

Paper VIII (MEL3T08): Industrial Process Control

Marks: 100 Duration: 60 Hrs

Course Objective:

The course offers students to develop the ability to design industrial control systems and analyze their performance.

Learning Outcomes

On successful completion of this subject students should be able to:

- Explore the fundamentals of Industrial process control and instrumentation
- Apply various controller principles in the instrument design
- Develop the design concepts of various controllers
- Design various control systems
- Design PLC based systems

Unit I: Basic Elements of control system

Introduction to functional elements of control system, control strategies, continuous and discrete state controllers, open loop control systems, closed loop control systems - feedback, feed forward and adaptive control strategies. Data logger, supervisory and direct digital control systems. block diagram algebra, signal flow graph

Unit II: System behaviors

Dynamic behaviour of control systems-servomechanism, characteristics parameters of control Systems-Accuracy, Sensitivity, Disturbances, Transient response, Stability of linear control systems. Methods of determining stability- Routh-Hurwitz stability criterion, root locus and frequency response methods of control system analysis, Bode and Nyquist plots

Unit III: Open and Closed Loop Controllers

Error amplifier, on-off controllers, Multi-position controllers, Proportional (P), Proportional-Integral (PI). Proportional-Derivative (PD), Proportional-Integral-Derivative (PID) controllers, applications of PID Controllers

Unit IV: Programmable Logic Controllers and SCADA

PLC Basics: Programmable Controllers - functional diagram, operation, programming PLC system. I/O modules and interfacing, CPU processor, devices connected to I/O modules, PLC Programming: Ladder diagrams for process control, construction of PLC ladder diagrams

Supervisory Control and Data Acquisition, typical SCADA System Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA

Reference Books:

1. *Process Control Instrumentation Technology:* Curtis Johnson
2. *Control Systems:* I. J. Nagrath and M. Gopal
3. *Feedback Control Systems:* U. A. Bakshi and S. C. Goyal

M. Sc. Semester III (Electronics)

Paper IX (MEL3T09): VLSI Design

Marks: 100 Duration: 60 Hrs

Course Objective:

To introduce various aspects of VLSI circuits and their design including testing and study the fundamentals of CMOS circuits and its characteristics.

Course Outcomes:

Upon completion of this course, the students will be able to

- Acquire qualitative knowledge about the fabrication process of integrated circuits using MOS transistors.
- Draw the layout of any logic circuit which helps to understand and estimate parasitic effect of any logic circuit
- Design building blocks of data path systems, memories and simple logic circuits using PLA, PAL, FPGA and CPLD.
- Understand different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.

Unit I: Introduction to VLSI Technology

VLSI design methodology, VLSI technology- NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up, VLSI testing -need for testing, manufacturing test principles, design strategies for test, chip level and system level test techniques.

Unit II: MOS Characterization

Characteristics of MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. MOS models, small-signal AC analysis. CMOS inverters, propagation delay of inverters, Pseudo NMOS, Dynamic CMOS logic circuits, power dissipation.

Unit III: Logic Synthesis

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls, Power: Dynamic & Static Power, Low Power Architecture.

Programmable logic cells. Programmable inversion and expander logic. Computation of interconnect delay, Techniques for driving large off-chip capacitors, long lines, Computation of interconnect delays in FPGAs Implementation of PLD, EPROM, EEPROM, static and dynamic RAM in CMOS.

Unit IV: VLSI Design Abstraction levels

Different abstraction levels in VLSI design; Design flow as a succession of translations among different abstraction levels; Gajski's Y-Chart; Need for manual designing to move to higher levels of abstraction with automatic translation at lower levels of abstraction; Need to model and validate the design at higher-levels, Necessity of HDLs

Reference Books:

1. *CMOS Digital Integrated Circuits: Analysis and Design:* Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill.
2. *CMOS VLSI Design- A Circuits and Systems Perspective:* Neil H. E. Weste and David Money Harris, 4th Edition, Pearson Education.
3. *Essentials of VLSI circuits and systems*: Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005 Edition

M. Sc. Semester III (Electronics)

Paper X (MEL3T10): Digital Signal Processing

Marks: 100 Duration: 60 Hrs

Course Objective:

