Rayat Shikshan Sanstha's

Karmaveer Bhaurao Patil Mahavidyalaya,

Pandharpur (Autonomous)

Syllabus under Autonomy

NAAC Reaccredited 'A^{+}' grade, CGPA:

3.51 Granted under FIST-DST and the

Best College

Affiliated To

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Program: M.Sc.- I

Subject: Electronics

Syllabus to be implemented

form w.e.f. June 2023

NEP 2020

Onwards

Syllabus

M.Sc.-I Electronics

1. Subject: Electronics

2. Year of Implementation

New Syllabi for the M.Sc. I Electronics will be implemented from June 2023 onwards.

3. Preamble

Master of Science (M.Sc.) in Electronics is the course disseminating knowledge of the subject from fundamental concepts to State-of-technologies. Indeed, the curriculum encompasses knowledge of various themes such as Numerical mathematics, Instrumentation Design, Microcontroller and interfacing, Fiber Optic Communication, Control Theory, Foundation of Microwave Technology, Microcontroller and Interfacing,

Digital Signal Processing, Real Time Operating System (RTOS) etc. NEP 2020 is implemented for this course. In each semester 4 paper, first semester 2 papers are of hard core and 1 Elective. Semester second 2 hard core and 1 elective paper. The curriculum is designed to ensure better job opportunities in industrial sector.

4. General Objectives of the Course

Following are objectives of the course.

- To provide exposure to the students to the recent technologies.
- To provide the knowledge of design and implementation of instrumentation of significant preciseness.
- To inculcate awareness among the student to perform the projects of industrial standards, which could also, ensures the interdisciplinary approach.
- To enhance the competencies by offering significant credit to the laboratory work.

5. Examination Pattern

i) Theory: Semester

ii) Practical: Semester

6. Medium of Instructions: English

7. Structure of Course

SEMISTER- I

Paper No.	Paper Code	Title of the Paper	Semester Exam			L	T	P	Credit
			Theory	IA	Total				
Major									
Paper-I	3021101	Numerical mathematics	80	20	100	4			4
Paper-II	3021102	Fiber Optic Communication	80	20	100	4			4
Elective									
Paper-III	3021103	Microcontroller and interfacing	80	20	100	4			4
	3021103	Instrumentation Design	80	20	100	4			
Paper-IV	3021104	Research Methodology	80	20	100	4			4
Practical's									
Paper-I	3021106	Numerical mathematics	40	10	50			2	6
Paper-II	3021107	Fiber Optic Communication	40	10	50			2	
Elective									
Paper-III	3021108	Microcontroller and interfacing	40	10	50			2	
	3021108	Instrumentation Design	40	10	50			2	
		Total for 1st semester	**440**	**110**	**550**		**550**		**22**
		Grand Total					**550**		

SEMESTER-II

Paper No.	Paper Code	Title of the Paper	Semester Exam			L	T	P	Credit
			Theory	IA	Total				
Major									
Paper-V	3021201	Control Theory	80	20	100	4			4
Paper-VI	3021202	Digital Signal Processing	80	20	100	4			4
Elective									
Paper-VII	3021203	Real Time Operating System (RTOS)	80	20	100	4			4
	3021203	Foundation of Microwave Technology	80	20	100	4			
OJT/ FP	3021104	OJT / FP	80	20	100	4			4
Practical's									
Paper-V	3021205	Control Theory	40	10	50			2	6
Paper-VI	3021206	Digital Signal Processing	40	10	50			2	
Elective									
Paper-VII	3021207	Real Time Operating System (RTOS)	40	10	50			2	
	3021207	Foundation of Microwave Technology	40	10	50			2	
		Total for 2nd semester	**440**	**110**	**550**		**550**		**22**
		Grand Total					**550**		

