गोंय विद्यापीठ
ताळगांव पठार,
गोंय – ४०३ २०६
फोन : +९१-८६६९६०९०४८

(Accredited by NAAC)

ATMANIRBHAR BHARAT
SWAYAMPURNA GOA

Goa University
Taleigao Plateau, Goa-403 206
Tel : +91-8669609048
Email : registrar@unigoa.ac.in
Website : www.unigoa.ac.in

GU/Acad –PG/BoS -NEP/2024/58 Date: 09.05.2024

Ref:GU/Acad –PG/BoS -NEP/2023/102/34 dated 16.06.2023
GU/Acad –PG/BoS -NEP/2023/544 dated 03/01/2024

CIRCULAR

In supersession to the above referred Circulars, the updated approved Syllabus of the **Bachelor of Science in Electronics** Programme approved by the Standing Committee of the Academic Council in its meeting held on 06th, 07th and 21st March 2024 is enclosed.

The Dean/ Vice-Deans of the School of Physical and Applied Sciences and Principals of the Affiliated Colleges offering the **Bachelor of Science in Electronics** Programme are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2024.05.09 12:36:05 +05'30'

(Ashwin Lawande)
Assistant Registrar – Academic-PG

To,

The Principals of Affiliated Colleges offering the Bachelor of Science in Electronics Programme.

Copy to:

1. The Director, Directorate of Higher Education, Govt. of Goa
2. The Dean, School of Physical and Applied Sciences, Goa University.
3. The Vice-Deans, School of Physical and Applied Sciences, Goa University.
4. The Chairperson, BOS in Electronics.
5. The Controller of Examinations, Goa University.
6. The Assistant Registrar, UG Examinations, Goa University.
7. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

GOA UNIVERSITY

Programme Structure for Semester I to VIII Under Graduate Programme- Electronics										
Semester	**Major -Core**	**Minor**	**MC**	**AEC**	**SEC**	**I**	**D**	**VAC**	**Total Credits**	**Exit**
I	**ELE-100 Electronic devices and circuits (3L+ 1P)**	**ELE-111 Analog Fundamentals- EDA (3L+1T)**	**ELE-131 Introduction to Electricity (1L+2T)**		**ELE-141 Electronics for Beginners (1L+2P)**				**20**	
II			**ELE-132 Repair and Maintenance of Domestic Electrical appliances (3L)**		**ELE-142 PCB Designing and Fabrication (1L + 2P)**				**20**	**ELE-161 CCTV Installation (1T+3P)**
III	**ELE-200 Basic Circuit Theory and Network Analysis (3L+1P)** **ELE-201 Linear Integrated Circuits (3L+1P)**	**ELE-211 Digital Fundamental- EDA (3L+1P)**	**ELE-231 Computer Troubleshooting and Maintenance (2L+1T)**		**ELE-241 PLC and HMI (1L + 2P)**				**20**	

IV	**ELE-202 8085-Microprocessor (3L+1P)** **ELE-203 Transducers and Instrumentation (3L+1P)** **ELE-204 Electronic Communication (3L+1P)** **ELE-205 Programming in C (1L+1P)**	**ELE-221 Robotics (3L+1P)**							**20**	**ELE-261 Repair and Maintenance of Electrical and Electronics equipment (1T+3P)**
V	**ELE-300 8051-Microcontroller (3L+1P)** **ELE-301 Power Electronics (3L+1P)** **ELE-302**	**ELE-321 Internet of Things and Application (3L+1P)**				**ELE-361 Internship (2I)**			**20**	

	Operating System (3L+1P) **ELE-303 Programming with Python (1L+1P)**									
VI	**ELE-304 Embedded Systems (3L+1P)** **ELE-305 Biomedical Instrumentation (3L+1P)** **ELE-306 Computer Networking and System Administration (3L+1P)** **ELE-307: Project(4)**	**ELE-322 Programming with MATLAB (3L+1P)**							**20**	

VII	**ELE-400 Augmented Reality and Virtual Reality (3L+1P)** **ELE-401 Artificial Intelligence (3L+1P)** **ELE-402 Fundamentals of Signal Processing (3L+1P)** **ELE-403 Optoelectronics (3L+1P)**	**ELE-411 Mobile App development (3L+1P)**							**20**	
VIII	**ELE-404 Remote Sensing in Agro-Electronics (3L+1P)** **ELE-405 Digital Image Processing (3L+1P)**	**ELE-412 Pharmaceutical Instrumentation (3L+1P)**							**20**	

	ELE-406 **VLSI Design** **(3L+1P)** **ELE-407** **Industrial Automation** **(3L+1P)**									

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-100**
Title of the Course : **Electronics Devices and Circuits**
Number of Credits : **04 (3L+1P)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. Introduces basic concepts of various electronic devices. 2. Study and analyse characteristics of various amplifiers. 3. Understand biasing and stability techniques for an amplifier. 4. To understand different types of amplifiers and oscillators.	
Content:	**Module 1 Electronics Devices and Circuits**	
	Junction Diode and its applications Conduction in Semiconductors, P type & N-type Semiconductor, PN junction diode (Ideal and practical)-constructions, Formation of Depletion Layer, Diode Equation and I-V characteristics. Idea of static and dynamic resistance, dc load line analysis, Quiescent (Q) point. Rectifiers- Half wave rectifier, Full wave rectifiers (centre tapped and bridge), circuit diagrams, working and waveforms, ripple factor and efficiency. Filter-Shunt capacitor filter, its role in power supply, output waveform, and working. Regulation- Line and load regulation	**14 Hours**
	Special Purpose Diode: Zener and avalanche breakdown, Zener Diode, V-I Characteristics, Zener diode as voltage regulator: Load and line regulation. Power Diode, Schottky Diode, Varactor Diode, LASER Diode, Tunnel diode, PIN diode	**05 Hours**
	Bipolar Junction Transistor: Bipolar Junction Transistor: Construction and working, Review of the characteristics of transistor in CB, CC and CE configurations, Comparison of the characteristics of CB, CC and CE, Regions of operation (active, cut off and saturation), Current gains alpha(α) ,beta(β) and gamma(Γ). Relations between α , β and Γ . dc load line and Q point, Transistor as switch, Transistor as Amplifier, Darlington Pair, Transistor biasing and Stabilization circuits: Fixed Bias, Emitter Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor S. Power Amplifiers: Class A, Class B, Class AB Push Pull and Class C Amplifier operation.	**12 Hours**
	Cascaded Amplifiers: Two stage RC Coupled Amplifier and its Frequency Response, Direct Coupled Amplifier and its Frequency Response	**02 Hours**
	Feedback in Amplifiers:	**02 Hours**

	Concept of feedback, negative and positive feedback, advantages of negative feedback (Qualitative only).	
	Sinusoidal Oscillators: Barkhausen criterion for sustained oscillations. Phase shift and Colpitt's oscillator. Determination of Frequency and Condition of oscillation.	**04 Hours**
	Unipolar Devices: JFET Construction, working and I-V characteristics (output and transfer), JFET as Amplifier, MOSFET: DE-MOSFET and E-MOSFET, Construction, working and I-V characteristics (output and transfer), UJT Construction, working, equivalent circuit and I-V characteristics, UJT as Relaxation Oscillator.	**06 Hours**
	Module 2 Practical's	**30 Hours**
	Any seven from below: 1. Study of the I-V Characteristics of (a) p-n junction Diode, and (b) Zener diode. 2. Half wave: Ripple factor and load regulation. 3. Full wave: Ripple factor and load regulation. 4. Bridge rectifiers: Ripple factor and load regulation. 5. Zener regulator on the output of FWR. 6. Fixed Bias and Voltage divider bias configuration for CE transistor. 7. class A amplifier, class B amplifier, class C amplifier. 8. RC Phase Shift Oscillator and Colpitt`s oscillator. 9. UJT as relaxation oscillator.	
Pedagogy:	Lectures/Practicals/Assignments/Presentation	
References/ Readings:	1. Floyd Thomas "Electronic Devices", 5th Edition, Pearson Education Publication, 2022 2. Malvino Albert Paul "Electronic Principles", 3rd Edition Tata McGraw-Hill Publication,1994. 3. Mottershead Allan "Electronic Devices & Circuits" EEE Publication,1973.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand a regulated power supply using rectifiers and filters. 2. Learn transistor biasing circuit for class A, B, AB and C amplifier. 3. Analyse a system as per the requirements and specifications. 4. Learn about FET/MOSFET as amplifier.	

