Syllabus

For

Bachelor of Science Programme

In

Electronic Science

Under

Choice Based Credit System (CBCS)

(2023-24 ONWARDS)

Of

NEW EDUCATION POLICY, 2020

To,

The Principal to Secretary,
Raj Bhavan, Patna

Sub:-**Regarding submission of proposed draft copy of course structure and uniform syllabus of Electronic Science for 3rd to 8th Semester of 4-Year undergraduate Course under CBCS System.**

Reference:- Letter No.- BSU(UGC)- 02/2023-1457/ GS(I) dated-14.09.2023 of Raj Bhavan, Patna, PPU, Patna Letter No. R/PPU/2053/23, dated 15.09.2023 and BRABU, Muzaffarpur, Letter No-B/2042, dated- 16.09.2023.

Sir,

In Compliance with your letter no. BSU(UGC)- 02/2023-1457/ GS(I) dated-14.09.2023 of Raj Bhavan, Patna, PPU, Patna Letter No. R/PPU/2053/23, dated 15.09.2023 and BRABU, Muzaffarpur, Letter No-B/2042, dated- 16.09.2023, we have prepared the Course Structure and uniform syllabus for 4 year undergraduate programme under CBCS System for Electronic Science subject in Major, Minor and Multidisciplinary courses for 3rd to 8th Semester.

We are submitting the proposed course structure and syllabus of Electronic Science for 3rd to 8th Semester as per UGC regulations.

Thanks & Regards,

Enclosed:-as above.

Yours faithfully

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Course Structure for 4 Year undergraduate Programme under CBCS System

Electronic Science

(A) Major Core Courses

Sl. No.	Sem	Type of Course	Name of Course	Credits	Marks
1.	I	MJC-1 (T)	Basic Circuit Theory and Network Analysis	4	100
		MJC-1 (P)	Basic Circuit Theory and Network Analysis Lab	2	100
2.	II	MJC-2 (T)	Mathematical Foundation for Elecetronics	4	100
		MJC-2 (P)	Mathematical Foundation for Elecetronics Lab	2	100
3.	III	MJC-3 (T)	Semiconductor Devices	3	100
		MJC-3 (P)	Semiconductor Devices Lab	2	100
4.	III	MJC-4 (T)	Electromagnetics	3	100
		MJC-4 (P)	Electromagnetics Lab	1	100
5.	IV	MJC-5 (T)	Electronic Circuits	3	100
		MJC-5 (P)	Electronic Circuits Lab	2	100
6.	IV	MJC-6 (T)	Digital Electronics and VHDL	3	100
		MJC-6 (P)	Digital Electronics and VHDL Lab	2	100
7.	IV	MJC-7(T)	Electronic Instrumentation	3	100
		MJC-7(P)	Electronic Instrumentation Lab	2	100
8.	V	MJC-8 (T)	Operational Amplifiers and Applications	3	100
		MJC-8 (P)	Operational Amplifiers and Applications Lab	2	100
9.	V	MJC-9 (T)	Microprocessors and Microcontrollers	3	100
		MJC-9 (P)	Microprocessors and Microcontrollers Lab	2	100
10.	VI	MJC-10 (T)	Communication Electronics	3	100
		MJC-10 (P)	Communication Electronics Lab	1	100
11.	VI	MJC-11(T)	Signals and Systems	3	100
		MJC-11(P)	Signals and Systems Lab	2	100
12.	VI	MJC-12 (T)	Computer Architecture and Programming in C, Python	3	100
		MJC-12 (P)	Computer Architecture and Programming in C, Python Lab	2	100
13.	VII	MJC-13 (T)	Modern Comminucation Systems	3	100
		MJC-13 (P)	Modern Comminucation Systems Lab	2	100
14.	VII	MJC-14	Research Methodology	5	100
15.	VII	MJC-15 (T)	Embeded Systems	4	100
		MJC-15 (P)	Embeded Systems Lab	2	100
16.	VIII	MJC-16 (T)	Artificial Intelligence & Robotics	3	100
		MJC-16 (P)	Artificial Intelligence & Robotics Lab	1	100

Sub Total = 80

Syllabus for 4 Year Undergraduate Programme under CBCS System

Electronic Science

Semester-III: Major Core Course (MJC)

Major Course-3 (MJC-3): Semiconductor Devices

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Describe the behavior of semiconductor materials.

CO2 Understand the I-V characteristics of diode/BJT/MOSFET devices.

CO3 Apply standard device models to explain/calculate critical internal parameters of semiconductor devices.

CO4 Explain the behavior and characteristics of power devices such as SCR/UJT etc.

Syllabus Contents

Unit 1 (10 Lectures)

Semiconductor Basics: Introduction to Semiconductor Materials, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Derivation of Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation And Recombination Processes, Continuity Equation.

Unit 2 (10 Lectures)

P-N Junction Diode: Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium. Concept of Linearly Graded

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Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism.Tunnel diode, varactor diode, solar cell: circuit symbol, characteristics, applications

Unit 3 (10 Lectures)

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base-Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations.

Unit 4 (15 Lectures)

Field Effect Transistors: JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristics of Depletion type MOSFET and Enhancement type MOSFET. Complimentary MOS (CMOS).

Power Devices: Basic construction, circuit symbols, operation and applications of UJT, SCR, Triac, Diac, IGBT.

Suggested Books:

1) S. M. Sze, Semiconductor Devices: Physics and Technology, 2nd Edition, Wiley India edition (2002).

2) Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)

3) Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)

4) Kanaan Kano, Semiconductor Devices, Pearson Education (2004)

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Semester-III: Major Core Course (MJC)

Major Course-3 (MJC-3): Semiconductor Devices Lab

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, Students will be able to

CO1 Examine the characteristics of basic semiconductor devices.

CO2 Perform experiments for studying the behavior of semiconductor devices for circuit design applications.

CO3 Calculate various device parameter values from their IV characteristics.

CO4 Interpret the experimental data for better understanding of the device behavior.

Syllabus Contents

1. Study of the I-V Characteristics of Diode Ordinary and Zener Diode.
2. Study of the I-V Characteristics of the CE configuration of BJT.
3. Study of the I-V Characteristics of the Common Base Configuration of BJT.
4. Study of the I-V Characteristics of the Common Collector Configuration of BJT.
5. Study of the I-V Characteristics of the UJT.
6. Study of the I-V Characteristics of the SCR.
7. Study of the I-V Characteristics of JFET.
8. Study of the I-V Characteristics of MOSFET.
9. Study of Hall Effect.

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Semester-III: Major Core Course (MJC)

Major Course-4 (MJC-4): Electromagnetics

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Understand the fundamentals of Electrostatics and Magnetostatics.

CO2 Understand the application of Vector Differential and Integral operators in Electromagnetic Theory.

CO3 Interpret Maxwell's equations in differential and integral forms, both in time and frequency domains.

CO4 Describe the complex ε, μ, and σ, plane waves, Snell's laws from phase matching, and calculate the reflection and transmission coefficients at the interface of simple media

CO5 Calculate input impedance and reflection coefficient of an arbitrarily terminated transmission line and can use Smith chart to convert these quantities.

Syllabus Contents

Unit-1 (12 Lectures)

Vector Analysis: Scalars and Vectors, Vector Algebra, Rectangular (Cartesian) Coordinate System, Vector Components and Unit Vector, Vector Field, Products, Cylindrical Coordinates, Spherical Coordinates, Differential Length, Area and Volume; Line Surface and Volume integrals, Del Operator, Gradient of a Scalar, Divergence and Curl of a Vector, the Laplacian.

Electrostatic Fields: Coulomb's Law and Electric Field, Field due to Discrete and Continuous Charge Distributions, Electric Flux Density, Gauss's Law and Applications, Electric Potential, Potential due to a Charge and Charge distribution, Electric dipole. Electric Fields in Conductors, Current and Current Density, Continuity of Current. Dielectric materials, Polarization, Dielectric Constant and Capacitance.

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Unit- 2 (12 Lectures)

Poisson's Equation and Laplace's Equation: Derivation of Poisson's and Laplace's equation, Uniqueness Theorem, Examples of Solution of Laplace's Equation.

Magnetostatics: Biot Savert's law and Applications, Magnetic dipole, Ampere's Circuital Law, Curl and Stoke's Theorem, Maxwell's Equation, Magnetic Flux and Magnetic Flux Density, Scalar and Vector Magnetic Potentials. Magnetic Forces, Torques and energy.

Unit-3 (10 Lectures)

Time-Varying Fields and Maxwell's Equations: Faraday's Law of Electromagnetic Induction, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Maxwell's Equations in differential and integral form, Concept of Retarded Potentials.

Unit-4 (11 Lectures)

Electromagnetic Wave Propagation: Time-Harmonic Electromagnetic Fields and use of Phasors, the Electromagnetic Spectrum, Wave Equation in a source free isotropic homogeneous media, Uniform Plane Waves in Lossless and Lossy unbounded homogeneous media, Wave Polarization, Phase and Group velocity, Flow of Electromagnetic Power and Poynting Vector.

Guided Electromagnetic Wave Propagation: Waves along Uniform Guiding Structures,TEM, TE and TM waves, Electromagnetic Wave Propagation in Parallel Plate and Rectangular Metallic Waveguides.

Suggested Books:

1. Murray. R. Spiegel, Vector Analysis, Schaum series, Tata McGraw Hill (2006)
2. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press (2001)
3. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)
4. D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
5. J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
6. N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Education (2006)
7. Introduction to Electrodynamics, D.J. Griffiths, Pearson Education (2012)
8. Electromagnetic Wave and Radiating System, Jordan and Balmain, Prentice Hall (1979)

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Semester-III: Major Core Course (MJC)

Major Course-4 (MJC-4): Electromagnetics Lab

(Using Scilab/ MATLAB / any other similar freeware)

Credit: 01 (Practical) Lectures: 30

Course Outcomes

At the end of this course, Students will be able to

CO1 Design capacitors & inductors and analyze their characteristics.