L = Lecture S = Seminar P = Practical
4 Credits of Theory = 4 Hours of teaching per week
2 Credit of Practical = 4 hours per week
HCT = Hard core theory,
Elective = Elective theory,
HCP = Hard core practical
Elective = Elective Practical,
RM : Research Methodology
OJT/FP: On Job training / Field Project

8. Evaluation Pattern

A) Mark Distribution of each Theory Paper (100 Marks)

i) College Assessment : 80 Marks

ii) Internal (Dept.) Assessment : 20 Marks

Scheme of Internal (Dept.) Assessment : 20 Marks

a) Unit Test : 10 Marks

b) Group Discussion/Seminar/Home Assignment/ Oral : 10 Marks

B) Mark Distribution of Practical semester wise (300 Marks)

Practical examination will be conducted at the end of **Each semester of 150 marks.** The candidates have toperform four practical, one from each group.

Sr. No.	CA (120)		DA (30)	
1	Practical: (30x3)	90		
2	Project/ Excursion Tour (Project-10,Report=5, Oral=5)	20	Practical Test	20
3	Journal	10	Seminar (Presentation & Report)	10
Total		**120**		**30**
Grand Total		**150**		

Abbreviations:

L- Lecture

T- Tutorials

P-Practical

Course CA- College Assessment

DA- Department Assessment

DSE- Discipline Specific Elective

AECC- Ability Enhancement

A) College Assessment

- **Break up of 30 Marks for each experiment**

i) Circuit diagram / Flow Charts	: 6 Marks
ii) Circuit Connections/Programming	: 6 Marks
iii) Procedure / Observations	: 6 Marks
iv) Graph /Calculations/ Execution	: 6 Marks
v) Results/Comments	: 4 Marks
vi) Oral	: 2 Marks

- **Project:** Every student should complete one project and submit the report of the work carried out to the department. The project work will be assessed independently at the time of practical examination.
- It is mandatory for the students to produce certified journal at the time of practical examination.

B) Department Assessment

- **Circuit Diagram Test:** One circuit diagram test of 10 marks.
- **Practical Test:** One practical test of 30 marks.
- **Seminar:** Every student have to deliver one seminar of at least 30 minutes on any advanced topic in Electronics using ICT (power point presentation) and submit the report of presentation.
- **Industrial visit / Local industry case study / Job training / Visit to industrial exhibition / Participation in the Conference / Workshop / seminars:** In order to give the exposure of Industry / Research Institute and advances in the field of Electronics, industrial visit should be arranged and submit the report to the department OR he should submit the report of the case study of local industry or on job training (minimum four days) OR he may visit to an industry / Science exhibition OR participate in conference / Seminar / workshop and produce certificate of participation.

Paper-I Numerical Methods

- **Learning Objectives:**
  1. To build the strong foundation in Mathematics of students needed for the field of Electronics
  2. To provide students with mathematics fundamentals necessary to formulate, solve and analyses complex problems.
  3. To prepare student to apply reasoning informed by the contextual knowledge to practice.
  4. To prepare students to use software for solving mathematical problems.
  5. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.

Unit-I System of Linear Algebraic Equation **15**

Formulation of system of linear algebraic equations using matrix and vector notations. Matrix transformations, adjoint and co-factors, Determinant of matrix, Inverse of matrix, Identification of square, Singular, upper-triangular(U), lower triangular(L), tri-diagonal, matrices, Fundamentals of Eigen Value Problem.

Direct methods: Forward and Backward Substitution, Gauss Jordan elimination method, Gaussian Elimination method and LU factorization method.

Case Study: Study of R-2R ladder network using tri-diagonal system.

Unit-II Laplace Transform **15**

Introduction to Laplace transform and its importance to study electrical circuits. Laplace transform of standard functions, properties of Laplace transform, Laplace transform of periodic functions, Inverse Laplace transform. Study of RL, RC, RLC circuits using Laplace transform. (Numerical Analysis on electrical and electronic problems)

Unit-III Curve Fitting

15

Curve fitting: Introduction to curve fitting.