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-111**
Title of the Course : **Analog Fundamentals - EDA**
Number of Credits : **04 (3L+1P)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. Provide students with a comprehensive understanding of analog electronics principles, combined with hands-on experience in using EDA software to design. 2. Simulate, and analyse analog circuits.	
Content:	**Module 1 Introduction to Basic Components and Circuit Analysis**	
	Overview of Analog Electronics: Definition and significance, Historical development, Applications in daily life Distinction between analog and digital electronics	**02 Hours**
	Basic Circuit Components: Passive and Active components, Resistors, capacitors, inductors, Characteristics and behaviour in circuits, Units, Values, Colour coding, series and parallel connection of resistors and capacitors	**04 Hours**
	Voltage and Current Sources: Definition and types, Understanding ideal and practical sources	**02 Hours**
	Kirchhoff's Laws: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Application of laws in circuit analysis	**07 Hours**
	Module 2 Basics of Analog Electronics	
	Introduction to Semiconductor Devices: Types of semiconductors, Overview of diodes, transistors, and integrated circuits (ICs)	**02 Hours**
	Diodes and Rectifiers: PN junction diode (symbol, construction, characteristics and working principle), Special purpose diodes (only application) Zener diode, LED, Diode as a rectifier, Half-wave rectifier circuit, Full-wave rectifier circuit(Circuit diagram and working principle)	**05 Hours**
	Bipolar Junction Transistors: Symbol, Types, Qualitative idea on construction, modes of operation, output characteristics, Load line, Transistor as a switch, Operating Point, Amplifier types(Class A, B and C), Amplifier frequency response, Transistor as an amplifier (single-stage CE amplifier)	**06 Hours**
	Integrated Circuits (ICs):	**02 Hours**

	Overview and common applications of ICs (eg. Regulator ICs 78XX, 79XX, LM317, OPAMP LM741, NE555)	
	Module 3 Operational Amplifier, Filters and Oscillators	
	Operational Amplifiers (Op-Amps) Block diagram, symbol, and ideal characteristics, Basic Op-Amp amplifier circuits: inverting and non-inverting amplifiers, voltage follower, adder and subtractor.	**05 Hours**
	Filter Circuits Low-pass and high-pass filters, First-order low-pass and high-pass filters using Op-Amp, Higher-order filters, Band-pass and band-stop filters	**05 Hours**
	Feedback System and Oscillators Concept of feedback, Understanding feedback in oscillators, Conditions for sustained Oscillations, Qualitative idea on oscillators, phase-shift oscillator and Colpitts oscillator (circuit diagram and working principle)	**05 Hours**
	Module 4 Practical's	**30 Hours**
	Discuss and demonstrate the below listed case studies (Use EDA tools) 1. Introduction to EDA and its importance in circuit design 2. Verify the KCL and KVL. 3. Half wave and Full wave rectifiers. 4. The working of a transistor as switch. 5. Transistor working as an amplifier. 6. Analyse the inverting and non-inverting amplifier using an Op-Amp for given gain. 7. First order active low pass and high pass filters for given cut-off frequency.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation/Circuit Simulation using EDA	
References/ Readings:	1. Mottershead Allan "Electronic Devices & Circuits" EEE Publication,1973. 2. Sudhakar A and Palli Shyammohan S "Circuits and Network Analysis and Synthesis",5th edition, Tata Mc Graw Hill,2017. 3. Gayakward Ramakant A. "Op-Amps and Linear Integrated Circuits", Pearson, 4th Ed. 4. V K Mehta, Rohit Mehta, "Principles of Electronics", S. Chand Publishing, 2000. 5. Albert Malvino, David J. Bates, "Electronic Principles", McGraw Hill Education, 2017 6. Website https://labcenter.s3.amazonaws.com/downloads/Tutorials.pdf	
Course Outcomes:	On completion of the course, students will be able to: 1. Define the basic laws in circuit analysis and identify and state the role and functions of various electronic components.	

	2. Understand the working of diode, transistor and apply the same to build dc power supplies and transistor amplifiers. 3. Design filters and Oscillators using Op-Amp. 4. Develop skills in using EDA tools and analyse the performance of Analog circuits using EDA tools.

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-131**
Title of the Course : **Introduction to Electricity**
Number of Credits : **03 (1L+2T)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. Familiarize with various electrical terms and components. 2. Understand working principle of the electrical components, their ratings and uses. 3. Develop necessary skills for house/farm wiring circuit. 4. Develop necessary skills for indoor and outdoor lighting system.	
Content:	**Module 1 Introduction to Electrical Components**	**10 Hours**
	Electrical Devices: Resistors, Capacitors, Inductors, Transformers: Symbols, specifications, working principle and their applications. **Electrical Sources and loads:** Definition of Current, Voltage, Energy, Power, power factor and measurements, Types of AC & DC sources and loads, Series and Parallel connection of sources and loads. **Batteries:** Chargeable and non-chargeable batteries, Battery bank installation and commissioning, Tools required for battery testing. Network laws: Ohms law, Kirchhoff's laws, voltage divider and current divider theorems, open and short circuits	
	Module 2 Introduction to Electricity	**10 Hours**
	Line Voltage: Distribution, Mains supply standards, Meaning of Single phase and three phase supply, conventions followed, Advantages and disadvantages of three phase supply, Star and delta inter-connection of sources and loads. **Importance of earthing and fuse:** Introduction of Earthing, Need of earthing, Hazard, Types of earthing, Advantage of earthing, working of earthing, Importance of fuse, types of fuse, Circuit Breaker and their ratings **House Wiring:** Introduction of Wiring, types of wiring, advantage of wiring, wiring methods, electrical panel, House wiring diagram, 2 and 3-wire systems, selection of proper wire size and voltage drop. Load calculation for residential and commercial purpose. **Lights and Lightning:** Types of lights and their power consumption and luminance, comparison of incandescent, LED and CFL bulbs.	
	Module 3 Energy Consumption and Preventive Maintenance	**10 Hours**

	General safety Precautions: Danger of high voltage and currents, handling and maintenance for all types of electrical and electronic domestic Appliances, Energy consumption, **Switches:** Types and their ratings. Stabilizer and UPS: Types , their working Principles (Block level only), their ratings and applications	
	Module 4 Tutorial	**15 Hours**
	1. Familiarization with various controls and use of CRO, Power Supply, Function Generator and Multi meter, Various Electronics components. 2. Battery fault detection and maintenance. 3. Battery diagnostic and capacity testing. 4. Inverter connection for residential house. 5. Power Calculation of Load. 6. Demonstrate the single and three phase wiring (EDA). 7. Introduction, working, Connection and Energy meter reading:	
Pedagogy:	Lectures/Tutorial	
References/ Readings:	1. Chetan Singh Solanki, "Solar Photovoltaic technology and systems" PHI learning Private ltd. EEE, 2013. 2. Sudhakar and Shyam Mohan, "Electrical analysis and Synthesis", TMH, 2015. 3. Theraja and Theraja, Electrical Technology, Vol 1 by, PHI, 2016 . 4. Satheesh Kumar, 'Electrical wiring, An Introduction' Ane Book Pvt Ltd. 2nd Edition, 2016.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand basics of electrical components. 2. Understand electrical wiring and safety measures. 3. Understand lighting and its applications 4. Apply the knowledge and techniques to design wiring and lightning for housing and commercial setup. 5. Get self-employed in ever growing battery industry	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-141
Title of the Course : Electronics For Beginners
Number of Credits : 03 (1L+2P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. Introduce to students the basic of electronics. 2. Understand how circuit diagrams are drawn and constructed on breadboard. 3. To implement real life application based electronic circuits.	
Content:	**Module 1 Electronics For Beginners**	
	Basics of Electronics: Electricity, Measuring Charge and Current ,AC vs. DC, Current Flow, Voltage and Resistance, Picturing Voltage, Volts Are Relative, Relative Voltages and Ground Potential ,Resistance .	**02 Hours**
	Building circuit Schematics: Circuit Requirements, Basic Components(resistor , inductor, capacitor), Creating Your First Circuit, Adding Wires, Drawing Circuits, Drawing the Ground.	**03 Hours**
	Constructing and Testing Circuits: The Solder-less Breadboard, Putting a Circuit onto a Breadboard, Using Fewer Wires, Testing Circuits with a Multi-meter, Using a Multi-meter with a Breadboard ,Measuring Current with a Multi-meter, Use of Function Generator and Oscilloscope to observe signals.	**05 Hours**
	Sensors and actuators: Working Principles of Diode, Transistor, LED, Buzzer, Switches, Sensors (PIR, Piezo-electric sensor etc.) and Actuators (Motors, Speaker etc).	**02 Hours**
	Applications (Circuit diagram and working): Simple touch sensor using transistor, Intruder Alarm, Water tank level indicator, LED chaser circuit, Rain detector, Light intensity measurement using LDR, LED flip flop, Smoke detector, Clap Switch, Door knock sensing doorbell, Motion detection using PIR sensors.	**03 Hours**
	Module 2 Practical's	**60 Hours**
	Any eight from below: 1. Simple touch sensor using transistor 2. Intruder Alarm 3. Water tank level indicator 4. LED chaser circuit 5. Rain detector 8. Light intensity measurement using LDR 9. LED flip flop	

	10. Smoke detector 11. Clap Switch 12. Door knock sensing doorbell. 13. Motion detection using PIR sensor.	
Pedagogy:	Lectures/Experiential/Practical's Learning	
References/ Readings:	1. Bartlett Jonathan, 'Electronics For Beginners A Practical Introduction To Schematics, Circuits, And Microcontrollers' Apress , 2020. 2. Boysen Earl, Muir Nancy C," Electronics Projects For Dummies" Wiley,2006.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the basics of Electronics. 2. Learn to draw schematics and also the implement the circuit on breadboards. 3. Implement electronics circuits of practical use. 4. Modify the implemented electronics circuits for some applications.	