CO2 Become efficient in solving simple boundary value problems, using Poisson's equation.

CO3 Interpret a Smith chart and also become familiar with describing & recognizing fundamental properties of waveguide modes.

CO4 Calculate the cutoff frequency and propagation constant for parallel plate, rectangular, and dielectric slab waveguides. Also, they can calculate the resonant frequency of simple cavity resonators.

CO5 Analyze problems involving TEM-waves.

Syllabus Contents

1. Understanding and Plotting Vectors.
2. Transformation of vectors into various coordinate systems.
3. 2D and 3D Graphical plotting with change of view and rotation.
4. Representation of the Gradient of a scalar field, Divergence and Curl of Vector Fields.
5. Plots of Electric field and Electric Potential due to charge distributions.
6. Plots of Magnetic Flux Density due to current carrying wire.
7. Solutions of Poisson and Laplace Equations – contour plots of charge and potential distributions

Semester-IV: Major Core Course (MJC)

Major Course-5 (MJC-5): Electronic Circuits

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Illustrate rectifiers, transistor and FET amplifiers and its biasing. Compare the performances of its low-frequency models.

CO2 Describe the frequency response of MOSFET and BJT amplifiers.

CO3 Explain the concepts of feedback and construct feedback amplifiers and oscillators.

CO4 Summarize the performance parameters of amplifiers with and without feedback

Syllabus Contents

Unit- 1 (10 Lectures)

Diode Circuits: Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent (Q) point. Clipping and clamping circuits. Rectifiers: HWR, FWR (center tapped and bridge). Circuit diagrams, working and waveforms, ripple factor & efficiency, comparison. Filters: types, circuit diagram and explanation of shunt capacitor filter with waveforms. Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.

Unit- 2 (12 Lectures)

Bipolar Junction Transistor: Transistor biasing, DC load line, operating point, thermal runaway, stabilityand stability factor, Fixed bias without and with RE, collector to base bias, voltage divider bias and emitter bias (+VCC and –VEE bias), circuit diagrams and their working. Transistor as a switch, circuit and working, Darlington pair and its applications. BJT amplifier

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(CE), dc and acload line analysis, hybrid model of CE configuration, Quantitative study of the frequency response of a CE amplifier, Effect on gain and bandwidth for Cascaded CE amplifiers (RC coupled).

Unit- 3 (10 Lectures)

Feedback Amplifiers: Concept of feedback, Negative and positive feedback, Advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances . Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.

Unit- 4 (13 Lectures)

Power Amplifiers: Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons. Operation of Transformer coupled Class A power amplifier, overall efficiency. Circuit operation of complementary symmetry Class B push-pull power amplifier, crossover distortion, heat sinks.

Single tuned amplifiers: Circuit diagram and working principle of single tuned amplifier.

Suggested Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronic devices, David A Bell, Reston Publishing Company
3. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
4. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
6. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
7. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw

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Semester-III: Major Core Course (MJC)

Major Course-4 (MJC-4): Electronic Circuits Lab

(Hardware and Circuit Simulation Software)

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Understand and analyze electronic circuits.

CO2 Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits.

CO3 Understand and apply circuit theorems and concepts in engineering applications

CO4 Prepare the technical report on the experiments carried.

Syllabus Contents

1. Study of the half wave rectifier and Full wave rectifier.
2. Study of power supply using Zener diode.
3. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation
4. Study of clipping and clamping circuits.
5. Study of Fixed Bias, Voltage divider and Collector-to-Base bias Feedback configuration for transistors.
6. Designing of a Single Stage CE amplifier.
7. Study of Class A, B and C Power Amplifier.
8. Study of the Colpitt's Oscillator.
9. Study of the Hartley's Oscillator.
10. Study of the Phase Shift Oscillator
11. Study of the frequency response of Common Source FET amplifier.

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Semester-IV: Major Core Course (MJC)

Major Course-6 (MJC-6): Digital Electronics and VHDL

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Understand and represent numbers in powers of base and converting one from the other, carry out arithmetic operations

CO2 Understand basic logic gates, concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions

CO3 Analyze and design combinatorial as well as sequential circuits

CO4 Explain the concepts related to PLD's

CO5 Use VLSI design methodologies to understand and design simple digital systems and understand the HDL design flow and capability of writing programs in VHDL.

CO6 Become familiar with Simulation and Synthesis Tools, Test Benches used in Digital system design

Syllabus Contents

Unit-1 (10 Lectures)

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal. Representation of signed and unsigned numbers, Binary Coded Decimal code.

Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators, Truth Tables of OR, AND, NOT, Basic postulates and fundamental theorems of Boolean algebra, Truth tables, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates.

Digital Logic families: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, TTL and CMOS families and their comparison.

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Unit-2 (10 Lectures)

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Encoder and Decoder, Multiplexers and Demultiplexers, Implementing logic functions with multiplexer, binary Adder, binary subtractor, parallel adder/subtractor.

Unit-3 (12 Lectures)

Sequential logic design: Latches and Flip flops , S-R Flip flop, J-K Flip flop, T and D type Flip flop, Clocked and edge triggered Flip flops, master slave flip flop, Registers, Counters (synchronous and asynchronous and modulo-N), State Table, State Diagrams, counter design using excitation table and equations, Ring counter and Johnson counter.

Programmable Logic Devices: Basic concepts- ROM, PLA, PAL, CPLD, FPGA

Unit-4 (13 Lectures)

Introduction to VHDL: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches. VHDL Modules, Delays, data flow style, behavioral style, structural style, mixed design style, simulating design.

Introduction to Language Elements, Keywords, Identifiers, White Space Characters, Comments, format. VHDL terms, describing hardware in VHDL, entity, architectures, concurrent signal assignment, event scheduling, statement concurrency, structural designs, sequential behavior, process statements, process declarative region, process statement region, process execution, sequential statements, architecture selection, configuration statements, power of configurations.

Suggested Books:

1. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India (2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
5. A Verilog HDL Primer - J. Bhasker, BSP, 2003 II Edition.
6. Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

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Semester-IV: Major Core Course (MJC)

Major Course-6 (MJC-6): Digital Electronics and VHDL Lab

(Hardware and Circuit Simulation Software)

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Understand the structure of various number systems and its application in digital design.

CO2 Design and verify the basic logic gates using different ICs.

CO3 The ability to understand, analyze, and design various combinational and sequential circuits.

CO4 Learn basic knowledge of VHDL and write programs in VHDL

CO5 Prepare the technical report on the experiments carried.

Syllabus Content

1. Design and verification of AND, OR, NOT and XOR gates using NAND gates.
2. Conversion of Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design a Half and Full Adder.
4. Design a Half and Full Subtractor.
5. Design a seven-segment display driver.
6. Design a 4 X 1 Multiplexer using gates.
7. Build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.

Experiments in VHDL

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates.
4. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.

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5. Code converters (Binary to Gray and vice versa).

6. 2 bit Magnitude comparator.

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Semester-IV: Major Core Course (MJC)

Major Course-7 (MJC-7): Electronic Instrumentation

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Describe the working principle of different measuring instruments.

CO2 Choose appropriate measuring instruments for measuring various parameters in their laboratory courses.

CO3 Correlate the significance of different measuring instruments, recorders and oscilloscopes.

Syllabus Contents

Unit-1 (12 Lectures)

characteristics of instruments and possible errors: Accuracy, Precision, Significant figures, sensitivity, Resolution, Repeatability, and Efficiency. Types of error and error analysis.

Basic Measurement Instruments: PMMC instrument, galvanometer, DC measurement ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter, digital multimeters.

Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc.

Unit-2 (12 Lectures)

Measurement of Resistance and Impedance: Low Resistance: Kelvin's double bridge method, Wheatstone bridge method, High Resistance by Megger. A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Hay'sbridge, Measurement of Capacitance, Schering's bridge, DeSauty's bridge, Measurement of frequency, Wien's bridge.

A-D and D-A Conversion: 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder. A-D conversion characteristics, successive approximation ADC.

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Unit-3 (10 Lectures)

Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, DSO: Block diagram, principle and working, Advantages and applications.

Unit-4 (11 Lectures)

Transducers and sensors: Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature compensation and applications), Capacitive (Variable Area Type – Variable Air Gap type-Variable Permittivity type), Inductive (LVDT) and piezoelectric transducers, Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors (ex. LM335 -temperature sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

Suggested Books:

1. H. S. Kalsi, Electronic Instrumentaion, TMH(2006)

2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice-Hall (2005).

3. Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH

4. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).

5. A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpat Raiand Sons (2007).

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Semester-IV: Major Core Course (MJC)

Major Course-7 (MJC-7): Electronic Instrumentation Lab

Credit: Practical-02 Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Perform experiments on measuring instruments.

CO2 Perform measurements of various electrical/electronic parameters using appropriate instruments available in the laboratory.

CO3 Prepare the technical report on the experiments carried out.

Syllabus Content

1. Design of multi range ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
3. Measure of low resistance by Kelvin's double bridge.
4. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
5. To determine the Characteristics of LVDT.
6. To determine the Characteristics of Thermistors and RTD.
7. Measurement of temperature by Thermocouples and study of transducers like LM 355, PT-100, K-type.

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Semester-V: Major Core Course (MJC)

Major Course-8 (MJC-8): Operational Amplifiers and Applications

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.

CO2 Elucidate and design the linear and non-linear applications of an op-amp and special application ICs.