Least Squares method of curve fitting : Straight line fitting, Second order polynomial fitting.

Interpolation : Difference between interpolation and extrapolation. Newton's forward difference formula for interpolation, Newton's backward difference formula for interpolation, Divided difference for unequal intervals, Lagrangian interpolating polynomials

Unit-IV Numerical Differentiation and Integration **15**

Numerical Differentiation : Introduction, Forward, central and backward formulae for differentiation,

Numerical Integration : Introduction, Newton-Cotes Quadrature formula, Trapezoidal rule, Simpson 1/3 rule and 3/8 rule of numerical integration

Solution of Ordinary Differentiation Equation

Taylor series method, Euler's method , Runge Kutta method.

- **Learning Outcomes:**
  1. Students will demonstrate basic knowledge of Laplace Transform., Vector differentiation and differentiation Integration.
  2. Students will demonstrate an ability to identify and Model the problems of the field of Electronics and Telecommunication and solve it.
  3. Students will be able to apply the application of Mathematics in the field of Electronics.
  4. Solve higher order linear differential equation using appropriate techniques for modelling and analysing electrical circuits.

Reference Books:

1. Circuit and Network analysis and synthesis by A. Sudhakar and S. P. Shammohan 2nd Edition, TMH,
2. Numerical Method with programming in C 2nd Edition, by T. Veerarajan and T. Ramchandran, TMH, New Delhi.
3. Applied Numerical Methods for Engineer, using MATLAB and C, Robert J Schilling and Sandra L Harries, Thompson publishers, 1999.
4. Numerical Methods for scientific and Engineering computation by M. K. Jain, S. R. K. Iyengar and R.
   K. Jain 5th Edn. New Age International, New Delhi.
5. A first Course in Numerical Methods by U. M. Ascher and Chen Greif, PHI, New Delhi, 2013.

Paper-II Fiber Optic Communication

- **Learning Objectives:**
  1. To understand basics of optical fiber
  2. To learn components of optical communication systems
  3. To know about the types of optical fibers
  4. To understand fiber optic communication system

Unit 1: Fundamentals of Optical Fiber Communication System **15**

Overview of basics of optical fiber: Total internal reflection. Ray model: Fundamental laws of optics, refraction, Snell's law, critical angle, total internal reflection Ray propagation in step index fiber , Numerical Aperture and acceptance angel , Definition of Skew rays and Meridional rays , Wave model :Phase velocity and group velocity , Modes in optical fiber , V- number & normalized frequency Classification of Optical fiber used in industry: Types of Optical Fiber: SI and GI , SM and MM

Types of losses in Optical fiber: Attenuation, Absorption losses: intrinsic and extrinsic, linear scattering losses: rayleigh and mie, Fiber bend losses: micro and macro. Dispersion: Intermodal Dispersion in multi-mode step index fiber, Intra-modal (Chromatic) Dispersion: material and wave guide dispersion. Dispersion shifted and dispersion flattened fibers

Unit 2: Components of Fiber Optics Communication System **15**

Advantages & disadvantages, General configuration of Fiber optic communication system, Understand driver circuits used in Optical communication system LED driver circuit: Analog, Digital , LASER driver circuit: analog, digital , Optical receiver block diagram Common source FET preamplifier ,Regenerative repeater

Connection losses: Extrinsic Parameters: Fresnel reflection, Misalignment, and Other factors, Intrinsic Parameters: NA mismatch, diameter mismatch, Fiber end preparation for loss minimization.

Splices: Fusions Splices, Mechanical splices: Capillary, V-grooved, Loose tube, spring groove and elastomeric splices. Process of connecting the fiber cable with connectors: Fiber optic connectors: Ferrule, Expanded beam.