Semester II
Name of the Programme : B.Sc. Electronics
Course Code : ELE-132
Title of the Course : Repair and Maintenance of Domestic Electrical Appliances
Number of Credits : 03 (3L)
Effective from AY : 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. Develop understanding of domestic wiring and key elements of electrical appliances with basic safety practices. 2. Impart knowledge to analyse and repair electrical appliances. 3. Develop practice of maintenance of electrical equipment's. 4. Students will be demonstrated the various equipment's working while delivery of lectures.	
Content:	**Module 1 Repair and Maintenance of Domestic Electrical Appliances**	
	Introduction to Electricity: Line Voltage: Distribution, Mains supply standards, Meaning of Single phase and three phase supply, conventions followed. Importance Of Earthing and Fuse: Introduction of Earthing, need ofearthing, Hazard, Types of earthing, Advantage of earthing, working of earthing, Importance of fuse, types of fuses. House Wiring: Introduction of Wiring, types of wiring, advantage of wiring, wiring methods, electrical panel, House wiring diagram.	**10 Hours**
	Energy Consumption and Preventive Maintenance: General Precautions, handling and maintenance for all types of electrical and electronic domestic Appliances, Energy consumption. Energy Meter: Introduction, working, Connection and Energymeter reading, Power Calculation of Load, Electricity Billcalculation.	**07 Hours**
	Heating Appliances: Introduction, working principle, construction, operation, Installation, Maintenance and Repair (fault-finding and removal of faulty component): Electrical iron, Electric stove, Electric Toaster, Immersion heater, Electric geyser, Electric Oven, Induction Cooktop, Electric Roti Maker, Electric Kettle.	**07 Hours**
	Motorized Appliances: Introduction, working principle, construction, operation, Installation, Maintenance and Repair (fault-finding and removal of faulty component): Electric fan (Ceiling Fan and Table Fan), Electric Mixer grinder, Electric washing machine, Hairdryer, Vacuum cleaner.	**07 Hours**
	Electrical and Electronic Appliances:	**07 Hours**

	Introduction, working principle, construction, operation, Installation, Maintenance and Repair (fault-finding and removal of faulty component): Electric gas lighter, Electric bell and buzzer,Emergency light, Voltage Stabilizer (Relay based), Linear Regulated Power Supply, Battery Charger, Solar Voltaic cell, Tube light.	
	Visual Electronic Appliances: Introduction, block diagram, working principal and different sections of: Public Address System, CD/DVD player, LCD/LED Television.	**07 Hours**
Pedagogy:	Lectures/Experiential Learning	
References/ Readings:	1. Sotcher Fred "The Repair & Maintenance of Electrical Equipment: A Complete Guide to Troubleshooting Portable Electric Tools and Generators", Miramar Publishing Company, 1980. 2. Khandpur R.S." Troubleshooting Electronic Equipment: Includes Repair and Maintenance" Second Edition, McGraw-Hill Education, 2006.	
Course Outcomes:	On completion of the course, students will be able to: 1. Acquire the basic knowledge of electricity and domestic wiring. 2. Understand the working of basic electrical appliances and their safety precautions. 3. Able to do repair and maintenance of the basic electrical appliances. 4. Able to do repair and maintenance of the motorized and heating type electrical appliances.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-142
Title of the Course : PCB Designing and Fabrication
Number of Credits : 03 (1L+2P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. Understand the need for PCB Design and steps involved in PCB Design and Fabrication process. 2. Familiarize Schematic and layout design flow using Electronic Design Automation (EDA)Tools. 3. Develop necessary skills for designing single sided and double-sided PCBs 4. using Electronic Design Automation (EDA) Tools.	
Content:	**Module 1 PCB Designing and Fabrication**	
	Introduction to PCB designing concepts: Introduction & Brief History: Background and History of PCB, Definition and Need/Relevance of PCB, Classification of PCBs: Single-sided PCBs, Double-sided PCBs, Multi-layer PCBs, Rigid and Flexible PCBs. Platted through holes technology and Surface mounttechnology, Terminology in PCB Design, Basic Electronic Components: Active vs Passive components and their symbols, Resistors, Capacitor, Inductors, Potentiometers, Diodes, Transistors, and Integrated Circuits.	**03 Hours**
	Layout and Artwork: PCB Design Process Layout Planning: Steps involved in layout design, General rules of Layout, Supply and Ground Conductors, Component Placing and Mounting, Cooling requirement, General design factor for digital and analog circuits. Artwork generation: Basic artwork approaches (manual and CAD), General Design guidelines for Artwork Preparation-Conductor orientation, Conductor routing, conductor spacing, Hole diameter and solder pad diameter, The square land pad, no conductor zones, pad conductor holes, conductor and solder joint pads.	**03 Hours**
	Laminates and Printed Circuit Board Production Techniques: Types of Laminates, Properties of laminates, Photo printing, film- master production, reprographic camera, Basic process for single and double sided PCBs, Photo resists, Screen-printing process.	**02 Hours**
	PCB Fabrication & Assembly: Steps involved in fabrication of PCB. PCB Fabrication techniques-single, double sided and	**02 Hours**

	multilayer Etching: Introduction to PCB etching process, Dry Etching and WetEtching, etching machine Post operations- stripping, black oxide coating and solder masking PCB component assembly processes: Solder connection, Solderjoints, Solder alloys, soldering fluxes, Soldering & Desolderingtools.	
	Transmission lines and crosstalk: Transmission Line: Transmission lines and its effects, Significance of Transmission line in Board design, Types of Transmission lines. Crosstalk: The crosstalk in transmission lines, Crosstalk control in PCB design parts, planes, tracks, connectors, terminations, Minimization of crosstalk. Thermal issues: Thermal mapping of design.	**02 Hours**
	Module 2 Practical's	**60 Hours**
	ny eight from below: Different Electronic design automation (EDA) tools and comparison. (Proteus, OrCAD, Eagle, Kikad, etc), Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Netlist generation, PCB Layout Designing, Auto routing and manual routing, assigning specific text (silkscreen) to design, Generating (GERBER file) for design. Part-A: Creating Artwork and Printing of single sided PCB for the following circuits (any 4) 1. Regulator circuit using 7805/LM317 2. Adder circuit using op-amp IC 741 3. Bridge Rectifier 4. LED flasher using IC555 5. Twilight Switch 6. Touch plate switches – transistorized or 555 based 7. Clapping switch and IR switch 8. Cell charger/battery charger/mobile charger 9. Fire/smoke/intruder alarm 10. Water level controller 11. Displaying decimal number on 7-segment display using BCD to 7- segment decoder IC 12. Audio amplifier using op-amp IC 741 Part-B: Etching and drilling of single sided PCB (Compulsory) 13. Etching of single-side PCB for any one of the circuits mentioned in Part-A Part-C: Fabricate single-sided PCB (Compulsory)	