CO3 Explain and compare the working of multivibrators using special application IC 555 and general purpose op-amp.

Syllabus Contents

Unit-1 (12 Lectures)

Basic Operational Amplifier: Concept of differential amplifiers, constant current bias, cascaded differential amplifier stages, block diagram of an operational amplifier (IC 741)

Op-Amp parameters: input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

Unit-2 (13 Lectures)

Op-Amp Circuits: Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter.

Comparators: Basic comparator, Level detector, Voltage limiters, Schmitt Trigger.

Signal generators: Phase shift oscillator, Wein bridge oscillator, Square wave generator, triangle wave generator, saw tooth wave generator, and Voltage controlled oscillator.

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Unit-3 (10 Lectures)

Multivibrators (IC 555): Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors.

Unit-4 (10 Lectures)

Signal Conditioning circuits: Sample and hold systems, Active filters: First order low pass and high pass butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers.

Suggested Books:

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)
3. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001)
4. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
5. K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011)

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Semester-V: Major Core Course (MJC)

Major Course-8 (MJC-8): Operational Amplifiers and Applications Lab

(Hardware and Circuit Simulation Software)

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Interpret op-amp data sheets (IC 741).

CO2 Analyze and design of op-amp based feedback circuits with various inverting and non-inverting configurations

CO3 Design application-oriented circuits using Op-amp and 555 timer ICs.

CO4 Create and demonstrate live projects using ICs.

CO5 Prepare the technical report on the experiments carried.

Syllabus Content

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an opamp.
3. Designing of analog adder and subtractor circuit.
4. Designing of a First Order Low-pass filter using op-amp.
5. Designing of a First Order High-pass filter using op-amp.
6. Designing of a RC Phase Shift Oscillator using op-amp.
7. Study of IC 555 as an astable multivibrator.
8. Study of IC 555 as monostable multivibrator.

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Semester-V: Major Core Course (MJC)

Major Course-9 (MJC-9): Microprocessors and Microcontrollers

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Understand the basic blocks of microcomputers.

CO2 Apply knowledge and demonstrate proficiency of designing hardware interfaces with microprocessors and microcontrollers.

CO3 Capable to write assembly language programs for basic operations.

CO3 Derive specifications of a system based on the requirements of the application and select the appropriate Microprocessor or Microcontroller.

Syllabus Contents

Unit-1 (12 Lectures)

Introduction to Microprocessor: Introduction, Applications, Basic block diagram, Speed, Word size, Memory capacity, Classification of microprocessors (mention of different microprocessors being used)

Microprocessor 8085: Features, Architecture -block diagram, General purpose registers, register pairs, flags, stack pointer, program counter, types of buses. Multiplexed address and data bus, generation of control signals, pin description of microprocessor 8085. Basic interfacing concepts, Memory mapped I/O and I/O mapped I/O.

Unit-2 (13 Lectures)

8085 Instructions: Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions. Assembly language programming examples. Stack operations,

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subroutine, call and return instructions. Delay loops, use of counters, timing diagrams-instruction cycle, machine cycle, T- states, time delay. Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts.

Unit-3 (12 Lectures)

Microcontrollers: Introduction, different types of microcontrollers, embedded microcontrollers, processor architectures. Harvard vs. Princeton, CISC vs. RISC architectures, microcontroller memory types, microcontroller features, clocking, I/O pins, interrupts, timers, and peripherals.

PIC16F887 Microcontroller: Core features, Architecture, pin diagram, memory organization-Program and data memory organization, I/O Ports, oscillator module, Timer modules (Timer 0, Timer 1 and Timer 2), comparator module, analog-to-digital converter (ADC) module, data EEPROM, Enhanced capture/compare/PWM module, EUSART, master synchronous serialport (MSSP) module, special features of the CPU, interrupts, addressing modes, instruction set.

Unit-4 (8 Lectures)

Interfacing to PIC16F887: LED, Switches, Solid State Relay, Seven Segment Display, 16x2 LCD display, 4x4 Matrix Keyboard, Digital to Analog Converter, Stepper Motor and DC Motor.

Suggested Books:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar – Wiley Eastern Limited- IV Edition.

2. Fundamentals of Microprocessor & Microcomputer: B. Ram, Danpat Rai Publications.

3. Microchip PIC16F87X datasheet

4. PIC Microcontrollers, Milan Verle, , mikro Elektronika, 1st edition (2008)

5. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006

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Semester-V: Major Core Course (MJC)

Major Course-9 (MJC-9): Microprocessors and Microcontrollers Lab

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Be proficient in use of IDE's for designing, testing and debugging microprocessor and microcontroller based system

CO2 Interface various I/O devices and design and evaluate systems that will provide solutions to real-world problem

CO3 Prepare the technical report on the experiments carried out.

Syllabus Content

8085 Assembly language programs:

1. Program to transfer a block of data.
2. Program for multibyte addition
3. Program for multibyte subtraction
4. Program to multiply two 8-bit numbers.
5. Program to divide a 16 bit number by 8 bit number.
6. Program to search a given number in a given list.
7. Program to generate terms of Fibonacci series.
8. Program to sort numbers in ascending/descending order.

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Microcontroller Programming

1. LED blinking with a delay of 1 second.
2. Solid State Relay Interface
3. Interfacing of LCD (2X16).
4. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with speed control.
5. To test all the gates of a given IC74XX is good or bad.
6. Generate sine, square, saw tooth, triangular and staircase waveform using DAC interface.
7. Display of 4- digit decimal number using the multiplexed 7-segment display interface.
8. Analog to digital conversion using internal ADC and display the result on LCD.
9. Digital to analog conversion using PWM (pulse delay to be implemented using timers).
10. Speed control of DC motor using PWM (pulse delay to be implemented using timers).

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Semester-VI: Major Core Course (MJC)

Major Course-10 (MJC-10): Communication Electronics

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Design basic digital communication systems to solve a given communications problem and they become conversant with the requirements and the protocols employed in the fundamental components in a communication network.

CO2 Understand simple block forward error correction codes and basic dispersion compensation concepts and also the concepts of up/down conversion and modulation

CO3 Determine the suitability of a particular communication system to a given problem

CO4 Describe the concept of "noise" in analog and digital communication systems. Also, get insight on the trade-offs (in terms of bandwidth, power, and complexity requirements) in basic digital communication systems.

Syllabus Contents

Unit-1 (10 Lectures)

Electronic communication: Block diagram of an electronic communication system, electromagnetic spectrum-band designations and applications, need for modulation. Concept of Noise, Types of Noise, Signal to noise ratio, Noise Figure, Noise Temperature, Friss formula.

Unit-2 (15 Lectures)

Amplitude Modulation: Amplitude Modulation, modulation index and frequency spectrum. Generation of AM, Amplitude Demodulation (diode detector), Concept of Double side band

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suppressed carrier, Single side band suppressed carrier, other forms of AM (Vestigial Side Band modulation, Independent Side Band Modulation). Block diagram of AM Transmitter and Receiver

Angle modulation: Frequency and Phase modulation, modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM (direct and indirect methods), FM detector (PLL). Block diagram of FM Transmitter and Receiver Comparison between AM, FM and PM.

Unit -3 (10 Lectures)

Pulse Analog Modulation: Channel capacity, Sampling theorem, PAM, PDM, PPM modulation and detection techniques, Multiplexing, TDM and FDM.

Pulse Code Modulation: Need for digital transmission, Quantizing, Uniform and Nonuniform Quantization, Quantization Noise, Companding, Coding, Decoding.

Unit -4 (10 Lectures)

Digital Carrier Modulation Techniques: Block diagram of digital transmission and reception, Information capacity, Bit Rate, Baud Rate and M-ary coding. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK)

Suggested Books:

1. Electronic communication systems- Kennedy, 3rd edition, McGraw international publications

2. Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill

3. Communication Systems, S. Haykin, Wiley India (2006)

4. Advanced electronic communications systems – Tomasi, 6th edition, PHI.

5. Communication Systems, S. Haykin, Wiley India (2006)

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Semester-VI: Major Core Course (MJC)

Major Course-9 (MJC-9): Communication Electronics Lab

(Hardware and Circuit Simulation Software)

Lectures: 30

Credit: 01 (Practical)

Course Outcomes

At the end of this course, students will be able to

CO1 Understand basic elements of a communication system.

CO2 Analyze the baseband signals in time domain and in frequency domain.

CO3 Build understanding of various analog and digital modulation and demodulation techniques.

CO4 Prepare the technical report on the experiments carried.

Syllabus Content

1. To study the function of Amplitude Modulation and demodulation (under modulation, perfect modulation & over modulation) and also to calculate the modulation index.
   Study of Frequency Modulation
2. To study the process of frequency modulation and demodulation and calculate the depth of modulation by varying the modulating voltage.
3. To verify the spectrum of AM and FM signals using the spectrum analyzer.
4. To study the frequency response of Pre-Emphasis and De-Emphasis circuits.
5. To study the frequency division multiplexing and De multiplexing Techniques.
6. To study the Pulse amplitude modulation & demodulation Techniques.
7. To study the operation of frequency synthesizer using PLL
8. To study the sampling theorem and its reconstruction.

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Semester-VI: Major Core Course (MJC)

Major Course-11 (MJC-11): Signals and Systems

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1- Understand different types of signals in continuous and discrete-time domain, odd and even, periodic and aperiodic etc. Be able to classify systems based on their properties

CO2- Familiarize the concepts Linear-time invariant system, convolution

CO3- Determine Fourier series and Fourier Transform and their properties

CO4- Familiar with Laplace transformation and its properties

Syllabus Contents

Unit-1 (Lectures -14)

Signals and Systems: Basic Continuous and discrete time signals, standard analog signals, Exponential and sinusoidal signals, Impulse and unit step functions, even and odd signal, power and energy signals, periodic and aperiodic signals, Continuous-Time and Discrete-Time Systems, Basic System Properties.