Unit 3: Optical Fiber Cables, connectors and integrated optics **15**

Optical components & integrated optics Optical couplers and isolators: types and functions, Optical switches, Beam splitter, Optical multiplexer and de multiplexer, Optical wavelength Converter, Bragg grating, working of optical amplifier

Concept of integrated optics: Optical Amplifiers-Semiconductor optical amplifier, EDFA, Raman amplifier, Concept of Integrated optics Characterization & Applications working principle of Optical Power Meter & OTDR, Optical power meter,Optical time domain reflect meter,

Application of WDM in Fiber optics communication system, WDM & DWDM Fiber Sensors, List application of various LASER used in industries & medical surgery.

Unit 4: Optical System Design: Considerations **15**

Component Choice, Multiplexing, Point-to- Point Links, System Considerations, Link Power Budget with Examples, Overall Fiber Dispersion In Multi-Mode and Single Mode Fibers, Rise Time Budget with Examples. Transmission Distance, Line Coding in Optical Links, WDM, Necessity, Principles, Types of WDM, Measurement of Attenuation and Dispersion, Eye Pattern.

- **Learning Outcomes:**
  1. Analyze the characteristics of optical fiber communication
  2. Find the Losses in optical fibers
  3. Preparation methods of optical fibers
  4. Do Optical fiber measurements

- **Reference Books:**

  1. John M Senior ,Optical Fiber Communication Pearson
  2. R P Khare, Fiber Optics & Optoelectronics Oxford
  3. D C Agarwal , Fiber Optic Communication S Chand
  4. Subir Kumar Sarkar, Optical Fiber & Fiber Optic Communication S Chands
  5. Rajappa PapannareddyPenram, Light wave Communication Systems: A Practical Perspectives

Paper-III **Microcontroller and Interfacing**

- **Learning Objectives:**

1. To understand the architecture of microcontrollers
2. To learn software techniques to embed codes in to the system
3. To learn the advanced architectures for advanced Embedded systems
4. Student should perform I/O port, timer, counter and interrupt operations

Unit 1 : Introduction PIC16F877 **15**

Salient Features of PIC16F877a, Internal architecture, Oscillator and clock, Reset Options, Special function registers, Introduction to Instruction set, Mikro-C Pro .

Unit 2 : PIC On-chip Peripherals **15**

Input/output pins, Ports, Timers, Capture-Compare Modules, On chip USART,On-chip ADCs configuration (With Embedded C Programming)

Unit 3 : Digital Interfacing **15**

Push-Button, Matrix Keyboard, Relay, Leds, Opto-coupler, 7-Segment, DC-motor(with CCP), Servo-Motor (Embedded C Programming expected)

Unit 4 : Analog Interfacing **15**

LM35, Thermister, Thermocouple(with AD595), LDR, Humidity(HY-HS220), Current sensor, Tachogenerator (Embedded C Programming expected)

- **Learning Outcomes:**

1. Learn architecture of microcontrollers
2. Able to write programs for any application
3. Design and test advanced Embedded systems using microcontrollers
4. Able to perform interfacings of various real world devices

Reference Books:

1. Design with PIC microcontroller By J B Peatman, Pearson education
2. Intel Handbook on 8 Bit and 16 bit embedded controllers
3. PIC microchip Midrange MCU family reference manual.
4. Microcontrollers theory and Applications"-By Ajay Deshmukh-TATA McGraw Hill

Paper-III Instrumentation Design

- **Learning Objectives:**
  1. To understand the working principles of various types of sensors and transducers
  2. To study the techniques involved in various types of instruments
  3. To understand the relevance of electronics with other disciplines
  4. To understand the Data Acquisition System (DAS)

Unit 1: Transducer and its interfacing **15**

Sensors and Transducers, Active and Passive sensors, characteristics of sensors, static and dynamic characteristics, Accuracy and precision, Linearity, hysteresis, loading effects, threshold and stiffness.

Thermocouples, Thermistors, RTD, PT 100, AD590, LM35, LM135, LM235, LM335. (characteristics, specifications).