	14. Fabricate and test single-side PCB for any one of the circuits mentioned in Part-A by mounting and soldering components.	
Pedagogy:	Lectures/Practicals/Assignments/Presentation	
References/ Readings:	1. Khandpur R.S. "Printed Circuit Board Design, Fabrication Assembly and testing", TMH, 2006 2. Bosshart Walter C. "Printed circuit Board Design and technology," TMH, 1983 3. Clyde F. Coombs, Jr, Happy T. Holden "Printed Circuits Handbook", 6th edition, TMH Education, 2016. 4. Kwashnak Kenneth "A Basic Introduction for Designing a Printed Circuit Board (PCB) with EAGLE eCAD/CAM Software " SURVICE Engineering 4695 Millennium Drive Belcamp, 2020.	
Course Outcomes:	On completion of the course, students will be able to: 1. Explain and describe the steps involved in schematic, layout, fabrication, and assembly process of PCB design. 2. Able to design a single- and double-layer PCB 3. Able to fabricate the single land double layer PCB. 4. Able to design and troubleshoot the circuit over PCB. 5. Able to design his own circuit for any application.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-161
Title of the Course : CCTV Installation
Number of Credits : 04 (1T+3P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. Develop understanding of basics of Networks& CCTV Technology. 2. Acquire knowledge of CCTV Camera Installation. 3. Develop skills to perform trouble shooting and maintenance CCTV systems.	
Content:	**Module 1 (Theory) CCTV Introduction**	
	Introduction to CCTV Technology: Introducing CCTV & Uses -Elements of a basic CCTV system: - Camera, monitor and digital recorder, Connectors and cables, Basics of Networking -Tools and Equipment, Power Supply- Types (UPS and DCPS), Functionality and Termination.	**04 Hours**
	Types of CCTV Cameras: Dome Camera - Bullet Type Camera - C-Mount Camera - Day/Night Camera - Infrared/Night Vision CCTV Camera - Varifocal Cameras - Wireless Cameras, PTZ and Bullet, indoor and outdoor, monochrome, Camera specifications: - Sensitivity, signal to noise ratio and resolution.	**04 Hours**
	Cables and Connectors: Types (Fibre & Copper), uses, limitations, preparation and testing, Types of Connectors, Cable Conduit, Cable Tray, Industrial Standard, laying Method,	**02 Hours**
	Networking: Introduction to IP technology. Network Devices- Switches (configuration & installation), Routers (configuration & installation), OLT and ONT, Configuration andTermination: Server- Installation, Configuration (software), Network configuration (Normal & High security).	**03 Hours**
	Wireless Communication: Types of Antennas, Radios, Configuration, Limitations.	**02 Hours**
	Module 2 (Practical's) CCTV Installation	
	Installation of CCTV: Planning for CCTV Camera Installation - Installing the Camera - Checking the Camera Functions, Connection to other security systems, Cable Termination method, Hard disk installation, Microphone configuration.	**30 Hours**
	Maintenance of CCTV & Data Management: Trouble Shooting and maintenance: Hardware, Managing Data: Data Storage Devices - Cloud Storage Technology, Recording the footage: - Analogue and Digital video	**15 Hours**

	recorders. Backup and Archiving. Video Management Software- Adding and Deleting camera, recording mode, Fail Over, Logs, report, Monitoring, Client. Password Recovery.	
	Live Stream of Video on Mobile Device: The Benefits of Remote Viewing - Connecting Your Recorder - Enabling Remote Viewing - Installing Viewing Software -Connecting to Your Smartphone - Using Web Services - Potential Risks.	**30 Hours**
	Evidence Creation: Role of CCTV footage - Importance of CCTV footage - Retrieve CCTV footage – Authentication- Analyze CCTV footage	**15 Hours**
Pedagogy:	Lectures/Experiential Learning	
References/ Readings:	1. Hill Thomas," CCTV Handbook: Buying, Installing, Configuring, & Troubleshooting A User's Guide to CCTV Security ",kindle edition,2019. 2. AISECT Content Group Participant's Guide for CCTV Installation Technician ", 3. kindle edition,2018.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand basics of Network & CCTV Technology. 2. Install CCTV System 3. Maintain of CCTV systems. 4. Note: Student can take some installation under guidance of lecture/ entrepreneur.	

Semester III
Name of the Programme : B.Sc. Electronics
Course Code : ELE-200
Title of the Course : Basic Circuit Theory and Network Analysis
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Basic knowledge of Ohm's law and electrical networks	
Course Objectives:	This course is intended to: 1. Develop understanding about fundamental concepts of electrical circuits. 2. Provide necessary tools and techniques to understand Laplace transforms and its analysis. 3. Discusses the transient and DC response of RLC circuit also different types of two-port parameters (z, y, h,)	
Content:	**Module 1 Circuit analysis**	
	Circuit Elements and Kirchoff's Laws: Concept of Voltage and Current Sources. Kirchhoff's Current Law, Kirchhoff's Voltage Law.	**04 Hours**
	Methods of Analysing Circuits: Mesh analysis, Mesh equation by inspection method, Supermesh analysis, Nodal Analysis, Nodal equation by inspection method, Supernode Analysis, Star and Delta networks, Star-Delta Conversion and Delta-star Conversion.	**06 Hours**
	Theorems in Circuit Analysis: Thevenin's Theorem, Norton's Theorem, Superposition Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Duals and Duality.	**05 Hours**
	Module 2 Laplace transform and stability criteria	
	Introduction to Laplace Transform: Definition of Laplace Transform, Step Function, Impulse Function, Functional Transforms; Unit Step function, Exponential function, Cosine function, Sine function. Inverse Laplace transform; Partial Fraction Expansion- Proper Rational Functions (When roots are real and distinct, when roots are real and Repeated). Initial and final value theorem and its application.	**08 Hours**
	S-Domain Analysis: Network function for one-port and two-port, Poles and Zeros of Network functions, Significance of Poles and Zeros, Properties of driving point functions and transform functions, Stability Criteria for an Active Network, Routh-Hurwitz criterion and its application.	**07 Hours**
	Module 3 Two port networks	
	Transients: Steady State and Transient Response, DC Response of an RL, RC, and RLC networks.	**08 Hours**

	Two-Port Networks: Two port parameters, short circuit admittance parameter, open circuit impedance parameters, Transmission parameters (ABCD), Hybrid parameters, Interconnection of Two-Port Networks, T- and π- Representations.	**07 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Verification of Thevenin's theorem 2. Verification of Norton's theorem. 3. Verification of Superposition Theorem 4. Verification of Reciprocity Theorem. 5. Verification of the Maximum Power Transfer Theorem. 6. Verification of the Star to Delta conversion /Delta to Star conversion. 7. DC Response of RC networks. 8. DC Response of RLC networks. 9. Conversion of the T to π /π to T.	
Pedagogy:	Lectures/Practicals/Assignments/Presentation	
References/ Readings:	1. Sudhakar, A. Shyammohan, "Circuits and Network", Third Edition,Tata McGraw Hill, 2006. 2. B.L. Theraja and A.K Theraja "A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering)", S. Chand Publishing, 2005 3. S. K. Bhattacharya, "Network Analysis and Synthesis", published by Pearson India Education Services, 2015. 4. Late Ajay V. Bakshi, Uday A. Bakshi, "Network Analysis & Synthesis", published by UNICORN Publishing Group, 2020. 5. Joel L. Schiff "The Laplace Transform: Theory and Applications", published by Springer New York, 2013.	
Course Outcomes:	On completion of the course, students will be able to: 1. Explain classification of electrical network circuits and theorems 2. Understand the Laplace transforms and s-domain analysis 3. Learn the transient response, dc response of RLC networks and different two-port networks 4. Apply the knowledge of basic circuit law to simplify the networks using network theorems.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-201
Title of the Course : Linear Integrated Circuits
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have the basic knowledge of Analog Electronic Circuits and devices.	
Course Objectives:	This course is intended to: • Introduce the basic concept of linear integrated circuits. • Study the characteristics and the applications of the operational amplifiers • Develop understanding about the few specialised integrated circuits.	
Content:	**Module 1 Introduction to Integrated circuits.**	
	IC Fabrication: Types of IC's, steps involved in monolithic IC's, Fabrication of Transistor, diode, resistor and capacitor using monolithic techniques, SSI, MSI, LSI, VLSI IC's	**05 Hours**
	Operational Amplifier: Introduction of Op-Amp, Characteristics of an Ideal and Practical Op-Amp, Block diagram, circuit symbol and terminals. Equivalent circuit of Op-Amp,	**03 Hours**
	OPAMP parameters: Input offset voltage, differential input resistance, offset voltage, CMRR and CMR, Slew rate, virtual ground, Open and closed loop configuration, Gain, Bandwidth, Inverting and non-inverting amplifiers, Differential amplifier, Unity gain amplifier, Comparator and Zero-crossing detector	**05 Hours**
	Arithmetic Operations using OPAMP: Addition, Integrator, Differentiator.	**02 Hours**
	Module 2 Applications of Op-Amps:	
	Comparative study of OPAMP: Operational amplifiers like 741, OP07, LM324, LF356, LM358 etc. based on their characteristics.	**02 Hours**
	Filter circuits using OPAMP: Characteristic terms and classifications, order of filter, cut off frequency, Bandwidth, Q factor, Active low pass and high pass Butterworth filter (1st order only).	**07 Hours**
	Oscillators using OPAMP: Phase shift Oscillator, Wein bridge oscillator, square wave generator, triangular wave generator and sawtooth wave generator.	**06 Hours**
	Module 3 Specialised IC Applications	
	OPAMP Basic Circuits: Voltage to Current converter, voltage limiter, small signal half wave rectifier, Sample and Hold circuit, phase detector,	**05 Hours**