- To provide basic knowledge, concepts and use of Digital Signal Processing
- To gain knowledge of DSP according to the different applications
- To be able to design a DSP application system
- To be able to implement DSP using hardware and software as per the requirement of the application

Course Outcomes:

On successful completion of this subject, student should be able to

- realize the importance of digital signal processing in different applications
- gain knowledge of the basic elements of digital signal processing and its requirement
- get familiar with the types of signals, systems, digital filters and digital transformation methods.
- get familiar with the types of operations that can be performed on the signals in digital signal processing.
- assimilate the concepts, choice of filter and steps for designing digital filters and its application
- ingest the importance and requirement of transformation in designing digital filters.
- assimilate the important aspects of DSP of noise and echo cancellation and encoding in wireless communication
- identify the types of DSP processors required in designing digital filters.
- acquire the knowledge of DSP and have knowledge to use it in different fields of application

Unit I: Discrete-time Signals and Systems

Discrete time signals: types, operations, D-T system classification; linear time-invariant systems: convolution, linear constant-coefficient difference equations, correlation functions, multirate signal processing.

Unit II: Transform methods

Introduction to Fourier series and Fourier transform, properties of Fourier transform, discrete Fourier transform and its properties, inverse Fourier transform, twiddle factor, circular convolution, FFT, Radix-2 FFT; z-transform: definition, region of convergence (RoC), pole zero plot, the inverse z-transform and its methods; Wavelet transform: introduction, discrete wavelet transform

Unit III: Digital Filter Design

FIR filter structures, IIR filter structures, Criterion Function for the Estimation of FIR Filter Parameters,

IIR filter design: impulsive invariance method, bilinear transformation method and matched z-transform method, FIR filter design: Fourier series method, windowing technique, Kaiser window filter design method, frequency sampling method, introduction to adaptive filters, optimal filter: wiener filter, Kalman filter.

Unit IV: DSP Chips and Applications

Introduction to DSP processors, types of DSP processors and architecture, general purpose DSP processors; Fixed-Point and Floating-Point Formats and Digital Signal Processors, Adaptive Filter applications: Adaptive channel equalization, Echo cancellation in Data transmission, Adaptive noise cancellation, Linear Predictive Coding of speech signals, Radar, 60-Hz Hum Eliminator and Heart Rate Detection Using Electrocardiography.

Practicals:

Minimum 20 practicals covering performing operations on signals, implementation of sampling theorem, design of filters such as types of IIR, FIR, Kalman and adaptive filters, implementation of Fourier Transformation, Z-Transformation and FFT,

Reference Books:

1. *Digital Signal Processing:* R. A. Barapate, Tech-Max Publications
2. *Digital Signal Processing: Principles, Algorithms and Applications:* John G. Proakis, Dimitris G. Manolakis, Pearson Publication
3. *Digital Signal Processing:* A. Nagoor Kani, TMH Publications
4. *Adaptive Digital Filter:* Branko Kovačević, Zoran Banjac, Milan Milosavljević, Springer-Verlag
5. *Digital Signal Processing: Fundamentals and Applications,* Li Tan, Jean Jiang, Elsevier Publication
6. *Adaptive Filtering: Algorithms and Practical Implementations,* Paulo S. R. Diniz, Springer
7. *Digital Signal Processing: A Computer Based Approach*, Sanjit K. Mitra, McGraw Hill

M. Sc. Semester III (Electronics)

Paper XI (MEL3T11.a): Artificial Neural Networks (Elective)

Marks:100 **Duration:60 Hrs**

Course Objective:

The course offers students ability to develop their own neural network models and analyze their performance.