Strain-gauge, load cell, piezo-electric, LVDT. Force, flow, level, displacement transducers, Hall effect and IR transducers and their interfacing

Unit 2: Instrumentation **15**

General block diagram of instrument design for measurement. Minimum requirements, AC and DC bridges, Excitation, Grounding and electromagnetic and electrostatic shielding. Readout, Need of display system in instrumentation. Digital and Analog display, LCD (16 x 2 line), Recorders, plotters.

Signal conditioners, Designing of pre-amplifiers, Instrumentation and chopper Amplifiers, Instrumentation amplifier, Signal conditioner (2B30), Programmable Excitation device (2B35) Programmable instrumentation amplifier 2B31, AD524, AD620, AD594/595, Isolation amplifier (Model 289)

Unit 3:Signal transformation **15**

Signal transmission, 4-20mA current, Characteristics of 4-20mA current loop,programmable 4-20mA current drivers. F-V & V-F, V-I & I-V converters.

Unit 4:Data acquisition system(DAS) **15**

Need of DAS, Single channel data acquisition system, Multi-channel DAS, data loggers, basic Operation of data loggers, compact data loggers. Microcontroller based minimum system for data acquisition

Designing of instrumentation for measurement of Temperature.Interfacing of PIR and ultrasonic sensor modules

- **Learning Outcomes:**
  1. Learn static and dynamic sensors
  2. Learn Characteristics and specification of sensors.
  3. Data Acquisition System
  4. Learn to Design interfacing circuits

- **Reference Books:**

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

Paper-IV Research Methodology

Learning / Course Objectives:

At the end of this course a candidate will be able to –

1. Understand the psychology of research which includes different perspectives and necessity of research.
2. Apply the research knowledge to formulate a suitable problem statement by adopting different research methods and models.
3. Analyze the research outcome by using suitable statistical tool.
4. Write or present a scientific report and research proposal by adopting copyright based ethical values.

Unit-I – Introduction to Research :

1) Definition- Scientific Research- Meaning and importance of Research – Types of Research Selection and formulation of Research Problem – Research Design Motivation and objectives 2) Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem- 3) Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - 4) Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs Fundamental, Quantitative vs. Qualitative, Conceptual vs Empirical, development of working hypothesis.

Unit-II – Methods of Research:

(a) Traditional Methods – Historical, Institutional, Legal, Philosophical, Comparative, Ethical methods.

(b) Modern Methods – Survey of Literature, Sampling method, Questionnaire, Schedule etc, Interview method and Focus Group discussion, Observation Method, Case Study method, Content analysis, Delphi method, Statistical Method, Experimental method, Brainstorming Techniques, Rating Scale.

(c) Ethnographic methods

(d) Documentation methods

Unit-III – Research Design :

Basic Principles- Need of research design, Features of good design important concepts relating to research design, Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. The nature of research design, formulation of research design, classification of research designs: Descriptive, experimental, exploratory, diagnostic, correlative, action and evaluation, developing a research plan; determining experimental and sample designs, Pilot Study

Unit-IV –: Introduction of IoT

Definition and characteristics of IoT, Building blocks of IoT Device, IoT Protocols- MQTT, CoAP, XMPP and AMQT, IoT communication models, IoT Communication technologies: Bluetooth, BLE, Zigbee, Zwave, NFC, RFID, LiFi, Wi-Fi, etc.

Case Studies

i) e-health: monitoring of health parameters, smart medicine box, elderly people monitoring, challenges.

ii) Smart City: Smart Environment, Smart Living, Smart Grid Energy Management, Smart Home, Smart Transport and Traffic Management, and security, challenges.

iii) Smart Agricultural: Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor-based field and resource mapping, Remote equipment monitoring

iv)Industry 4.0 (IIoT): Measurement of Industrial parameters such as temperature, pH, monitoring and control of industrial application with etc.