	Active peak detector, logarithmic and antilogarithmic amplifier using diodes.	
	OPAMP as an Instrumentation amplifier: working and application	**02 Hours**
	555 Timer: Block diagram, Pin diagram and working principle, Astable, Monostable, Bistable, multivibrator, Schmitt trigger and voltage control oscillator, PLL: 5	**05 Hours**
	Regulated IC: 78XX & 79XX series, IC723, LM317, Line regulation, Load regulation, Crowbar protection	**03 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. To design an inverting amplifier using Op-amp (741, 351) for dc voltage of given gain 2. To design inverting/ non-inverting amplifier using Op-amp (741,351) & study its frequency response. 3. To add two dc voltages using Op-amp in inverting and non-inverting mode. 4. To study the zero-crossing detector and comparator using Op-amp. 5. To investigate the use of an op-amp as an Integrator and Differentiator. 6. To design and test Instrumentation amplifier using IC LM324. 7. To design a Wien bridge oscillator for given frequency using an op-amp. 8. To design an Astable / Monostable Multivibrator of given specification using IC 555. 9. To study the operation of Voltage regulator using IC 723.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. R. A. Gayakwad, OP-Amps and Linear Integrated Circuit, 4th Edition, Prentice Hall, 2000 2. D. Roy Choudhury, Linear Integrated Circuits, 4th Edition, New Age, International Publication, 2017 3. Operational Amplifiers and Linear ICs, David A. Bell, 5th Edition, Oxford University Press, 2011.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the applications of Op-Amp in linear electronic circuits. 2. Analyse the various configurations of Op-Amp 3. Learn the filters and oscillators used in various electronic circuits 4. Learn to troubleshoot specified applications using various linear ICs	

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-211**
Title of the Course : **Digital Fundamentals - EDA**
Number of Credits : **04 (3L+1P)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Should have the basic knowledge of Semiconductors	
Course Objectives:	This course is intended to: 1. To develop understanding about digital electronic circuits, the logic gates and logic families. 2. To provide with necessary tools and techniques to analyse various digital circuit and their applications 3. Also discuss different types of sequential circuits, digital and analog converters. 4. Construct and simulate various digital circuits using EDA tools.	
Content:	**Module 1 Fundamentals of Digital Electronics**	
	Number systems: Decimal, Binary, Octal and Hexadecimal number systems and arithmetic addition, base conversions, signed and unsigned numbers, BCD code, gray code, subtraction by 2's complement method.	**06 Hours**
	Logic Gates and Boolean algebra: Truth Tables of OR, AND, NOT, NOR, NAND, XOR, XNOR, Universal Gates, Basic postulates and fundamental theorems of Boolean algebra.	**04 Hours**
	Digital Logic Families: Characteristics of Digital ICs, Brief introduction to RTL & DTL, Transistor- Transistor Logic (TTL), Emitter- Coupled Logic (ECL), (MOS & CMOS Logic)	**05 Hours**
	Module 2 Combinational Logic and Circuits	
	Combinational Logic Analysis and Design: Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh map minimization up to 4 variables for SOP & POS), Don't Care-Conditions.	**04 Hours**
	Arithmetic Circuits: Binary Addition, Half and Full Adder, Half and Full Subtractor	**03 Hours**
	Data processing circuits: Multiplexers, De-multiplexers, Encoders, Decoders.	**03 Hours**
	Flip-Flops: SR, JK Flip-Flops and D FF, T-FF. Clocked (Level and Edge Triggered), Preset and Clear operations. Race-around conditions in JK Flip-Flop., Master-slave JK Flip-Flop.	**05 Hours**
	Module 3 Sequential Circuits and Converters	
	Sequential Circuits: Shift Registers, Ring Counter, Twisted Ring Counter, Asynchronous counters, Synchronous Counters, Decade Counter.	**07 Hours**

	A/D and D/A converters Binary weighted and R-2R D-A converters, circuit and working. Accuracy and Resolution. A-D conversion characteristics, Types of ADC & its working: Flash, Ramp, Dual Slope, Successive approximation ADC.	**08 Hours**
	Module 4 Practical's	**30 Hours**
	Discuss and demonstrate the below listed case studies (Use EDA tools) 1. Introduction to EDA and its importance in circuit design (a) To design a combinational logic system for a specified Truth Table. (b) To convert Boolean expression into logic circuit & design it using logic gate ICs. (c) To minimize a given logic circuit. 2. Full Adder and Full Subtractor. 3. To build a 3:8 encoder using logic gates. 4. To build Multiplexer (1-to-4) and Demultiplexer (4-to-1) using logic gates. 5. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates. 6. To build a decade Counter using Flip-Flop ICs.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation/Circuit Simulation using EDA	
References/ Readings:	1. R P Jain, 'Morden Digital Electronics', Tata McGraw Hill, 4th Edition. 2. Allen Mottershead, 'Electronic devices and circuits -An Introduction' 3. A.P. Malvino, D.P.Leach and Saha, 'Digital Principles and Applications', Tata McGraw 7th Ed., 2011 4. Anand Kumar, 'Fundamentals of Digital Circuits', PHI Learning Pvt. Ltd. 2nd Ed. , 2009 5. Venugopal, 'Digital Circuits and systems', Tata McGraw Hill. , 2011 6. R.J.Tocci, N.S.Widmer, 'Digital Systems: Principles & Applications', PHI Learning, 2001. 7. Thomas L. Flyod, 'Digital Fundamentals', Pearson Education Asia (1994) 8. **Website -** https://labcenter.s3.amazonaws.com/downloads/Tutorials.pdf	
Course Outcomes:	On completion of the course, students will be able to: 1. Explain classification of digital electronic circuits, the logic gates and logic families. 2. Understand Boolean algebra and apply to design, analyse and build various digital circuits 3. Learn to Build the sequential circuits and understand the analog and digital converters 4. Develop skills in using EDA tools and analyse the performance of digital circuits using EDA tools.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-231
Title of the Course : Computer troubleshooting and Maintenance
Number of Credits : 03 (2L+1T)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have the basic knowledge of basic computer hardware components	
Course Objectives:	1. To Understand the functioning of hardware parts and Operating Systems. 2. To Increase knowledge about How Computers work. 3. To Develop skills in diagnosing the faults. 4. To Troubleshoot the computer system.	
Content:	**Module 1 Computer Hardware, Software & Motherboard**	**15 Hours**
	Hardware & Software Basics Fundamental components of a computer, Factors that affect computer performance, inside a computer hardware, Types of computers and their applications, Storage technologies, what is a software, Programming languages, Types of software, Software development process, open-source software. **Introduction to Motherboard:** Functions of various Components and connections on the motherboard, Types of motherboards, Types of processors and their specifications, Types of primary memories and their functions, Types of ports and applications, Types of connectors for peripheral interfacing, types of buses and their specifications, SMPS: Block diagram and pin assignments, types of UPS and their importance, SSD: functions, types, Applications.	
	Module 2 Peripheral Devices, Troubleshooting and Preventive Maintenance	**15 Hours**
	Introduction to Peripheral Devices: Disk structure: Cylinders, Heads, Platters, Tracks and sectors, Structure of a disk, Hard disk controllers, Types of interface controller and drives, Hard disk software installation: Physical formatting, partitioning, High level formatting, Hard disk installation Keyboard: Keyboard and Mouse operation, Key switches Common faults and diagnostics, Scanner: Working Principle, Types, Fault finding, Monitors: Display basics, Display adapter cards, VGA and super VGA, Failure, Troubleshooting and Elimination, Printer: Types, Interface, Parts, Working Principle, Connection to Computers, Types of switches, wireless and wired media connection. **Troubleshooting and Preventive Maintenance:** Troubleshooting basics , Troubleshooting by visual Inspection, Preventative Maintenance , Using Preventative	

	Maintenance Tools, POST: Functions , Test Sequence , Error messages, Troubleshooting Procedures and Preventative Maintenance:, Identifying Troubleshooting Tools, Hardware tools , Diagnostic software , Materials and equipment , Software utilities , Maintaining Environmental Controls , Ventilation and airflow, Humidity and liquids, Dirt and dust , Power, UPS, and suppressors , Completing Maintenance Tasks , Case and components , Power supplies	
	Module 3 Tutorials	**15 Hours**
	1. Identification of Components of a computer and Motherboard configuration 2. Assemble and Disassemble, BIOS/CMOS setup, Boot process diagnosis and process 3. Hard disk drive partition and format using disk manager. 4. Study of Cables (Coaxial, twisted pair, fibre optics), switch, router and connectors. 5. Setup and installation of Operating systems. 6. Setup and installation of Dual Operating systems. 7. Troubleshooting general system problems (hardware & software) and maintenance. (**Refer to Module 2**)	
Pedagogy:	Lectures/Tutorial	
References/ Readings:	1. Pelin Aksoy, Laura Denardis, Information Technology in theory, 1st Edition, Cengage learning, 2008 2. Behrouz A. Forouzan, Data communications and networking, 4th Edition, McGraw Hill Education, 2017 3. ITL Education Solutions Limited, Introduction to Information Technology, 2nd Edition, Dorling Kindersley Pvt.Ltd, 2011. 4. Satish Jain, Shashank Jain, Dr. Madhulika Jain, 0"- level made simple: IT tools and applications,1st edition, BPB publications, 2003. 5. Anita Goel, Computer fundamentals ,1st Edition, Dorling Kindersley Pvt.Ltd, 2010 6. B. Govindarajalu, IBM PC & Clones: Hardware Troubleshooting and Maintenance, Tata, 2nd Edition, McGraw Hill, 2002.	
Course Outcomes:	On completion of the course, students will be able to: 1. Acquire knowledge of Finding Faults in Components 2. Install, Configure and maintain various components in computer systems and peripherals. 3. Diagnose faults of Different Component 4. Repair and maintain computer systems and its peripherals.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-241
Title of the Course : PLC and HMI
Number of Credits : 03 (1L+2P)
Effective from AY : 2023-24