Course Outcomes:

On successful completion of this subject students should be able to:

- Explore the concepts of various artificial neural networks
- Design various neural network models
- Apply artificial neural network models to real time applications

Unit I Introduction to ANN:

Basics of artificial neural networks (ANN): Artificial neurons, Computational models of neurons, Structure of neural networks, Functional units of ANN for pattern recognition tasks

Feedforward neural networks: Pattern classification using perceptron, Multilayer feedforward neural networks (MLFFNNs), Backpropagation learning, Empirical risk minimization, Regularization, Auto-encoders

Unit II: Deep neural networks (DNNs):

Difficulty of training DNNs, Greedy layer wise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods for training, Regularization methods (dropout, drop connect, batch normalization)

Unit III: Convolutional neural networks (CNNs):

Introduction to CNNs – convolution, pooling, Deep CNNs, Different deep CNN architectures: LeNet, AlexNet, VGG, ResNet, training a CNNs: weights initialization, batch normalization, hyper parameter optimization, Understanding and visualizing CNNs.

Unit IV: Recurrent neural networks (RNNs) & Generative models:

Sequence modelling using RNNs, Back propagation through time, Long Short Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, Gated RNN Architecture.

Restricted Boltzmann Machines (RBMs), Stacked RBMs, Belief nets, Learning sigmoid belief nets, Deep belief nets, Applications: Applications in vision, speech and natural language processing

Reference Books:

1. *Neural Networks and Learning Machines:* S. Haykin, Prentice Hall of India, 2010
2. *Neural Networks and Deep Learning*: Charu C. Agrawal, Springer, 2018
3. *Essence of Nueral Networks,* Robert Callan, Pearson, 2011
4. *Pattern Recognition and Machine Learning,* C.M. Bishop, Springer, 2006

M. Sc. Semester III (Electronics)

Paper XI (MEL3T11.b): Applied Ultrasonics (Elective)

Marks: 100 Duration: 60 Hrs

Course Objective:

- To provide basic knowledge, concepts and use of ultrasound
- To provide knowledge of various ultrasonic measurement techniques
- To provide basic knowledge of designing different digital ultrasonic systems

Course Outcomes:

On successful completion of this subject, student should be able to

- assimilate the importance of ultrasound
- Become familiar with the use of ultrasonic transducers for generation of sound waves.
- ingest the basic elements of an ultrasonic measurement system
- get familiar with the process of generation, reception and interpretation of ultrasonic signals
- Accustom with different ultrasonic techniques used and their application domains

Unit I: Fundamentals of Ultrasound

Ultrasonic waves: reflection, refraction, attenuation, radiation; ultrasonic propagation: propagation in solids, liquids and gases; relaxation phenomenon and low frequency measurement, propagation in high temperature and pressure; and attenuation measurements; ultrasonic Transducers: capacitive, piezoelectric, magneto-strictive, EMAT, transducers operating with an electric discharge

Unit II: Ultrasonic Digital Measuring Methods

Fundamental ultrasonic measuring methods: phase evaluation, pulse; distance and level measurements: ultrasonic echo sounders, ultrasonic length meters, ultrasonic level meters; position measurements: plane coordinate pick-ups, pick-ups of spatial coordinates, possibilities of dimensional measurements, methods of increasing the precision of a measurement, ultrasonic measurement of liquid flow velocity, cross-correlation technique, measurement of thickness of materials, temperature and pressure measurement, electro-dynamic methods (EMATs); NDT methods: basic principle, transmission, pulse reflection, resonance, impedance, holographic, acoustic emission (AE)

Unit III: Ultrasonic Systems

The pulser, cabling, coupling, transducer characterization, detection and measurement of ultrasound, methods of measuring velocity of sound: interferometric, resonance, Pulse methods: Sing-Around, pulse-superposition, Pulse-Echo-Overlap; measurements in Materials of high attenuation, Measurements at High Temperatures, Measurements at High Pressures, Impulse echo method,

Unit IV: Applications

Flaw detector, level measurement applications of impulse echo method in sonography: internal medicine, cardiography, encephalography, ophthalmology ultrasound-guided aspiration, Doppler sonography, ultrasonic cleaning, joining with ultrasound, diagnosis by reflection method, tissue characterization, material characterization, non-destructive testing and analysis, proximity sensors robotics, air pollution detection, under water communication

Reference Books:

1. *Ultrasonics: Fundamentals,* Technologies and Applications, Dale Ensminger and Leonard J. Bond, CRC Press
2. *Ultrasonics Fundamentals and Applications*, Heinrich Kuttruff, Elsevier
3. *Ultrasonic Testing of Materials,* Josef Krautkramer and Herbert Krautkramer, Springer
4. *Ultrasonic Non-destructive Evaluation Systems Models and Measurements,* Lester W.