Unit-2 (Lectures-11)

Linear Time -Invariant (LTI)Systems: Discrete time LTI systems, the Convolution Sum, Continuous time LTI systems, the Convolution integral. Properties of LTI systems, Commutative, Distributive, Associative properties, LTI systems with and without memory, Invariability, Causality, Stability, Unit Step response.

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Unit-3 (Lectures-14)

Fourier Series Representation of Periodic Signals: Continuous-Time periodic signals, Dirichlet's condition, Fourier series expansion, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series.

Fourier Transform: Aperiodic signals, Periodic signals, Fourier transform representation of aperiodic Continuous-time signals, Dirac-delta function, Properties of Continuous-time Fourier transform, Convolution and Multiplication Properties

Unit-4 (Lectures-6)

Laplace Transform: Laplace Transform, Inverse Laplace Transform, Laplace Transform for standard signals, Properties of the Laplace Transform.

Suggested Books:

1. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education (2007)
2. S. Haykin and B. V. Veen, Signal and Systems, John Wiley & Sons (2004)
3. H. P. Hsu, Signals and Systems, Tata McGraw Hill (2007)
4. S. T. Karris, Signal and Systems: with MATLAB Computing and Simulink Modelling, Orchard Publications (2008)
5. W. Y. Young, Signals and Systems with MATLAB, Springer (2009)
6. M. Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill (2007)

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Semester-VI: Major Core Course (MJC)

Major Course-11 (MJC-11): Signals and System Lab

(Scilab/MATLAB/ Other Mathematical Simulation software)

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Learn the practical implementation issues stemming from the lecture.

CO2 Learn the use of simulation tools and design skills.

CO3 Learn to work in groups and to develop MATLAB simulations of various signals and systems.

CO4 Prepare the technical report on the experiments carried.

Syllabus Content

1. Generation of Signals: continuous time
2. Generation of Signals: discrete time
3. Time shifting and time scaling of signals.
4. Convolution of Signals
5. Solution of Difference equations.
6. Fourier series representation of continuous time signals.
7. Fourier transform of continuous time signals.
8. Laplace transform of continuous time signals.

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Semester-VI: Major Core Course (MJC)

Major Course-12 (MJC-12): Computer Architecture and Programming in C, Python

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Write code in C language for arithmetic and logical problems

CO2 Write code in C language for arithmetic and logical problems

CO3 write simple Python programs.

CO4 Develop Python programs with conditionals and loops.

Syllabus Contents

Unit-1 (10 Lectures)

Computer Architecture: History of computer, Introduction of Computer, Major Components of computer, Hardware, Software, Software & Firmware, Computer Application in various fields of science and managements.

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupt. Design of Basic Computer, Design of Accumulator Logic.

Unit- 2 (10 Lectures)

C Programming Language: Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program, Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators.

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Unit-3 (10 Lectures)

Decision making, branching & looping: Decision making, branching and looping: if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions: Defining functions, function arguments and passing, returning values from functions.

Unit-4 (15 Lectures)

Python Programming: Introduction, History, features, Installing Python, Running Python program, Debugging : Syntax Errors, Runtime Errors, Semantic Errors, Experimental Debugging, Formal and Natural Languages, The Difference Between Brackets, Braces, and Parentheses, Variables and Expressions Values and Types, Variables, Variable Names and Keywords, Type conversion, Operators and Operands, Expressions, Interactive Mode and Script Mode, Order of Operations. **Conditional Statements**: if, if-else, nested if –else **Looping:** for, while, nested loops

Suggested Books:

1. Yashavant Kanetkar, Let Us C , BPB Publications
2. Programming in ANSI C, Balagurusamy, 2nd edition, TMH.
3. Byron S Gottfried, Programming with C , Schaum Series
4. Computer system Architecture- M. M . Mano (PHI)
5. Computes Organization & Architecture-William Stallings (PHI)
6. Ellis Horowitz and Sartaz Sahani "Fundamentals of Computer Algorithms", Computer Science Press.
7. Introduction to Problem Solving with Python E. Balagurusamy TMH 1st 2015
8. Think Python Allen Downey O'Reilly 1st 2012

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Semester-VI: Major Core Course (MJC)

Major Course-12 (MJC-12): Computer Architecture and Programming in C, Python Lab

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Write Programs in C for arithmetic and logical operations.

CO2 Write Programs in Python for arithmetic and logical operations.

CO3 Prepare the technical report on the programming carried.

Syllabus Content

C-Programming

1. C Program to Print Your Own Name
2. C Program to Add, subtract, and multiply Two Numbers
3. C Program to Check Whether a Number is Prime or Not
4. C Program to Swap Two Numbers
5. C Program to Calculate Fahrenheit to Celsius and vice-versa
6. C Program to Find Simple Interest
7. C Program to Find Compound Interest
8. C Program for Area and Perimeter of Rectangle
9. C Program for Area and Perimeter of circle
10. C Program to Find Factorial of a Number
11. Generate the Fibonacci series up to the given limit N and also print the number of elementsin the

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series.

12. Find the GCD of two integer numbers.

Python Programming

1. Python Program to Print Hello world!
2. Python Program to Add Two Numbers
3. Python Program to Find the Square Root
4. Python Program to Calculate the Area of a Triangle
5. Python Program to Solve Quadratic Equation
6. Python Program to Swap Two Variables
7. Python Program to Generate a Random Number
8. Python Program to Convert Kilometers to Miles
9. Python Program to Convert Celsius to Fahrenheit

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Semester-VII: Major Core Course (MJC)

Major Course-13 (MJC-13): Modern Communication Systems

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Apply the basic knowledge of signals and systems and understand the basics of communication system and analog modulation techniques.

CO2 Apply the knowledge of digital electronics and understand the error control coding techniques.

CO3 Summarize different types of communication systems and its requirements.

CO4 Design and Analyse the performance of communication systems.

Syllabus Contents

Unit-1 (8 Lectures)

Advanced Digital Modulation Technique: DPCM, DM, ADM. Binary Line Coding Technique, Multi level coding, QAM (Modulation and Demodulation)

Unit-2 (10 Lectures)

Optical Communication: Introduction of Optical Fiber, Types of Fiber, Guidance in Optical Fiber, Attenuation and Dispersion in Fiber, Optical Sources and Detectors, Block Diagram of optical communication system, optical power budgeting

Unit-3 (14 Lectures)

Cellular Communication: Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, Comparative study of GSM and CDMA, 2G, 3G, 4G and 5G concepts.

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Unit-4 (13 Lectures)

Satellite communication: Introduction, need, satellite orbits, advantages and disadvantages of geostationary satellites. Satellite visibility, satellite system – space segment, block diagrams of satellite sub systems, up link, down link, cross link, transponders (C- Band), effect of solar eclipse, path loss, ground station, simplified block diagram of earth station. Satellite access, TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA, Satellite antenna (parabolic dish antenna), GPS-services like SPS & PPS.

Local area networks (LAN): Primary characteristics of Ethernet-mobile IP, TCP/IP model, wireless LAN requirements-concept of Bluetooth, Wi-Fi and WiMAX.

Suggested Books:

1. W. Tomasi, Electronic Communication Systems: Fundamentals through Advanced, Pearson Education, 3rd Edition

2. Martin S. Roden, Analog & Digital Communication Systems, Prentice Hall, Englewood Cliffs, 3rd Edition

3. Modern digital and analog Communication systems- B. P. Lathi, 4rd Edition 2009 Oxford University press.

4. ThiagarajanVishwanathan, Telecommunication Switching Systems and Networks, Prentice Hall of India.

5. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2nd Edition, Pearson Education Asia.

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Semester-VII: Major Core Course (MJC)

Major Course-13 (MJC-13): Modern Communication Systems

Lab

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Understand the functioning of various digital communication techniques.

CO2 Study and learn the basic concepts of optical transmitting and receiving

CO3 Calculate the performance parameters involved in electronic communication systems.

CO4 Prepare the technical report on the experiments carried.

Syllabus Content

1. Measurement of the numerical aperture (NA) of multimode fibers
2. Modulation of LED and detection through Photodetector.
3. Calculation of the transmission losses in an optical communication system.
4. Study of 16 QAM modulation and Detection with generation of Constellation Diagram.
5. Study of DPCM and demodulation.
6. Simulate the Pulse code modulation and demodulation system and display the waveforms (using software).
7. Simulate the QPSK transmitter and receiver. Plot the signals and its constellation diagram (using software).
8. Test the performance of a binary differential phase shift keying system (DPSK) (using software).

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RESEARCH METHODOLOGY FOR FACULTY OF SCIENCE

SEMESTER-VII: MAJOR COURSE-14 (MJC-14)

Credits: Theory-05 **Full Marks:ESE-70 + CIA-30 = 100**

Objective of the Course

- To introduce fundamental of research process including problem identification, hypothesis concept and to draw conclusion.

Learning outcome:

After completion of this course the students will be able to

- Develop the skill of contextualization of knowledge and critical thinking
- Choose appropriate methods of research aims and objectives.
- Apply ethical principle in research work.
- Understand the philosophy of research integrity and publication ethics.