References Books:

1. An introduction to Research Methodology; Garg B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002., RBSA Publishers.
2. Research Methodology: Methods and Techniques ,Kothari C.R., 1990.. New Age International.
3. Research Methodology; Sinha S.C. and Dhiman, A.K., 2002. Ess Publications. 2 volumes.
4. Research Methods: the concise knowledge base; Trochim W.M.K., 2005. Atomic Dog Publishing. 270p.
5. "Internet of Things –A hands-on approach", Arshdeep Bahga, Vijay Madisetti, Universities Press.
6. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases forthe Internet of Things, David Hanes, Cisco Press
7. "The Internet of Things:Applications to the Smart Grid and Building Automation", Olivier Hersent, Omar Elloumi and David Boswarthick, Wiley.
8. "The Internet of Things –Keyapplications and Protocols", Olivier Hersent, David Boswarthick, Omar Elloumi , Wiley.

M.Sc. -I Sem-II

Paper-V Control

Theory

- **Learning Objectives:**
  1. To teach the fundamental concepts of Control systems and mathematical modelingof the system
  2. To study the concept of time response and frequency response of the system
  3. To teach the basics of stability analysis of the system Learning Outcomes

Unit 1: Introduction **15**

Basic concepts of control system, Classifications, Open loop and closed loop systems, Effect of feedbacks on control system performance, Transfer functions, Pole & zero concept, Mathematical modeling of electrical systems and mechanical systems, Block diagram reductions, Signal flow graph, Mason's gain formula.

Unit 2: Time Domain Analysis and stability **15**

Type and order of control system, Typical tests signal, Time response of first and second order systems to unit step input, Steady state error, Time domain specifications for unit step response. Concept of Stability: absolute, relative and marginal, Nature of system response, Stability analysis using Routh Hurwitz's criterion, Root locus technique, Construction of root locus.

Unit 3: Frequency Domain and State Variable Analysis **15**

Steady state response of a system to sinusoidal input, Relation between time and frequency response, Frequency response specifications, Stability analysis with Bode plot, Nyquist stability criterion. Introduction to state space analysis, State space representation for i) Electrical Network ii) nth order differential equation and iii) Transfer function. State model from transfer function using: Direct, parallel, cascade and decomposition method.

Unit 4: Control system components and controller **15**

Modeling and transfer function of control system components - Potentiometer, DC motor and Tachometer. Design concepts of Proportional (P), Proportional Integral (PI), Proportional Derivative (PD), Proportional Integral Derivative (PID) controllers, Compensator Networks - lag and lead.

- **Learning Outcomes:**
  1. Represent the mathematical model of a system
  2. Determine the response of different order systems for various step inputs
  3. Analyze the stability of the syste

Reference Books

1. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, PHI.
2. Farid Golnarghi and Benjamin C. Kuo, "Automatic Control System", 9th Edition, PHI.
3. Norman S. Nise, "Control System Engineering", 5th Edition, Wiley.
4. I. J. Nagrath and M.Gopal, "Control Systems Engineering", 5th Edition, New AgeInternational Publication
5. Les Fenical "Control Systems", 1st Edition, Cengage Learning India.
6. S.K. Bhattacharya, "Control Systems Engineering", 1st edition, Pearson education

Paper-VI Digital Signal Processing

- **Learning Objectives:**
  1. Understand fundamentals of Digital Signal Processing.
  2. Analyze & compare different signal processing strategies.
  3. Become aware of some applications of DSP.
  4. Understand digital filter design

Unit 1: Discrete Time Signals and Systems **15**

Introduction to DSP, Advantages, Applications Discrete time: Classification and representation of Signals, continuous time/discrete-time, deterministic/non-deterministic, periodic/Non-periodic, even-odd, energy-power signals, elementary signals, exponential, sinusoidal, impulse, unit step, ramp, parabolic, Triangular, Rectangular Signals. Basic operations on signals, Time shifting, scaling, Time Reversal, signal addition and signal multiplication.