Pre-requisites for the Course:	**Nil**	
Course Objectives:	This course is intended to: 1. Understand Industrial Automation and its applications 2. Design and develop ladder logic programming for PLC 3. Understand the working principle of HMI, DCS and SCADA system	
Content:	**Module 1**	
	Automation: Introduction, Advantages and disadvantages of automation, Reliability and precision, Automation tools, Applications of Automation.	**02 Hours**
	Programmable logic Controller: Automation and its need, PLC basics, Industrial Automation, What is a PLC? Logics in the Physical world, Input and output contact program symbols, Switches: ON/OFF and Push Button, Numbering system of inputs and outputs, PLC Input Output Modules: Introduction, Input field devices, Output field devices, Classification of I/O modules, I/O system overview.	**04 Hours**
	PLC Timers and Counters: Definition and Classification of a Timer, Characteristics of a Timer, Functions in a Timer, Classification of a PLC Timer, Format of Timer Instructions, PLC Counter, Operation of a PLC counter, Counter Parameters, Counter Instructions.	**02 Hours**
	Human Machine Interface (HMI): Definition and applications of HMI, Basic concept of SCADA and DCS and their comparison.	**02 Hours**
	Ladder logic Programming: Program Format, Addressing data files, Format of logical address, Introduction to Logic, ladder design, Few industrial examples using logical gates, Simple automated systems using Timers, Counters, Arithmetic and Number comparison functions, Selecting a PLC, Applications of PLC.	**05 Hours**
	Module 2 Practical's	**60 Hours**
	Any eight from below: 1. PLC ladder Program for logic functions: AND, OR, NAND, NOR and XOR. 2. PLC ladder Program to prove De Morgan's theorem. 3. PLC ladder program to interface multiple inputs and multiple outputs 4. PLC ladder Program to apply timer function to process control.	

	5. PLC ladder Program to apply counter function to process control. 6. PLC based application program for automatic indication for water tank level. 7. PLC based application program for traffic light indication. 8. PLC based application program for controlling Robotic arms. 9. PLC based application program for interfacing digital input and output devices 10. PLC based application program for interfacing analog input and output devices 11. PLC based application program using HMI 12. PLC based application program using VFD	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Programmable Logic Controllers and Industrial automation by Madhuchhanda Mitra and Samarpit Sengupta, Penram Int. Pub. 2nd edition. 2. PLC and SCADA by Jitender Singh and Monika Deswal, University Science Press. 3. John W. Web, Ronald A. Reis, "Programmable Logic Controllers" 5th Edition, PHI 4. PLCs & SCADA Theory and Practice by Prof. Rajesh Mehra and Er. Vikrant Vij , University Science Press.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand working principle PLC, HMI. 2. Understand working principle DCS and SCADA. 3. Develop necessary skill to implement consumer and industrial based applications using PLC. 4. Develop PLC based applications for various appliances and devices.	

Semester IV
Name of the Programme : B.Sc. Electronics
Course Code : ELE-202
Title of the Course : 8085 Microprocessor
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	**Nil**	
Course Objectives:	This course is intended to: 1. Study the internal architecture of 8085 microprocessor and the functional block diagram of a microcomputer. 2. Study assembly language programming and memory and I/O interfacing to microprocessor 3. Study hardware interrupts and working of various general purpose programmable devices.	
Content:	**Module 1 Organization microprocessor**	
	Architecture: Organization of a microprocessor-based system, Microprocessor architecture and its operations, Pin layout of 8085 MPU - and the function of each pin, Demultiplexing of the bus, Generating control signals, 8085 MPU Internal Architecture, Timing diagram for MOV and MVI instructions, Block diagram of single board Microcomputer system and its description.	**10 hours**
	Memory and basic Interfacing concept: Memory map and addresses, Memory Classification, Recent advances in memory technology, Basic concept in memory interfacing, Interfacing I/P and O/P devices using decoders, Comparison of Memory-Mapped I/O and Peripheral I/O.	**05 Hours**
	Module 2 8085 instruction set and programming	
	Assembly Programming: Instruction classification, Instruction format, Addressing modes, Overview of the 8085 Instruction Set, Programming techniques: Looping, Counting and Indexing, Simple programs based on Data transfer, Arithmetic operations, Counters and Time Delays.	**10 Hours**
	Stack and Subroutine: PUSH, POP, CALL and RET instruction, Illustration of use of Stack and Subroutine using simple programs.	**05 Hours**
	Module 3 Interrupts and peripheral devices	
	Basic of 8085 Interrupts: 8085 Interrupt: INTR, RST instructions, 8085 Vectored Interrupts: RST 5.5, RST 6.5, RST 7.5 & TRAP, their Priorities and implementation, Importance of SIM and RIM instruction. DMA transfer- HOLD and HLDA	**07 Hours**
	General purpose programmable peripheral devices:	**08 Hours**

	8255 Programmable Peripheral Interface: Block diagram, Control Logic, Control word, Programming 8255 in Mode 0 and BSR mode only, 8254 (8253) Programmable Interval Timer: Block diagram, Control Logic, Control Word, Modes, Programming 8254 in Mode 0 and Mode 3 only, 8251 Programmable UART Controller: Block Diagram, 8279 Programmable Keyboard/Display Controller: Block diagram.	
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Addition of 16 bit numbers (using ADC instruction and DAD instruction) 2. Subtraction of 8 bit numbers (Using SUB instruction and by two's complement). 3. Block transfer of data (forward and reverse order) . 4. Multiplication of two one-byte using repetitive addition. 5. Division of 2 sixteen-bit numbers. 6. Multi-byte BCD addition. 7. Program to sort out numbers (Ascending & Descending). 8. Program to count 10 numbers using 1 second time delay. 9. Programming 8255 for Stepper Motor Controller in Mode 0. 10. Programming 8255 for waveform generation in Mode 0. 11. Programming 8254 in Mode 0 and Mode 3.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Ramesh Gaonkar, Microprocessor Architecture, Programming And Applications With The 8085, 6th Edition, Penram Publications. 2. Tawade & Borole, Microprocessor Architecture, Programming and Applications,4th Edition, Technova Pub. 3. Douglas V Hall,Microprocessors and Interfacing-SIE,3rd Edition, Tata McGraw Hill Education Private Limited, 2005	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the basics of Microprocessor Architecture. 2. Analyze addressing modes, Instruction categories, memory mapping. 3. Develop assembly programs using Microprocessor. 4. Build a microprocessor system to interface devices	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-203
Title of the Course : Transducers And Instrumentation
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have the basic knowledge of Electronic fundamentals	
Course Objectives:	This course is intended to: 1. Understand the Performance characteristics and compare the various types of standards used in measurements. 2. Understand the working principle of various types of transducers. 3. Understand the working principle of instruments used in electrical and electronics laboratory.	
Content:	**Module 1 Qualities Of Measurements, Signal Conditioning and Bridges**	
	Qualities Of Measurements: Introduction, Performance Characteristics, Static characteristics, Error in measurement, Types of Error, Sources of Error, Dynamic characteristics, Statistical analysis, Standard, Atomic frequency and time standards.	**06 Hours**
	Signal Conditioning: Introduction, Basic Instrumentation amplifier: Instrumentation amplifier, Instrumentation system, Instrumentation amplifier using Transducer Bridge. Types of Active filters: Butterworth, Chebyshev, Bessel and Elliptic.	**04 Hours**
	Bridges: DC Bridges and applications: Wheatstone, Kelvin, And AC Bridges: General form of AC bridge balance, comparison bridges, Maxwell, Hay, Schering, Wien, LCR Bridge.	**05 Hours**
	Module 2 Transducers	
	Transducers:	**05 Hours**
	Electrical transducer: Characteristics, advantages, Selecting a Transducer	**02 Hours**
	Resistive Transducer: Potentiometer, Resistance pressure transducer, Resistive Position Transducer, Resistance thermometer. Strain Gauges: Resistance wire Gauge (Unbounded and Bonded), Foil strain Gauge, semiconductor strain Gauge.	**02 Hours**
	Inductive transducer: Change in self-inductance with number of turns and with change in permeability, Variable reluctance type transducer, Differential output Transducer, LVDT, Pressure inductive transducer. Capacitive Transducer (pressure), Load cell (Pressure Cell), Piezo Electric Transducer	**05 Hours**
	Photoelectric transducer:	**02 Hours**