MJC-XIV :Research Methodology (Credit: 5)		
Unit	**Topics to be covered**	**No. of Hours (50)**
1	**Fundamental of Research** 1.1 Philosophy, concept, aims, objectives, purpose and scope of research. 1.2 Types of Research : Descriptive *vs* Analytical, Pure *vs* Applied, Conceptual *vs* Empirical, Qualitative *vs* Quantitative,Scientific *vs*Technical. 1.3 Good Laboratory Practices and safety measures.	04 03 02
2	**Concept of Research Problem and Research Designing** 2.1 Identifying the Research Problem: meaning; importance; sources; selecting, stating and evaluating a research problem 2.2 Hypothesis: Designing and Testing 2.3 Experimental Research and Design: Approximation of data, simulation and modelling 2.4Sampling: Types of sampling, Questionnaire and observational methods of data collection.	03 03 02 03

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3	**Use of Tools and Techniques in Research**	
	3.1 Use of Search engines for reviewing of literature and data retrieving(Google scholar, PubMed, ResearchGate and ShodhGanga)	02
	3.2 Use of Software: Microsoft Word, Microsoft Excel, Latex,SPSS/R/MATLAB/SCILAB/EndNote	03
	3.3 Basic Statistical Methods and Techniques: Descriptive Statistics, Test of Significance, ANOVA, Regression Analysis.	03
	3.4 Electronic submission of paper in different journals, Transferring big files through software	03
4	**Scientific Communication**	
	4.1 Steps of Research Paper writing: Title, Abstract and Keywords, Introduction, Material and Methods, Results and Discussion, Conclusion, Conflict of Interest, Acknowledgment, Table and Graphs, Appendices.	04
	4.2 Research Proposal: Writing and Submission	03
	4.3 Funding Agencies: BCST, UGC, CSIR, ICMR,DST, DBT, ICAR	02
	4.4Seminar/Conference/Webinar presentation: Abstract writing and oral (PPT)and poster presentation.	02
	4.5Journal: Types, Indexing, Concept of Impact factor and Citation.	02
5	**Research Publication and Ethics**	
	5.1 Ethical issues in Research	02
	5.2 Plagiarism : Meaning, Types and Implications, Checking Software	02
	5.3 IPR: Patent, Copyright and Trademark	01
	5.4 UGC guidelines on Research Ethics	01
	TOTAL	**50**

Recommended Books:

1. Research Methodology- C.R. Kothari
2. Research Methodology :Methods & Technique (2023) – VimalSagar, AGPH, Bhopal
3. Research Methodology for PhD Coursework (2023)- D.N. Pandit, Hindustan Publishing Corporation, New Delhi
4. Statistics: A modern approach (2022) - D.N. Pandit, Hindustan Publishing
5. Essays on Research Methodology (2015)-Hegde D.S. Springer
6. Research Methodology Step by Step Guide for Beginners (2019)-Kumar R. Sage Publication.
7. Research Methodology for Science: Michael P. Marden Cambridge Univ. Press
8. Fundamentals of Research Methodology and Statistics (2006): Singh Y.K. New Edge Publication

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Semester-VII: Major Core Course (MJC)

Major Course-15 (MJC-15): Embedded System

Credit: 04 (Theory) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Explain the concepts related to embedded systems and the architecture of microcontrollers

CO2 Familiarize with serial bus standards.

CO3 Design systems for common applications like general I/O, counters, PWM motor control, data acquisition etc.

CO4 Demonstrate knowledge of the development tools for a microcontroller, and write assembly language code according to specifications

Syllabus Contents

Unit – 1 (8 Lectures)

Introduction to Embedded Systems: Overview of Embedded Systems, Features, Requirements and Applications, Recent Trends in the Embedded System Design, Common architectures for the Embedded System Design, Embedded Software design issues.

Unit –2 (16 Lectures)

AVR RISC Microcontrollers: Introduction to AVR RISC Microcontrollers, Architecture overview, status register, general purpose register file, memories, Instruction set, Data Transfer Instructions, Arithmetic and Logic Instructions, Branch Instructions, Bit and Bit-testInstructions, MCU Control Instructions.

Interrupts and Timer: Introduction to System Clock, Reset sources, Introduction to interrupts, External interrupts, IO Ports, 8-bit and 16-bit Timers, introduction to differentmodes, Input Capture and Compare Match.

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Unit – 3 (16 Lectures)

Embedded C Programming: Introduction to C programming, Structure of C program, character set, keywords and identifiers, constants and variables, data types and data ranges, expressions and operators. Study of IO statements, Structure of embedded C program, Need of OS, Concept of Super loop, Time delay program using timer, square wave generation, I/O port programming, Serial Port Programming. Introduction of Aurdino programming.

Unit – 4 (20 Lectures)

Peripherals: Analog Comparator, Analog-to-Digital Converter, Serial Peripheral Interface (SPI), The Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART), Two Wire Interface (TWI).

Interfacing: Interfacing Techniques, Interfacing and programming for Switches, Relays, LEDs, Transistor, Seven Segment Display, 16X2 LCD, ADC 0804/0809 and DAC 0808.

Designing of an Embedded System: Designing of microcontroller/ based embedded system for Measurement of Temperature and DC motor control using PWM.

Suggested Books:

1. AVR Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, PHI
2. Embedded system Design - Frank Vahid and Tony Givargis, John Wiley, 2002
3. Programming and Customizing the AVR Microcontroller by D V Gadre, McGraw- Hill
4. Atmel AVR Microcontroller Primer: Programming and Interfacing by Steven F. Barrett, Daniel J. Pack, Morgan & Claypool Publishers
5. An Embedded Software Primer by David E Simon, Addison Wesley

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Semester-VII: Major Core Course (MJC)

Major Course-15 (MJC-15): Embedded System Lab

Credit: 02 (Practical) Lectures: 60

Course Outcomes

At the end of this course, students will be able to

CO1 Use various peripherals on the microcontroller to implement systems, interrupts driven I/O and modes of timer/ counter

CO2 Understand Assembly Language/embedded C programming of Microcontroller.

CO3 Design and implement simple embedded systems.

CO3 Prepare the technical report on the experiments carried out.

Syllabus Content

1. Problems related to data transfer and exchange.
2. Problems related with programming serial communication with and without interrupts.
3. Toggle the LED every second using Timer interrupt.
4. Connect the LCD I/O Board and print 'Hello World' on the LCD. Scroll display from left to right.
5. Use the thermistor to estimate the temperature and print the raw value on the serial monitor.
6. Interface LCD and matrix keypad.
7. Interfacing of ADC and DAC.
8. Designing of microcontroller/Aurdino based embedded system for Measurement of Temperature.
9. Designing of microcontroller/Aurdino based embedded system for DC motor control using PWM.

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Semester-VIII: Major Core Course (MJC)

Major Course-16 (MJC-16): Artificial Intelligence & Robotics

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1- Understand the importance, applicability and strength of AI.

CO2- Apply various search and knowledge representation schemes for intelligent systems

CO3- Understand the logics and knowledge representation techniques.

CO4- Understand various phases involved in NLP and understand the architecture of the Expert system.

Syllabus Contents

Unit-1 (Lectures – 10)

Introduction to AI: Definition and history of AI, Domains and Applications of AI, advantages and disadvantages of AI, Subsets of AI, Intelligent agents in AI and their types, Agent Environment in AI, Turing Test.

Unit- 2 (Lectures-10)

Searching techniques: Search Algorithm Terminologies, Properties of search algorithms, types of search algorithms, Breadth-first search, Uniform cost search, Depth-first search, Best-first search, A* search, Hill climbing algorithm.

Unit-3 (Lectures-14)

Knowledge Representation: Knowledge-Based Agent and its architecture, types of knowledge, Techniques of knowledge representation, Propositional logic, Syntax & Semantic for Propositional logic, rules of inference, First order logic (FOL) and syntax, Inference rule for FOL. Introduction to logical programming, PROLOG.

Unit 4 (Lectures-11)

Introduction to Robotics:

Basic: Robot-Basic concepts, Need, Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot, safety standards.

Sensors and Actuators in robotics: Touch sensors, Tactile sensor proximity and range sensors, Pressure sensors, Actuators: DC Motor, Servo Motor and Stepper Motor.

Applications: Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, and Disaster management.

Recommended Books:

1. S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, Third Edition, 2011
2. Vinod Chandra S.S., and Anand Hareendran S. Artificial Intelligence and Machine Learning 1st Edition.
3. Dan W. Patterson, Introduction to Artificial Intelligence and expert systems, PHI, 2006

Semester-VIII: Major Core Course (MJC)

Major Course-16 (MJC-16): Artificial Intelligence & Robotics Lab

Credit: 01 (Practical) Lectures: 30

Course Outcomes

At the end of this course, students will be able to

CO1 Understand the importance, applicability and strength of AI.

CO2 Apply various search and knowledge representation schemes for intelligent systems

CO3 Understand the logics and knowledge representation techniques.

CO4 Understand the basic of logical programming, PROLOG.

CO5 Prepare the technical report on the experiments carried.

Syllabus Contents

1. Write a program of depth-first search
2. Write a program to conduct min-max algorithm
3. Write a PRO LOG program for Family Relationships.
4. Study the components of Robot.
5. Forward kinematics and validate using any software (Robo analyzer or other).
6. Demonstration of robot with 2 dof, 3 dof, 4 dof using any software (Robo analyzer or other).
7. Design a Robotic Arm using Aurdino.