Unit 2: Continuous Time Fourier Transform **15**

Overview of Signals and Systems, Development of FT, Existence of FT, FT of some standard signals, Properties of FT, Linearity, Time shift and time reversal, frequency shift, scaling, FT of complex function, FT of periodic signals, Inverse FT.

Unit 3 : Discrete Fourier Transform **15**

Discrete Fourier Transform, Existence of DFT, Properties of DFT, sampling of continuous signal, Nyquist rate & aliasing problem, anti aliasing, Pulse Sampling, Circular convolution, Fast Fourier Transform(FFT), DIT, DIF and their comparison.

Unit 4 : Z-transform and Digital filter design **15**

Z-transform, properties of ZT, inverse ZT, Poles & Zeros, discrete time signal, properties of ZT.

FIR filter: Realization of digital linear system, Ideal filters, filter categories, Methods for design of FIR Filter, FIR filter design using Kaiser window.

IIR filter: Methods for design of IIR Filter, Bilinear transformation IIR filter, impulse invariance method, Design of Butterworth digital filter.

- **Learning Outcomes:**
  1. Understand the Discrete Time Signals analytically & Visualize them in the time and frequency domain.
  2. Able to Understand the Transform domain & its significance & problems related to computational complexity.
  3. Be able to specify & design digital filters.

Reference Books:

1. Introduction to DSP – Proakis, Pearsons Edn.
2. Discrete Time Signal Processing – Oppenhiem & Schafer
3. Digital Signal Processing - Pallan Technova Publications
4. Digital Signal Processing – Luedmon.

Paper-VII Real Time Operating System

- **Learning Objectives:**
  1. To introduce students to the fundamental problems, concepts, and approaches in the design and analysis of real-time systems.
  2. To study issues related to the design and analysis of systems with real-time constraints.
  3. To understand Different types of operating systems.
  4. To understand different real time case studies.

Unit 1: Overview of Embedded system design with AVR microcontrollers **15**

Introduction: Concept of embedded system, structure of embedded system, characteristics of embedded system, types of embedded system,

Microcontroller based embedded system: Minimum requirement. Microcontroller, Clock circuit, Reset circuit, in system programming (ISP)

Embedded system design: Designing of AVR ATmega8L microcontroller based embedded systems for Measurement of pH, Humidity, wind velocity, temperature etc.

Unit 2: Fundamentals of Real Time Operating System **15**

Introduction: Concept of Real Time, Real Time operating System, Characteristics of Real-Time operation system, Hard and Soft Real Time Systems.

Structure of RTOS: Structure of RTOS, RTOS Kernel, Kernel Objects, Services of Scheduler.

Task : Task, Task structure, Creation of task, types of task, Task Control block, context, States of task and FSM, idle task, Priority, Static and dynamic priority, Resources, Sharing of resources, ISR, Task Management.

Scheduling Algorithm: Task scheduling Algorithm, preemption, FIFO, Round Robin scheduling, priority based preemptive scheduling. Priority Inversion, Software and hardware time Ticks, context switching.

Simple programs based on Tiny RTOS kernel.

Unit: 3 Task Synchronization and Intertask communication **15**

Synchronization of task: Concept of Sharing of resources, Race condition, Critical condition, deadlocks, spinlocks.

Semaphores and mutexes: Concept of semaphore, Binary semaphore, Counting semaphore, Semaphore management.

Mutex: Concept of mutex , mutex management.

Intertask communication: Intertask Communication, Messages, Queues, Mailboxes.

Unit:4 The RTOS Kernel Micro C/OS-II, The RTOS RT Linux **15**

Micro C /OS-II kernel, creation of task, task management, Simple programs on creation of task.

RT Linux Kernel, POSIX P threads, Processes and Threads, Thread Basics, Process management, semaphores, mutexes. Simple programs on creation of threads.