	Photomultiplier tube, Photocells, Photo-Voltaic cell, Semiconductor Photodiode, Phototransistor.	
	Temperature Transducer: Thermocouple, Thermistor, Magnetic flow meters.	**02Hours**
	Module 3 Oscilloscope and Digital Instruments	
	Oscilloscope: Basic principle, Block diagram of oscilloscope, Types of CRO: Principles of Dual beam and Dual Trace Oscilloscope, Analog storage Oscilloscope, DSO.	**07Hours**
	Digital Instruments: Digital Voltmeters: Ramp type DVM, Dual Slope integrating type DVM, Staircase Ramp Type, Successive Approximation DVM, 31/2 Digit, Resolution & Sensitivity of Digital Meters, Digital Multimeter, Digital Frequency meter.	**08Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Instrumentation amplifiers. 2. Temperature control using a thermistor. 3. LVDT displacement sensor. 4. Ultrasonic sensor for ranging. 5. Characteristics of a Phototransistor. 6. Characteristics of Photocell and its application. 7. Interfacing of solar panel for lighting application. 8. Generation of waveforms using 8038/XR 2206 (Sine, Square, and Triangle). 9. Fluid level sensor using opamp. 10. Characteristics of thermocouple. 11. Design of Bessel/Chebyschev Filter. 12. Frequency measurement using Wein Bridge. 13. Unknown resistance measurement using Wheatstone Bridge.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. H. S. Kalsi, Electronics Instrumentation, 2nd Edition, Tata Mc Graw Hill 2. M.M.S Anand, Electronic Instruments and Instrumentation Technology, PHI 3. K. Krishnaswami, S. Vijayachitra, Industrial Instrumentation, New Age Int. pub 4. Michael Sayer, Abhai Mansingh, Measurement, Instrumentation and Experiment Design in Physics and Engineering, PHI Ltd	
Course Outcomes:	On completion of the course, students will be able to: 1. Explain the Performance characteristics and compare the various types of standards used in measurements. 2. Explain the working principle of various transducers. 3. Explain the working principle of instruments used in electrical and electronics laboratory.	

	4. Design hardware circuits for amplification and Signal Conditioning of Signal from Source

Name of the Programme : B.Sc. Electronics
Course Code : ELE-204
Title of the Course : Electronic Communication
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have the basic knowledge Electronics Fundamentals, Signals and Systems.	
Course Objectives:	This course is intended to: 1. Understand the communication system, Principle and working of communication system. 2. Understand the Principle and working of different modulation techniques. 3. Understand the Principle and working of Mobile communication system & Satellite communication	
Content:	**Module1 Modulation**	
	Introduction: Introduction to communication – means and modes. Need for modulation. Block diagram of an electronic communication system. Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band designations and usage. Channels and base-band signals. Concept of Noise, signal-to-noise (S/N) ratio.	**05 Hours**
	Analog Modulation: Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver.	**10Hours**
	Module2 Analog and Digital Modulations	
	Analog Pulse Modulation: Channel capacity, Sampling theorem, Basic Principles-PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.	**07Hours**
	Digital Pulse Modulation: Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK)	**08 Hours**
	Module3 Satellite and Mobile Communication	
	Introduction to Communication and Navigation systems: Satellite Communication:	**06 Hours**

	Introduction, need, Geosynchronous satellite orbits, geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink.	
	Mobile Telephony System: Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, 2G, 3G, 4G and 5G concepts (qualitative only).	**08 Hours**
	GPS navigation system (qualitative idea only):	**01 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Amplitude modulation and demodulation. 2. Frequency modulation and demodulation. 3. Analog multiplexer 4. Sample and Hold Circuit. 5. Study of super heterodyne radio receiver. 6. Study of PLL. 7. Generation of PWM using 555 timer 9. Generation of PPM using 555 timer 10. Generation of PAM 11. Study of PCM generation and detection. 12. Study of TDM 13. Study of FDM 14. Generation of ASK 15. Generation of FSK 16. Generation of PSK	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Electronic Communications, D. Roddy and J. Coolen, Pearson Education India. 2. Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall. 3. Modern Digital and Analog Communication Systems, B.P. Lathi, 4th Edition, 2011, Oxford University Press. 4. Electronic Communication systems, G. Kennedy, 3rd Edn., 1999, Tata McGraw Hill. 5. Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill 6. Communication Systems, S. Haykin, 2006, Wiley India 7. Electronic Communication system, Blake, Cengage, 5th edition. 8. Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press	

Course Outcomes:	On completion of the course, students will be able to: 1. Remember and recognize important terms, ideas and technologies in communication and navigation systems learned during the course. 2. Explain the working of various electronic communication techniques, and understand the importance of modulation and the working of navigation systems. 3. Analyze communication systems, apply techniques to modulate and demodulate signals. 4. Design Circuits for modulation of signal for various applications.

Name of the Programme : B.Sc. Electronics
Course Code : ELE-205
Title of the Course : Programming in C
Number of Credits : 02 (1L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	**Nil**	
Course Objectives:	This course is intended to: 1. Introduce to programming using C programming language and provide a thorough understanding of the fundamentals of C programming. 2. Develop skills in writing C programs	
Content:	**Module 1 Programming in C**	
	Introduction to C: Overview of programming concepts, Introduction to the C language, Setting up the development environment	**01 Hours**
	Basics of C: Structure of a C program, Variables, data types, and constants, Input and output in C	**02 Hours**
	Control Flow Statements Conditional statements (if, else if, else), Switch statement, Looping constructs (while, for, do-while).	**02 Hours**
	Functions and Modular Programming: Function declaration and definition, Function prototypes, Passing arguments to functions, Return values from functions.	**03 Hours**
	Arrays and Strings Arrays and their declaration, Working with one-dimensional arrays, Strings in C (character arrays), String handling functions	**03 Hours**
	Pointers: Introduction to pointers, Pointer arithmetic	**02 Hours**
	Structures: Introduction to structures, Declaration and initialization of structures	**02 Hours**
	Module 2 Practical's	**30 Hours**
	Any seven from below: 1. Write a C program to check whether a number (user input) is even or odd. 2. Write a C program to find the largest among three numbers. 3. Write a C program to print the Fibonacci series up to a certain number of terms. 4. Write a C program to check if a number is prime or not using a loop. 5. Write a function in C to calculate the factorial of a number.	

	6. Write a C program to find the sum and average of elements in an array. 7. Write a C program to check if a given string is a palindrome. 8. Write a C program to swap the values of two variables using pointers. 9. Define a structure to represent a student with name, roll number, and marks and write a program to calculate the total marks and average marks of students. 10. Write a recursive program in C to calculate the factorial of a number. 11. Write a C program to sort a given integer array in ascending/descending order using the bubble sort algorithm.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Yashavant Kanetkar "Let Us C: Authentic guide to C programming language" - 19th Edition, BPB Publication 2022. 2. Byron S. Gottfried "Schaum's Outline of Programming with C" 2nd Edition McGraw Hill 1996. 3. E. Balguruswamy "Programming in ANSI C" 8th edition, Mc-Graw Hill Education, 2019.	
Course Outcomes:	On completion of the course, students will be able to: 1. Define and explain fundamental programming concepts, and apply them to write programs in C. 2. Develop skills for writing an algorithm and translating in C program to solve a given problem in structured manner. 3. Develop skills for writing an algorithm and translating in C program with Control Flow Statements. 4. Develop skills for writing an algorithm and translating in C program with Pointers and Structures.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-212
Title of the Course : Robotics
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have knowledge of Basic electronics hardware, Mathematics, and programming	
Course Objectives:	This course is intended to: 1. Develop understanding of the basic principles of robotics 2. Introduce the components and anatomy of robotic system. 3. Impart the knowledge of sensors and actuators. 4. Impart skills to develop applications using robots.	
Content:	**Module 1 Introduction, Robot Anatomy and Motion Analysis**	
	Introductions: Introduction to robotics, Brief history, basic components of robot, need of robots, classification of robots: General-purpose autonomous robots, Mobile robot, Industrial robot, Service robot, Education robot; Laws of Robotics; essential characteristics: Sensing, Movement, Energy, Intelligence; common robot specifications: Size of the Robot, Maximum Payload Capacity**,** Repeatability, degrees of freedom, Horizontal and Vertical Reach**;** safety measures in robotics, Robot application areas-Manufacturing industry, defence, rehabilitation, medical, etc.; advantages and disadvantages of robots, social impact, upcoming technologies in robots.	**07 Hours**
	Robot Anatomy and Motion Analysis: Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Work volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.	**08 Hours**
	Module 2 Sensors and Actuators:	
	Sensors: Definition, classification of sensors: active and passive sensors, classification based on the means of detection used in the sensor (Electric, Biological, Chemical, Radioactive etc.), classification is based on conversion phenomenon (Photoelectric, Thermoelectric, Electrochemical, Electromagnetic, Thermooptic, etc,),Analog and Digital sensors; Different Types of Sensors(basic principle their applications): Temperature Sensor, Proximity Sensor, Accelerometer, IR Sensor (Infrared Sensor), Pressure Sensor, Light Sensor, Ultrasonic Sensor, Smoke, Gas and Alcohol Sensor, Touch Sensor, Colour Sensor, Humidity Sensor ,	**05 Hours**