Course Structure for 4 Year undergraduate Programme under CBCS System

Electronic Science

(B)Minor Courses to be offered by the Department for students of other Departments of Science

Sl. No.	Sem	Type of Course	Name of Course	Credits	Marks
1.	I	MIC-1 (T)	Basic Circuit Theory and Network Analysis	2	100
		MIC -1 (P)	Basic Circuit Theory and Network Analysis Lab	1	100
2.	II	MIC -2 (T)	Mathematical Foundation for Elecetronics	2	100
		MIC -2 (P)	Mathematical Foundation for Elecetronics Lab	1	100
3.	III	MIC -3 (T)	Semiconductor Devices	2	100
		MIC -3 (P)	Semiconductor Devices Lab	1	100
4.	IV	MIC -4	Electromagnetics	3	100
5.	V	MIC -5 (T)	Electronic Circuits	2	100
		MIC -5 (P)	Electronic Circuits Lab	1	100
6.	V	MIC -6 (T)	Digital Electronics and VHDL	2	100
		MIC -6 (P)	Digital Electronics and VHDL Lab	1	100
7.	VI	MIC -7(T)	Electronic Instrumentation	2	100
		MIC -7(P)	Electronic Instrumentation Lab	1	100
8.	VI	MIC -8 (T)	Operational Amplifiers and Applications	2	100
		MIC -8 (P)	Operational Amplifiers and Applications Lab	1	100
9.	VII	MIC -9 (T)	Microprocessors and Microcontrollers	3	100
		MIC -9 (P)	Microprocessors and Microcontrollers Lab	1	100
10.	VIII	MIC -10 (T)	Communication Electronics	3	100
		MIC -10 (P)	Communication Electronics Lab	1	100

Sub Total = 32

Note: The Department may reduce the syllabus of the Minor Courses as per the credit distribution, The Department concerned may also decide practical courses.

Syllabus for 4-Year Undergraduate Programme under CBCS System

Electronic Science

Semester III- Minor Course (MIC)

Minor Course-3 (MIC-3): Semiconductor Devices

Credit: 02 (Theory) Lectures:30

Course Outcomes

At the end of this course, Students will be able to

CO1 Describe the behavior of semiconductor materials

CO2 Study of I-V characteristics of diode/BJT/FET devices

CO3 Apply standard device models to explain/calculate critical internal parameters of semiconductor devices

Syllabus Contents

Unit 1 (12 Lectures)

Semiconductor Basics: Introduction to Semiconductor Materials, Energy Band in Solids, concept of Fermi Level for Intrinsic and extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. Carrier Transport Phenomena: Carrier Drift, Mobility.

Unit 2 (6 Lectures)

P-N Junction Diode: Formation of Depletion Layer, Depletion Width. Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism.

Unit 3 (12 Lectures)

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations.

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Field Effect Transistors: JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. Introduction of MOSFET.

Suggested Books:

1. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002).
2. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
3. Dennis Le Croissette, Transistors, Pearson Education (1989)
4. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
5. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
6. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)

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Semester III- Minor Course (MIC)

Minor Course-3 (MIC-3): Semiconductor Devices Lab

Credit: 01 (Practical) Lecture: 30

Course Outcomes

At the end of this course, Students will be able to

CO1 Examine the characteristics of basic semiconductor devices.

CO2 Perform experiments for studying the behavior of semiconductor devices for circuit design applications.

CO3 Calculate various device parameters values from their IV characteristics

CO4 Interpret the experimental data for better understanding the device behavior

Syllabus Contents

1. Study of the I-V Characteristics of P-N junction diode and Zener Diode.
2. Study of the I-V Characteristics of Zener Diode.
3. Studyof the I-V Characteristics of the CE configuration of BJT.
4. Studyof the I-V Characteristics of the CommonBase Configuration of BJT .
5. Study of the I-V Characteristics of JFET.
6. Study of the I-V Characteristics of MOSFET.

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Semester IV- Minor Course (MIC)
Minor Course-4 (MIC-4) Electromagnetics

Credit: 03 (Theory) Lectures:45

Course Outcomes

At the end of this course, Students will be able to

CO1 Become familiar with vector algebra, coordinate system and coordinate conversion.

CO2 Plot fields (Electrostatic and Magnetostatics) and solve Laplace's equation.

CO3 Interpret Maxwell's equation physically and solve problems in different media.

CO4 Understand the propagation of an electromagnetic wave.

Syllabus Contents

Unit- 1 (13 Lectures)

Vector Analysis: Scalars and Vectors, Vector Algebra, Vector Components and Unit Vector, Vector Field Products, Differential Length, Area and Volume, Del Operator, Gradient of a Scalar, Divergence and Curl of a Vector.

Electrostatic Fields: Coulomb's Law and Electric Field, Field due to Discrete and Continuous Charge Distributions, Electric Flux Density, Gauss's Law and Applications, Electric Potential, Potential due to a Charge and Charge distribution, Electric dipole. Dielectric materials, Polarization, Dielectric Constant, and Capacitors. Electrostatic forces and Energy.

Unit- 2 (10 Lectures)

Poisson's Equation and Laplace's Equation: Derivation of Poisson's and Laplace's equation, Uniqueness Theorem, Examples of Solution of Laplace's Equation.

Magnetostatics: Biot Savert's law and Applications, Magnetic dipole, Ampere's Circuital Law, Maxwell's Equation, Magnetic Flux and Magnetic Flux Density, Scalar and Vector Magnetic Potentials.

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Unit-3 (10 Lectures)

Time-Varying Fields and Maxwell's Equations: Faraday's Law of Electromagnetic Induction, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Concept of Retarded Potentials.

Unit-4 (12 Lectures)

Electromagnetic Wave Propagation: Time-Harmonic Electromagnetic Fields and use of Phasors, Electromagnetic Spectrum, Wave Equation in a source free isotropic homogeneous media, Uniform Plane Waves in Lossless and Lossy unbounded homogeneous media, Wave Polarization, Phase and Group velocity, Flow of Electromagnetic Power and Poynting Vector. Uniform Plane wave incident on a Plane conductor boundary, concept of reflection and standing wave.

Suggested Books:

1. Murray. R. Spiegel, Vector Analysis, Schaum series, Tata McGraw Hill (2006)
2. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press (2001)
3. W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)
4. D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
5. J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
6. N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Education (2006)
7. Introduction to Electrodynamics, D.J. Griffiths, Pearson Education (2012)
8. Electromagnetic Wave and Radiating System, Jordan and Balmain, Prentice Hall (1979)

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Semester V- Minor Course (MIC)
Minor Course-5 (MIC-5): Electronic Circuits

Credit: 02 (Theory) Lectures:30

Course Outcomes

At the end of this course, Students will be able to

CO1 Illustrate rectifiers, transistor amplifiers and its biasing.

CO2 Describe the frequency response of BJT amplifiers.

CO3 Explain the concepts of feedback and construct feedback amplifiers and oscillators.

CO4 Illustrate the performance parameters of amplifiers with and without feedback.

Syllabus Contents

Unit- 1 (7 Lectures)

Diode Circuits: Rectifiers: Half Wave Rectifier, Full Wave Rectifier (center tapped and bridge). Circuit diagrams, working and waveforms, ripple factor & efficiency, comparison. Zener diode regulator circuit diagram and explanation for load and line regulation.

Unit- 2 (10 Lectures)

Bipolar Junction Transistor: Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias, collector to base bias, voltage divider bias, circuit diagrams and their working. Transistor as a switch application. BJT amplifier (CE), dc and ac load line analysis, hybrid model of CE configuration.

Unit- 3 (13 Lectures)

Feedback Amplifiers: Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances. Barkhausen criteria for oscillations, Study of phase

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shift oscillator, Colpitts oscillator and Hartley oscillator.

Power Amplifiers: Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons.

Suggested Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronic devices, David A Bell, Reston Publishing Company
3. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
4. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001) J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
6. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)
7. Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation

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Semester V- Minor Course (MIC)
Minor Course-5 (MIC-5): Electronic Circuits Lab

Credit: 01 (Practical) Lecture: 30

Course Outcomes

At the end of this course, Students will be able to

CO1 Understand various stages of a diode based regulated power supply.

CO2 Understand various biasing concepts, BJT based amplifiers.

CO3 Understand the concept of various BJT Oscillators.

CO4 Prepare the technical report on the experiments carried.

Syllabus Contents

1. Study of the half wave rectifier and Full wave rectifier.
2. Study of power supply using Zener diode.
3. Designing of a Single Stage CE amplifier.
4. Study of the Colpitt's Oscillator.
5. Study of the Hartley's Oscillator.
6. Study of the Phase Shift Oscillator.
7. Study of Fixed Bias, Voltage divider, and Collector-to-Base bias Feedback configuration for transistors.

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Semester V- Minor Course (MIC)
Minor Course-6 (MIC-6): Digital Electronics and VHDL

Credit: 02 (Theory) Lectures:30

Course Outcomes

At the end of this course, Students will be able to

CO1 Understand and represent numbers in powers of base and converting one from the other and carry out arithmetic operations

CO2 Understand basic logic gates, concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions

CO3 Analyze and design combinational as well as sequential circuits.

CO4 Understand the HDL design flow and capability of writing programs in VHDL.

Syllabus Contents

Unit-1 (10 Lectures)

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic, Binary Coded Decimal code.

Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators, Truth Tables of OR, AND, NOT, Basic postulates and fundamental theorems of Boolean algebra, Truth tables, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates.

.Unit-2 (12 Lectures)

Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Encoder and Decoder, Multiplexers and Demultiplexers, half adder and full adder.

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Sequential logic design: Latches and Flip flops , S-R Flip flop, J-K Flip flop, T and D type Flip flops, Clocked and edge-triggered Flip flops, Master-slave flip flop, Registers, Counters.

Unit-3

(8 Lectures)

Introduction to Verilog: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches.

Suggested Books:

1. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India (2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
5. A Verilog HDL Primer - J. Bhasker, BSP, 2003 II Edition.
6. Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

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Semester V- Minor Course (MIC)
Minor Course-6 (MIC-6): Digital Electronics and VHDL Lab

Credits: 01 (Practical) Lecture: 30

Course Outcomes

At the end of this course, Students will be able to

CO1 Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.