Schmerr Jr. And Sung-Jin Song, Springer
5. *Ultrasonic Measurements and Technologies*, Stefan Kočiš, Zdenko Figura, Chapman & Hall
6. *Fundamentals and Applications of Ultrasonic Waves,* J. David N. Cheeke, CRC Press
7. *Physical Acoustics*, Volume I-XVII

M. Sc. Semester III (Electronics)

Paper XI (MEL3T11.c): Fuzzy Logic (Elective)

Marks: 100 **Duration: 60 Hrs**

Course Objective:

To introduce various aspects of Fuzzy Set theory and their applications including statistical analysis and study the fundamentals of Fuzzy Inference systems and its characteristics.

Course Outcomes:

Upon completion of this course, the students will be able to

- decode the difference between Crisp set and fuzzy set theory.
- recognize fuzzy logic fuzzy inference systems
- make applications on Fuzzy logic membership function and fuzzy inference systems.
- analyse statistical data by using fuzzy logic methods.
- evaluate fuzzy statistics applications.

UNIT 1: Introduction to Fuzzy Logic

Origin of Fuzzy Set Theory, Historical developments Fuzzy Logic, Benefits, Limitations of Fuzzy Logic, Application potentials and application domains of Fuzzy Logic

UNIT 2: Fuzzy Set Theory

Fuzzy Set: discrete and continuous domains, Crisp Set versus Fuzzy Set, Concept of membership function and its features, Types of Fuzzy Sets, Characteristic properties of Fuzzy Set, Methods of assigning membership grade values, Hedges, Labels, Fundamental operations (Union, Intersection, Complement, Containment)

UNIT 3: Fuzzy Relation and Implications

Classical (Crisp) and Fuzzy Relations, Fundamental operations (Union, Intersection, Complement, Containment), Properties of Fuzzy Relation, Fuzzy Proposition, Formation of Fuzzy Rules, Compound rules, Aggregation of Fuzzy rules, Fuzzy (Approximate) Reasoning, Types of Fuzzy Reasoning, Mamadani and TSK methods of Fuzzy Reasoning,

Fuzzy Inference System (FIS), Types of FIS: Mamadani and Sugeno type, Comparison, Fuzzy Implication: Generalized Modus Ponens and Tolens, Types of Implications, Conversion of Fuzzy Rules into Fuzzy Relation by Zadeh and Mamadani type implications, Compositional Rule of inference.

UNIT 4: FKBC Design Parameters

The FKBC architecture, choice of variables & content of rules, Derivation of rules, choice of membership functions, choice of scaling factors, choice of fuzzification procedure, choice of defuzzification procedure, comparison and evaluation of defuzzification methods.

Nonlinear Fuzzy Control: The Control Problem, The FKBC as a Non-Linear Transfer Element, Types of FKBC such as PID-like FKBC, Sliding Mode FKBC, Sugeno FKBC.

Reference Books:

1. *Fuzzy Logic with Engineering Applications:* Timothy J. Ross, Mc Graw Hill Inc.
2. *Fuzzy Logic using MATLAB:* Sivanandam et al. Springer
3. *Neuro-Fuzzy and Soft Computing:* Jang, Sun and Mizutani, Pearson Education, Asia
4. *An introduction to fuzzy control:* D. Driankov, H. Hellendoorn and M Reinfrank

M. Sc. Semester IV (Electronics)

Paper XII (MEL4T12): Electromagnetic Fields and Antennas

Marks: 100 **Duration: 60 Hrs**

Course Objectives:

- To study the various of antennas and their characteristics
- To build the foundation of experimental methods of antenna characterization

Course Outcomes:

On successful completion of this subject, student should be able to

- Understand the design, working and characterization of antenna
- Understand the basics of electromagnetic fields and Maxwell's unified equations
- To design experimental methods for antenna characterisation