- **Learning Outcomes:**
  1. An ability to analyze, design and implement a real-time system.
  2. Characterize and debug a real-time system.
  3. Apply formal methods for scheduling real-time systems

Reference Books:

1. Embedded C - Michael J Pont
2. Embedded C Programming and the Atmel AVR - R. H. Barnett, S. Cox and L. O'Cull
3. Embedded C Programming and the Microchip PIC - R. H. Barnett, S. Cox and L. O'Cull
4. Operating Systems – A.S. Godbole
5. Real-Time Systems – C.M. Krishna and K.G. Shin
6. Embedded / Real Time Systems – Concepts design – programming- KVVK Prasad.
7. MicroC/OS-II, The Real Time Kernel, - J.J. Labrosse, 2nd Edn. (2006) CMP Books

Paper-VII Foundations of Microwave Technology

- **Learning Objectives:**
  1. To study fundamentals of electromagnetic waves, use Maxwell's equations
  2. To study transmission lines and to use Smith charts for solving transmission line problems
  3. To study waveguides and various passive microwave devices

Unit 1: Electrostatics, steady magnetic field and Maxwell's Equations **15**

Vector analysis, physical interpretation of gradient, divergence and curl, Vector relations in other coordinate systems, Integral theorems, Fundamental relations of the electrostatic field, Gauss's law, Potential function, Field due to a continuous distribution of charge, Equipotential surfaces, Divergence theorem, Poisson's equation and Laplace's equation, electrostatic energy, magnetic induction and Faraday's law, Magnetic field strength and magnetomotive force, Ampere's work law in differential vector form, Energy stored in a magnetic field, Ampere's law for current element, Ampere's force law, Maxwell's equations, Conditions at a boundary surface

Unit 2: Electromagnetic Waves **15**

Electromagnetic waves in a homogeneous medium- solution for free-space conditions, uniform plane-wave propagation, uniform plane waves, Wave equations for a conducting medium, Sinusoidal time variations, conductors and dielectrics, polarization, Direction cosines, Reflection and Refraction of plane waves - Reflection by perfect conductor-normal incidence, Reflection by a perfect conductor-oblique incidence, Reflection by perfect dielectric-normal incidence, Reflection by perfect insulator-oblique incidence, Reflection at the surface of a conductive medium, Surface impedance, Poynting's theorem

Unit 3: Transmission Lines **15**

Distributed constants of a line, A-C steady state solution for Uniform line, Variation of Zo, α and β with frequency, Various exponential forms of A-C steady state solution, hyperbolic form of the solution, Interference and standing wave patterns, Half-wavelength and Quarter wavelength lines, short sections as circuit elements, measurement of standing waves, Smith chart - solving transmission line problems, impedance matching, Coaxial connectors

Unit 4: Waveguides, Cavity Resonators and Passive Microwave Devices **15**

Solution of wave equations in rectangular and circular waveguides, TE and TM modes, power loss and power transmission, excitation of modes, field components of rectangular cavity resonators, expression for Q

Terminations, Attenuators, Phase changers, directional couplers, Hybrid Circuits, Corners, Bends, Twists, Faraday rotation, Gyrator, Isolator, circulator, S parameters

- **Learning Outcomes:**
  1. The students will understand wave equations, equations in various media, reflection and refraction of em waves
  2. They will be able to write the transmission line equations in various forms, solve transmission line problems, use Smith charts
  3. They will be able to obtain field components of TE and TM waves for waveguides and cavity resonators. They will also learn principles of operation of various microwave passive components and their applications.

Reference Books

1. Edward C. Jordan and Keith G.Balmain, Electromagnetic waves and Radiating Systems. New Delhi : Prentice-Hall of India Pvt. Ltd., 2003
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4. John D. Ryder, Networks Lines and Fields. New Delhi : PHI, 1983
5. Samuel Y. Liao, Microwave Devices and Circuits. New Delhi : PHI, 2001
6. H.R.L. Lamont, Waveguides. London : Methuen and Company Limited, 1963
7. Robert E. Collin, Foundations for Microwave Engineering. New Delhi : McGraw Hill Book Comp.
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