CO2 Understand and examine the structure of various number systems and its application in digital design.

CO3 The ability to understand, analyse and design various combinational and sequential circuits.

CO4 Prepare the technical report on the experiments carried.

Syllabus Contents

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design a Half adder.
4. Design a Full Adder.
5. Design a 4 X 1 Multiplexer using gates.
6. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
7. Design a counter using D/T/JK Flip-Flop.

Experiments in VHDL

1. Write code to realize basic and derived logic gates.
2. Half adder, Full addder using basic and derived gates.

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Semester VI- Minor Course (MIC)
Minor Course-7 (MIC-7): Electronic Instrumentation

Credit: 02 (Theory) Lectures:30

Course Outcomes

At the end of this course, Students will be able to

CO1 Describe the working principle of different measuring instruments.

CO2 Choose appropriate measuring instruments for measuring various parameters in their laboratory courses.

CO3 Correlate the significance of different measuring instruments, recorders and oscilloscope.

Syllabus Contents

Unit-1 (12 Lectures)

Qualities of Measurement & Instruments: Galvanometer, DC measurement: ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems, Multimeter.

Connectors and Probes: low capacitance probes, high voltage probes, current probes

Oscilloscopes: Measurement of voltage, frequency, and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, DSO: Block diagram, principle and working, Advantages and applications.

Unit-2 (10 Lectures)

Measurement of Resistance and Impedance: Low Resistance: Wheatstone bridge method, A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Measurement of Capacitance, Schering's bridge, Measurement of frequency, Wien's bridge.

Unit-3 (8 Lectures)

Transducers and sensors: Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive, Capacitive, Inductive and piezoelectric transducers. Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors) and light transducers.

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Suggested Books:

1. H. S. Kalsi, Electronic Instrumentaion, TMH(2006)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice- Hall (2005).Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH
3. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
4. Oliver and Cage, "Electronic Measurements and Instrumentation", TMH (2009).
5. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann- 2008).
6. K Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpatRai and Sons (2007).
7. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).

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Semester VI- Minor Course (MIC)

Minor Course-7 (MIC-7); Electronic Instrumentation Lab

Credit: 01 (Practical) Lectures:30

Course Outcomes

At the end of this course, students will be able to

CO1 Perform experiments on the measuring instruments.

CO2 Perform measurements of various electrical/electronic parameters using appropriate instruments available in the laboratory.

CO3 Prepare the technical report on the experiments carried.

Syllabus Contents

1. Design of multi range ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
3. Measurement of Capacitance by de'Sautys.
4. Measure of low resistance by Kelvin's double bridge.
5. To determine the Characteristics of LVDT.
6. To determine the Characteristics of Thermistors and RTD.
7. To study the Characteristics of LDR, and Photodiode.

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Semester VI- Minor Course (MIC)
Minor Course-8 (MIC-8): Operational Amplifiers and Applications

Credit: 02 (Theory) Lectures:30

Course Outcomes

At the end of this course, students will be able to

CO1 Understand basic building blocks of an op-amp and its parameters for various application designs.

CO2 Design the linear and non-linear applications of an op-amp.

CO3 Understand the working of multivibrators using IC 555 timer.

CO4 Design Schmitt Trigger using op-amp.

Syllabus Contents

Unit-1 (12 Lectures)

Basic Operational Amplifier: Concept of differential amplifiers, block diagram of an operational amplifier (IC 741), Op-Amp parameters: input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

Unit-2 (10 Lectures)

Op-Amp Circuits: Open and closed loop configuration Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter, Schmitt Trigger.

Unit-3 (8 Lectures)

Multivibrators (IC 555): Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, output voltage equation.

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Suggested Books:

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)
3. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001)
4. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
5. K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011)

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Semester VI- Minor Course (MIC)
Minor Course-8 (MIC-8): Operational Amplifiers and Applications Lab

Credit: 01 (Practical) Lectures:30

Course Outcomes

At the end of this course, students will be able to

CO1 Understand the non-ideal behaviour by parameter measurement of Op-amp.

CO2 Design application-oriented circuits using Op-amp ICs.

CO3 Generate square wave using different modes of 555 timer IC.

CO4 Prepare the technical report on the experiments carried.

Syllabus Contents

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
3. Designing of analog adder and subtractor circuits.
4. Designing an integrator using op-amp for a given specification.
5. Designing a differentiator using op-amp for a given specification.
6. Study of IC 555 as an astable multivibrator.
7. Study of IC 555 as monostable multivibrator.

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Semester VII- Minor Course (MIC)

Minor Course-9 (MIC-9): Microprocessors and Microcontrollers

Credit: 03 (Theory) Lectures: 45

Course Outcomes

At the end of this course, students will be able to

CO1 Understand the basic blocks of microcomputers.

CO2 Apply knowledge and demonstrate proficiency of designing hardware interfaces with microprocessors and microcontrollers.

CO3 Write assembly language programs for basic operations.

CO3 Derive specifications of a system based on the requirements of the application and select the appropriate Microprocessor or Microcontroller.

Syllabus Contents

Unit-1 (12 Lectures)

Introduction to Microprocessor: Introduction, Applications, Basic block diagram, Speed, Word size, Memory capacity, Classification of microprocessors (mention of different microprocessors being used)

Microprocessor 8085: Features, Architecture -block diagram, General purpose registers, register pairs, flags, stack pointer, program counter, types of buses. Multiplexed address and data bus, generation of control signals, pin description of microprocessor 8085. Basic interfacing concepts, Memory mapped I/O and I/O mapped I/O.

Unit-2 (13 Lectures)

8085 Instructions: Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions. Assembly language programming examples. Stack operations, subroutine, call and return instructions. Delay loops, use of counters, timing diagrams-instruction cycle, machine cycle, T-

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states, time delay. Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts.

Unit-3 (12 Lectures)

Microcontrollers: Introduction, different types of microcontrollers, embedded microcontrollers, processor architectures. Harvard vs. Princeton, CISC vs. RISC architectures, microcontroller memory types, microcontroller features, clocking, I/O pins, interrupts, timers, and peripherals.

PIC16F887 Microcontroller: Core features, Architecture, pin diagram, memory organization- Program and data memory organization, I/O Ports, oscillator module, Timer modules (Timer 0,Timer 1 and Timer 2), comparator module, analog-to-digital converter (ADC) module, data EEPROM, Enhanced capture/compare/PWM module, EUSART, master synchronous serialport (MSSP) module, special features of the CPU, interrupts, addressing modes, instruction set.

Unit-4 (8 Lectures)

Interfacing to PIC16F887: LED, Switches, Solid State Relay, Seven Segment Display, 16x2 LCD display, 4x4 Matrix Keyboard, Digital to Analog Converter, Stepper Motor and DC Motor.

Suggested Books:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar, Wiley Eastern Limited- IV Edition.
2. Fundamentals of Microprocessor & Microcomputer: B. Ram, Danpat Rai Publications.
3. Microchip PIC16F87X datasheet
4. PIC Microcontrollers, Milan Verle, , mikro Elektronika, 1st edition (2008)
5. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006

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Semester VII- Minor Course (MIC)
Minor Course-9 (MIC-9): Microprocessors and Microcontrollers Lab

Credit: 01 (Practical) Lectures:30

Course Outcomes:

At the end of this course, students will be able to

CO1 Proficient in use of IDE's for designing, testing and debugging microprocessor and microcontroller based system

CO2 Interface various I/O devices and design and evaluate systems that will provide solutions to real-world problem

CO3 Prepare the technical report on the experiments carried.

Syllabus Contents:

8085 Assembly language programs:

1. Program to transfer a block of data.
2. Program for multibyte addition
3. Program for multibyte subtraction
4. Program to multiply two 8-bit numbers.
5. Program to divide a 16 bit number by 8 bit number.
6. Program to search a given number in a given list.
7. Program to generate terms of Fibonacci series.
8. Program to find minimum and maximum among N numbers
9. Interfacing using 8253
10. Interfacing using 8253
11. Interfacing using 8259

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PIC Microcontroller Programming

1. LED blinking with a delay of 1 second.
2. Solid State Relay Interface/Seven Segment display interfacing.

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Semester VIII- Minor Course (MIC)
Minor Course-10 (MIC-10); Communication Electronics

Credit: 03 (Theory) Lectures:45

Course Outcomes

At the end of this course, students will be able to

CO1 Understand the basic concept of a communication system and need for modulation.

CO2 Evaluate modulated signals in time and frequency domain for various continuous modulation techniques.

CO3 Describe working of transmitters and receivers and effect of noise on a communication system

CO4 Understand baseband Pulse Modulation

Unit-1 (10 Lectures)

Electronic communication: Block diagram of an electronic communication system, electromagnetic spectrum-band designations and applications, need for modulation, concept of channels and base-band signals. Concept of Noise, Types of Noise, Signal to noise ratio, Noise Figure, Noise Temperature, Friss formula.

Unit-2 (13 Lectures)

Amplitude Modulation: Amplitude Modulation, modulation index and frequency spectrum. Generation of AM, Amplitude Demodulation (diode detector), Concept of Double side band suppressed carrier, Single side band suppressed carrier, Vestigial Side Band modulation, Block diagram of AM Transmitter and Receiver

Angle modulation: Frequency and Phase modulation, modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM (direct and indirect methods), FM detector (PLL). Block diagram of FM Transmitter and Receiver Comparison between AM, FM and PM.

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Unit-3 (10 Lectures)

Pulse Analog Modulation: Channel capacity, Sampling theorem, PAM, PDM, PPM modulation and detection techniques, Multiplexing, TDM and FDM.

Pulse Code Modulation: Quantizing, Uniform and Non uniform Quantization, Quantization Noise, Companding, Coding, Decoding, Regeneration.