Unit I: Electromagnetic waves

Coulomb's law, Lenz's law, Biot- Sawarts law, Ampere's law, Stokes theorem, Greens theorem, gradient, curl, Laplacian operator, divergence theorem, magnetic field, electric field, Maxwell's equations: differential and integral forms, origin of Maxwells equations, the equation of continuity for time varying fields, EM waves in a homogeneous medium, wave equations for a conducting medium, conductors and dielectrics, Poynting's theorem, interpretation of E x H, Poynting vector and its utility

Unit II: Antenna Basics

Basic radiation equation, radiation resistance, antenna radiation patterns, half-power bandwidth, half-power beam width, radiation intensity, directivity and gain, resolution, apertures, effective heights, Frii's transmission formula, field zones: near and far field; polarization: linear, elliptical and circular polarization, experimental method to determine polarization of electromagnetic wave

Unit III: Antenna types

Antenna family, short dipole antenna, antenna arrays, broad-side and end-fire arrays, linear arrays, folded dipole, Yagi-Uda array, helical beam antenna, horn antenna, V-antenna, inverted V-antenna, rhombic antenna, parabolic reflectors, lens antenna

Unit IV: Antennas for mobile communications and antenna measurements

Antennas for terrestrial mobile communications, base station antennas, switched beam and beam forming antennas, antennas on cellular handsets, micro-strip lines and antenna: construction, working and radiation pattern; Antenna measurements: The reciprocity theorem, antenna ranges: near and far field, compact antenna test ranges (CATR), single, double layer CATR, anechoic chamber, absorbing materials, instrumentation for measurement of gain, phase, polarization, impedance, efficiency, radiation pattern of antenna under test (AUT)

Reference Books:

1. *Electromagnetic waves and Radiating Systems:* E. C. Jordan and R. E. Balmain, PHI, New Delhi
2. *Antennas: For All Applications:* John D. Kraus and R. J. Marhefka, TMH, New Delhi
3. *Antennas and Radiowave Propagation:* R. E. Collin, Mc Graw Hill, International Edition

M. Sc. Semester IV (Electronics)

Paper XIII (MEL4T13): Digital Communication

Marks: 100 Duration: 60 Hrs

Course Objectives:

- To acquire knowledge of various digital signals and spectra
- To study various aspects of digital communication techniques
- To compare various information coding aspects in digital communication

Course Outcome:

On successful completion of this subject, student should be able to

- Acquire knowledge of the importance of signals and spectra
- Become familiar with the basics of digital communication
- Design systems based on digital modulation techniques
- Understand different information coding

Unit I: Signals and spectra

Classification of signals, energy and power signals, energy spectral density, power spectral density, unit impulse function, sifting property of the Dirac delta function, Fourier series, exponential Fourier Spectra, Parseval's theorem, Fourier transform, properties of Fourier transform, convolution properties

Unit II: Digital Communication system

Elements of digital communication system, the sampling theorem, aliasing error, PAM, PPM &PWM signals generation and detection

Pulse code modulation, uniform and non-uniform quantization, SNR, companding characteristics, Inter-symbol interference, Nyquist criteria of zero ISI, vestigial spectrum, eye diagrams

Unit III: Digital Modulation Techniques

Coherent binary modulation techniques, PSK, FSK, Bit Error Rate (BER), QPSK, MSK, differential pulse code modulation (DPCM), predictor, delta modulation, slope overload and granular noise, adaptive delta modulation, M-ary signaling

Unit IV: Information Coding

Measure of information, entropy, Shannon's coding theorem, source coding, Huffman code, channel coding, block codes, syndrome decoding, convolutional codes, code tree,

Mutual information, channel capacity, capacity of Gaussian channel, spread spectrum communication: PN sequences, direct sequence and frequency hopping spread spectrum systems

Reference Books:

1. *Modern Digital and Analog Communication Systems:* B. P. Lathi and Zhi Ding (Oxford Univ. Press)
2. *Digital communications:* Symon Haykin (John Wiley & Sons)
3. *Analog and Digital Communications:* Hwei Hsu (Schaum S e r i e s Mc Graw Hill)
4. *Digital communications:* Bernard Sklar (Pearson Education, Asia Publishers)
5. *Modern Digital communications Systems:* Leon W. Couch (PHI, New Delhi)
6. *Digital communications:* J. G. Proakis (MGH)