Unit-4 (12 Lectures)

Digital Carrier Modulation Techniques: Block diagram of digital transmission and reception, Information capacity, Bit Rate, Baud Rate and M-ary coding. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK)

Suggested Books:

1. Electronic communication systems- Kennedy, 3rd edition, McGraw international publications.
2. Principles of Electronic communication systems - Frenzel, 3rd edition, McGraw Hill
3. Communication Systems, S. Haykin, Wiley India (2006)
4. Advanced electronic communications systems - Tomasi, 6th edition, PHI.
5. Communication Systems, S. Haykin, Wiley India (2006)

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Semester VIII- Minor Course (MIC)

Minor Course-10 (MIC-10): Communication Electronics Lab

Credit: 01 (Practical) Lectures:30

Course Outcomes:

At the end of this course, students will be able to

CO1 Understand basic elements of a communication system.

CO2 Analyze the baseband signals in time domain and in frequency domain.

CO3 Build understanding of various analog and digital modulation and demodulation techniques.

CO4 Prepare the technical report on the experiments carried.

Syllabus Contents

1. Study of Amplitude Modulation
2. Study of Amplitude Demodulation
3. Study of Frequency Modulation
4. Study of Frequency Demodulation
5. AM Transmitter/Receiver
6. FM Transmitter/Receiver
7. Study of Pulse Width Modulation
8. Study of Pulse Code Modulation
9. Study of Amplitude Shift Keying
10. Study of Frequency Shift Keying.

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Syllabus for 4-Year Undergraduate Programme under CBCS System

Electronic Science

Semester-I: Multidisciplinary Course (MDC)

Multidisciplinary Course-1 (MDC-1): Introduction to Electronics

Credit: 02 (Theory) Lectures: 30

Course Outcomes

At the end of this course, students will be able to

CO1 Understand and analyze core components, Devices, processes, and functionalities of Electronics.

CO2 Understand the use of the basic measuring equipments required to perform electronic experiments.

CO3 Understand the importance of Electronics in day-to-day life.

CO4 Develop a comprehensive understanding of electronic devices and circuits and their application in various fields.

Syllabus Contents

Unit-I: (10 Lectures)

Fundamentals of Electronics: The Historical Evolution of Electronics and its Impact on Society & Innovation, Electric current & Voltage, Introduction to Basic Components (Resistor, Capacitor, Inductor) of Electronics and their applications, Introduction to Electronic Equipment (Oscilloscope, Function Generator, Power Supply, Multimeter).

Unit-II: (10 Lectures)

Introduction to Semiconductor Devices and their applications: P-N Junction Diode: Formation of Depletion Layer, Depletion Width. Derivation of Diode Equation and I-V Characteristics, Rectifiers: Half Wave Rectifier, Full Wave Rectifier, Filters: types, circuit diagram and explanation of shunt capacitor filter with waveforms. Zener diode regulator circuit diagram. Transistor: Types of transistors and its configurations, applications: Transistor as a switch and Amplifier circuit.

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Unit-III: (10 Lectures)

Electronics in Daily Life: Consumer Electronics Office Gadgets like calculators, Personal computers, Digital cameras, Microphones, Loudspeakers, CCTV, FAX machines, Printers, Scanners, projectors, etc.

Advanced Consumer Electronic Devices: Smart Phones, Tablets, Bluetooth, Wi-Fi, barcode scanners, ATM, POS terminals, Generation of Mobile Networks, and GPS Navigation Systems.

Suggested Books:

1. Boylested, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education
1. Getting Started in Electronics by Forrest M. Mims
2. Consumer Electronics by S P Bali, Pearson, 2008
3. Handbook of Biomedical Instrumentation, R S Khandpur, Tata Mc Graw Hill, 2014
4. Emerging Trends in Electronics Vijay G. Yangalwar Nirali Prakahshan Publishers, 2020
5. Paul Horowitz The Art of Electronics Cambridge University Press; 1st edition, 2020.

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Semester-I: Multidisciplinary Course (MDC)

Multidisciplinary Course-1 (MDC-1): Introduction to Electronics Lab

Credit: 01 (Practical) Lectures: 30

Course Outcomes

At the end of this course, students will be able to

CO 1 Develop a comprehensive understanding of electronic devices, circuits and their application in various fields.

Syllabus Contents

1. Identification, study and testing of various electronic components.
2. Analog & digital multimeters
3. V-I characteristic of P-N junction diode
4. V-I characteristic of zener diode and study of zener diode as a voltage regulator.
5. Input and output characteristics of BJT
6. Study the transistor as a switch circuit.
7. Study of analog/digital CRO, measurement of time period, amplitude, frequency.

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Semester-II: Multidisciplinary Course (MDC)

Multidisciplinary Course-2 (MDC-2): Artificial Intelligence & Robotics

Credit: 02 (Theory) Lectures: 30

Course Outcomes

At the end of this course, students will be able to

CO1- Understand the importance, strength, and application of AI.

CO2- Apply various search and knowledge representation schemes for AI systems

CO3- Understand the concept of logic and knowledge representation techniques.

CO4- Understand the basic knowledge of robotics and its applications.

Syllabus Contents

Unit-1 **Lectures - 10**

Introduction to AI: Definition and history of AI, Domains and Applications of AI, Advantages and disadvantages of AI, Subsets of AI, Intelligent agents in AI and their types, Agent Environment in AI.

Searching techniques: Search Algorithm Terminologies, Properties of search algorithms, Types of search algorithms, Breadth-first search, Depth-first search, Best-first search.

Unit-2 **Lectures-10**

Knowledge Representation: Knowledge-Based Agent and its architecture, types of knowledge, Techniques of knowledge representation, Propositional logic, Syntax & Semantic for Propositional logic, rules of inference, First order logic (FOL) and syntax, Inference rule for FOL.

Unit 3 **Lectures-10**

Introduction to Robotics:

Basic: Basic concepts of Robotics, Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot.

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Applications: Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defence, and Disaster management.

Recommended Books:

1. S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, Third Edition, 2011
2. Vinod Chandra S.S., and Anand Hareendran S. Artificial Intelligence and Machine Learning 1st Edition.
3. Dan W. Patterson, Introduction to Artificial Intelligence and expert systems, PHI, 2006
4. Saha, S.K., Introduction to Robotics, 2nd Edition, McGraw-Hill Education, New Delhi, 2014
5. R.K. Mittal, I.J. Nagrath, "Robotics & Control", Tata McGraw & Hills, 2005.

Semester-II: Multidisciplinary Course (MDC)

Multidisciplinary Course-2 (MDC-2): Artificial Intelligence & Robotics Lab

Credit: 01 (Practical) Lectures: 30

Course Outcomes

At the end of this course, students will be able to

CO1- Understand the importance, applicability and strength of AI.

CO2- Apply various search and knowledge representation schemes for AI systems

CO3- Basic understanding of programming language for robotics.

CO4- Identify robots and its peripherals for satisfactory operation.

CO4- Prepare the technical report on the experiments carried.

Syllabus Contents

1. Write a program of depth-first search
2. Write a program to conduct min-max algorithm
3. Study the components of Robot.
4. Forward kinematics and validate using any software (Robo analyzer or other).
5. Assignments on programming of robots for applications.

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Semester-III: Multidisciplinary Course (MDC)

Multidisciplinary Course-3 (MDC-3): Programming with Matlab/SciLab

Credit: 02 (Theory) Lectures: 30

Course Outcomes

At the end of this course, students will be able to

CO1 Basic Knowledge of MATLAB/SciLab software.

CO2 Get introduced to the Matlab technical computing environment.

CO3 To introduce the Matlab/SciLab for scientific problem-solving with applications.

Syllabus Contents

Unit-I: **(12** Lectures)

MATLAB Basics: MATLAB environment, Basic computer programming, Variables and constants, operators and simple calculations, Formulas and functions, MATLAB toolboxes. Matrix and linear algebra review, Vectors and matrices in MATLAB, Matrix operations and functions in MATLAB.

Unit-II: **(10** Lectures)

MATLAB Programming: Reading and writing data, file handling, Personalized functions, Toolbox structure, MATLAB graphic functions, Algorithms and structures, MATLAB scripts and functions (m-files), Simple sequential algorithms, Control structures.

Unit-III: **(08** Lectures)

Numerical Simulations: Numerical methods and simulations, Random number generation, Montecarlo methods.

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Suggested Books:

1. PratapR., "Getting Started with MATLAB- A Quick Introduction for Scientists and Engineers", Oxford University Press.
2. Dukkipati R.V., "MATLAB- An Introduction with Applications", New Age International Publishers.
3. HanselmanD. and LittlefieldB., "Mastering MATLAB 8", Pearson Education.
4. Gilat A., "MATLAB: An Introduction with Applications", John Wiley & Sons.

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Semester-III: Multidisciplinary Course (MDC)

Multidisciplinary Course-3 (MDC-3): Programming with Matlab/SciLab

Credit: 01 (Practical) Lectures: 30

Course Outcomes

At the end of this course, students will be able to

CO1: Understand Basics of MATLAB coding.

CO2: Write the program for a given problem in MATLAB coding.

CO3: Simulate various electric circuits in MATLAB simulation tool.

Syllabus Contents

1. Study of Introduction to MATLAB
2. Study of basic matrix operations.
3. Write a MATLAB program to multiply two matrices, 'A' and 'B' of 3x3 and display results with input matrices.
4. To solve linear equations.
5. Solution of Linear equations for Underdetermined and Overdetermined cases.
6. Determination of Eigen values and Eigen vectors of a Square matrix.
7. Solution of Differential Equations using Euler Method.
8. Determination of time response of an R-L-C circuit..

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