M. Sc. Semester IV (Electronics)

Paper XIV (MEL4T14): Microwave and Optical Communication

Marks: 100 Duration: 60 Hrs

Course Objectives:

- To understand microwave generators and wave guides
- To acquire knowledge about different microwave components and measurement parameters
- To be familiar with the concepts in optical communication

Course Outcomes:

On successful completion of this subject, student should be able to

- Assimilate the knowledge of the microwave components, generators and measurement techniques
- Become familiar with the basics of optical communication
- Design experimental method for microwave measurements
- Design experimental method for optical measurements

Unit I: Microwave Generators and wave guides

Failure of vacuum tubes at high frequency, Two cavity klystron, reflex klystron oscillator,magnetron oscillator, TWT amplifier, backward wave oscillator, GaAs oscillator;

Propagation of EM waves through wave guide, TE, TM and TEM waves

Unit II: Microwave components and Measurements

Microwave components: scattering matrix, attenuators, Tees, directional couplers, circulators,isolators, phase shifters, cavity resonators

Microwave measurements: Measurement of VSWR, phase shift, frequency, power, attenuation,dielectric constants of liquids and solids, Q of cavity

Unit III: Fiber optics

Principles of optical communication, single mode and multi mode fibers, step index, graded index, ray model, multi path dispersion, material dispersion, optical fiber as wave guide, fiber sources anddetectors,

Unit IV: Manufacture and Measurements of fibers

Optical fiber cable, fiber joints, splices, couplers and connectors, measurement in optical fibers, attenuation measurement, dispersion measurement, refractive index profile measurement, transmission links, optical transmitters and receivers

Reference Books:

1. *Microwave devices and Circuits:* Liao
2. *Microwave Engineering:* David Pozar
3. *Electronics and Radio Engineering:* Terman
4. *Introduction to Microwave Theory and Measurement:* A. L .Lance
5. *Optical Fiber Communication :* B. Keiser, Mc Graw Hill
6. *Optical Communication Systems:* J. Gower, Prentice Hall India
7. *Optical Fiber Systems:* Kao, Mc Graw Hill)
8. *Fiber Optic Communication:* D. C. Agrawal, A. H. Wheeler Co.

M. Sc. Semester IV (Electronics)
Paper XV (MEL5T15.a): Satellite Communication (Elective)

Marks: 100 Duration: 60 Hrs

Course Objective:

- To know the evolution of Satellite communication.
- Learn emerging technologies in satellite communication
- To become acquaintance with the different sub-systems of earth stations and satellite and communication between them

Course Outcomes:

On successful completion of this subject, student should be able to

- Illustrate the basic concepts of satellite communication and different Frequency allocations for satellite services.
- Analyze the satellite orbits and link design for transmission & reception of signals
- Have an in-depth knowledge of various satellite subsystems and its functionality
- identify the issues in transport due to distance between satellite and ground station.
- Apply the concept of Satellite Communication in real time applications

Unit I: Fundamentals of Satellite System

Overview of Satellite Systems, Types of Satellite Orbits, Useful orbits for satellite communication, Perturbations of orbits, Orbital Parameters, Satellite Constellations, System elements – space segment, ground segment, overall system; stabilization, attitude and orbit control systems, work angle, telemetry-tracking-command-monitoring (TTCM) systems

Unit II: Link Design and Payloads

Configuration of a link, Antenna parameters, Radiated power, Received signal power, Influence of the atmosphere, Transmission Losses, System Noises, Carrier-to-Noise Ration, The uplink, down link, Effects of Rain, Combined Uplink and Downlink C/N Ratio, Payload - Functions of the payload, Characterisation of the payload, The relationship between the radio-frequency characteristics

Unit III: Satellite Networks

Network reference models and protocols, Reference architecture for satellite networks, Basic characteristics of satellite networks, Satellite on-board connectivity, Connectivity through intersatellite links (ISL), Broadband satellite networks, Point-to-Multipoint (Broadcast) Networks, Content Distribution Networks. VSAT networks

Unit IV: Satellite Access and Satellite Application Systems

FDMA - Preassigned FDMA, Demand-Assigned FDMA; TDMA - Preamble and postamble, Carrier recovery, Network synchronization, Unique word detection, Traffic data, Frame efficiency and channel capacity, Preassigned TDMA, Demand-assigned TDMA; Direct-to-Home Television, Mobile Satellite Communications, Remote sensing satellites - Weather Satellites, Land Observation Satellites, Marine Observation Satellites

Practicals:

1. Any suitable practicals on the above topics

Books:

1. *Satellite Communications Systems: Techniques and Technology,* Gerard Maral, Michel Bousquet , 5th edition, John Wily and Sons Ltd., 2009
2. *Satellite Communications*, Dennis Roddy, 4th edition, McGraw-Hill, 2001
3. *Satellite Communication*: T. Pratt, Wiley Eastern Publication
4. *Satellite Communication:* D. C. Agrawal, Khanna Publications, New Delhi

M. Sc. Semester IV (Electronics)
Paper IV (MEL4T15.b): Mobile Communication (Elective)
Marks: 100 **Duration: 60 Hrs**

Course Objective:

- To know the evolution of Mobile communication and cell concept.
- Learn emerging technologies in mobile wireless communication
- To become acquaintance with the architectures of different mobile technologies

Course Outcomes:

On successful completion of this subject, student should be able to

- Understand the new trends in mobile/wireless communications networks.
- Understand the different communication protocols and its frame structure
- Have an in-depth knowledge of optimization of cellular capacity
- identify the issues in transport and application layers.
- Apply the concept of GSM in real time applications

Unit I: Fundamentals of Mobile Cellular System

Cellular telephone system, Basics of Radio Network Planning, elements of cellular radio system design – concept of frequency reuse channels, co-channel interference reduction and its factors, Hand-off mechanism, cell splitting, types of non-co-channel interference, frequency management and channel assignment, switching and traffic, data links

Unit II – Channels, Transmission Layer and Access Control

Radio Specifications, Background for the Choice of Radio Parameters, Communication Channels in GSM - Logical channels, Physical Channels, Synchronization, Mapping the Logical Channels onto Physical Channels, TDMA, FDMA, SDMA, CDMA.

Unit III – Channel Encoding and Decoding

Linear Block Codes, Cyclic Codes, BCH Codes, Reed-Solomon Codes, LDPC, Polar Codes, Convolutional Encoding - structure of non-systematic and systematic convolutional encoder, Punctured convolutional codes, Viterbi Decoding Algorithm, Tail Biting Convolutional Codes; LDPC – Properties, Construction and Representation of Parity Check Matrix H, Encoding and Decoding; Polar Codes – Channel polarization, Encoder structure and encoding, decoder.

Unit IV - Mobile Network Evolution

Mobile Network Evolution - The First-generation System (Analogue), The Second-generation System (Digital), Third-generation Networks (WCDMA in UMTS), Fourth-generation Networks, 4G-Long Term Evolution (LTE) System, The GPRS System – Interfaces and protocol structures, GSM system architecture – The SIM concept, Addressing, Registers and subscriber data, Network interfaces and configurations

Practicals:

2. Measurement of field strength – mobile towers
3. AT-Command Based Practicals
4. Any suitable practicals on the above topics

Books:

1. *Mobile Cellular Telecommunication*: William C. Y. Lee, MGH Inc., 1995
2. *Introduction to Mobile Network Engineering:* Alexander Kukushkin, John Wily and Sons Ltd., 2018
3. *Channel Coding Techniques for Wireless Communications*: K. Deergha Rao, 2nd Edition, Springer
4. *Fundamentals of Cellular Network Planning and Optimization*: Ajay R. Mishra, John Wily and Sons Ltd., 2004
5. *Advanced Cellular Planning and Optimization*: Edited by Ajay R. Mishra, John Wily and Sons Ltd, 2007
6. *GSM architecture protocols and Services:* Jörg Eberspächer, Hans-Jörg Vögel, Christian Bettstetter, Christian Hartmann, 3rd Edition, John Wily and Sons Ltd, 2009