	Position Sensor, Magnetic Sensor (Hall Effect Sensor), Microphone (Sound Sensor), Tilt Sensor, Flow and Level Sensor, PIR Sensor, Strain and Weight Sensor, White line sensors, Analog directional light intensity sensors, Position encoders ,Servo mounted sensor pod/ Camera Pod, Wireless color camera ,Ultrasound scanner ,Gyroscope, Magnetometer, soil moisture sensor, Battery voltage sensing, Current Sensing .	
	Actuators: DC Motors, rpm, Gearing and Efficiency, Importance's of Gear and Uses of Gears: Increase speed, Increase force and Change direction, Importance's of BO (Battery Operated) motor, BO Motor and it's features, Application of BO motors, Why DC Motors Are Used in Robotics, Motor driver L293D,why it is required, H-bridge, Logic for turning Motor clockwise and anti-clockwise, Servo Motors: Importance's of Servo motor: Feature, Principle of Operation of Servo Motor, working of Servo motor, Servo motor controlled by PWM, Variable Pulse width control servo position, Applications of servo motor, Gripper, Types of Grippers	**06 Hours**
	Module 3 Robot applications:	
	Basics of simple machines: Definition of machine, types of machines: simple and complex, 6 types of simple machine: Inclined Plane, Wedge, Screw, Pulley, Wheel and Axle, Lever.	**02 Hours**
	Introduction to Embedded System, Arduino Basics: Introduction, Features of Embedded System, Application of Embedded System, introduction to Micro-Controller, Features of Microcontroller, Differences between Micro-Controller and Micro-Processor, Applications of Micro-Controller; Getting start with Arduino: Introduction to Arduino, Why Arduino, Exploring the Arduino Board and the IDE(Installation Process),Pin Configuration and platform features, Arduino I/O Functions, Interfacing Switches, LED's, Buzzer, DC motor, 16x2 LCD Display, potentiometer with Arduino.	**05 Hours**
	BLUETOOTH: Features of Bluetooth, Bluetooth Spectrum, HC-05 BLE module: Features, Working, Modes of Communication: Master and Slave, need for Bluetooth pairing, Application of HC-05 BLE Module.	**02 Hours**
	Applications: Design of car chassis with Forward, Backward, stop, Left and Right movement; agribot which checks for obstacle in front and stop, and displays the moisture level on LCD screen; Fanbot illustrating change in speed; roller bike showing change in direction; Line follower robot.	**06 Hours**

	Module 4 Practical's	**30 Hours**
	1. Interfacing DC Motor to Arduino 2. (a) Interface Servo motor to the Arduino –move the servo motor angle wise. (b) Interface Servo motor to the Arduino –Sweep from 0º to 180 º and 180º to 0º. 3. ArgiBot- Using Ultrasonic sensor the bot will check for obstacle in front and stop, using soil sensor the moisture level will be displayed on LCD screen. 4. Robotic Gripper using Servo motor (Sweep –open and close, change in force gear assembly required). 5. Design a Fanbot showing change in speed: Using big and small gear pair, Metal or DIY component, dc motor, battery, screw, bolts, metal shaft, motor shaft, spacer and axel lock. 6. Programming obstacle avoidance robot. 7. Programming Line follower Robot.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Ghosal, A., 'Robotics: Fundamental Concepts and Analysis', Oxford University Press, 9 th reprint, 2013 2. Robert J Schilling, 'Fundamentals of Robotics', Prentice Hall India, 1st ED, 2003 3. John J Craig, 'Introduction to Robotics', Prentice Hall International, 3rd ED, 2005 4. S.K. Saha, 'Introduction to Robotics', Tata McGraw Hill Education Pvt. Ltd. 5. R. K. Mittal, I. J. Nagrath, "Robotics and Control", Tata McGraw-Hill Publishing Company Ltd,1st ED, 2003 6. Ian Sinclair , 'Sensors and transducers', Newnes, 3rd ED,2000. 7. Ashwin Pajankar, ' Arduino Made Simple: with interactive projects' BPB Publications, 1st ED, 2018.	
Course Outcomes:	On completion of the course, students will be able to: 1. Explain the basic concepts in robotics and constituents of the robotic system 2. Explain the various sensors and actuators to be used to develop robot applications 3. Develop robotic systems for various interfaces. 4. Develop robotic systems for various applications.	

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-261**
Title of the Course : **Repair and Maintenance of Electrical and Electronics equipment**
Number of Credits : **04 (1T+3P)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. To enable the students to understand the working principle of electrical and electronic equipment. 2. To identify the common faults that occur in electrical and electronic equipment. 3. To be able to carry out minor repairs in the equipment. 4. To increase knowledge in understanding the technical specifications of the equipment.	
Content:	**Module 1 Heating and Motorized Appliances**	
	Heating Appliances: Electrical iron, Electric stove, Electric Toaster, Immersion heater, Electric geyser, Electric Oven, Induction Cooktop, Electric Roti Maker, Electric Kettle, Electrical iron- Introduction, working principle, construction, operation, Installation, Maintenance and Repair (fault finding and removal of faulty component).	**03 Hours**
	Motorized Appliances: Electric fan (Ceiling Fan and Table Fan), Electric Mixer grinder, Electric washing machine, Hair dryer, Vacuum cleaner: Introduction, working principle, construction, operation, Installation, Maintenance and Repair (fault finding and removal of faulty component).	**02 Hours**
	Module 2 Electrical, electronic and Visual electronic appliances	
	Electrical and electronic appliances: Electric gas lighter, Electric bell and buzzer, Emergency light, Voltage Stabilizer (Relay based), Linear Regulated Power Supply, Battery Charger, Solar Voltaic cell, Tube light: Introduction, working principle, construction, operation, Installation, Maintenance and Repair (fault finding and removal of faulty component).	**03 Hours**
	Visual electronic appliances: Introduction, block diagram, working principle and different sections of Public address system, CD/DVD player, LCD/LED Television.	**02 Hours**
	Module 3 Audio Systems and Mobile Telephony	**5 Hours**
	AM/FM, Audio recording and reproduction, Mobile Phones, Smart Phone, Smart Watch, GPRS, Bluetooth, GPS, Navigation System, Office equipment: Scanners, Barcode, printers, Photocopier machine.	

	Module 4 Practical's	**90 Hours**
	1. Use of tong tester, tester, Multimeter for measurement of Voltage, Current, Resistance and Continuity test. 2. Dismantling and reassembling of ordinary/automatic iron, Testing and repair of ordinary/automatic iron. 3. Construction of Electric Extension board, Testing and repair of extension board. 4. Testing, fault finding, repair and overhauling of electric fan. 5. Testing, fault finding, repair and overhauling of electric mixer. 6. Testing, fault finding, repair and overhauling of vacuum cleaner. 7. Testing, fault finding and repair of stabilizer. 8. Testing, fault finding and repair of Heating and Motorized Appliances (two nos). 9. Testing, fault finding and repair of Electrical, electronic and Visual electronic appliances(two nos). 10. Testing, fault finding and repair of Audio Systems and Mobile Telephony (two nos).	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Fred Sotcher, The Repair & Maintenance of Electrical Equipment: A Complete Guide to Troubleshooting Portable electric Tools And Generators, 1st Edition, Miramar Publishing Company, 1980. 2. R.S.Khandpur, Troubleshooting Electronic Equipment: Includes Repair And Maintenance, 2nd Edition, McGraw Hill Edition, 2006.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the technical specifications of the equipment. 2. Analyze and understand the working principle of electrical and electronic equipment. 3. Identify the common faults that occur in electrical and electronic equipment. 4. Carry out minor repairs in the equipment.	

Semester V
Name of the Programme : B.Sc. Electronics
Course Code : ELE 300
Title of the Course : 8051-Microcontroller
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	This course is intended to: 1. Understand basic architecture, instruction set and addressing modes of 8051 microcontroller. 2. Interface 8051 microcontroller with different peripheral devices and develop assembly language for the same. 3. Learn the concept of Timers/Counters for 8051. 4. Learn the concept of Serial Communication for 8051.	
Content:	**Module 1 8051 Microcontroller**	
	Introduction to Microcontrollers: Introduction, Microcontrollers and microprocessors, CISC and RISC processors, Harvard and Von Neumann architecture.	**02 Hours**
	8051 Microcontroller: Features of 8051, Architecture of 8051, Pin diagram of 8051, Memory organization, External Memory interfacing, Stacks, 8052 Microcontroller.	**06 Hours**
	8051 Addressing Modes and Instructions: Instruction Syntax, Data types, Subroutines, Addressing modes, 8051 instructions.	**07 Hours**
	Module 2 8051 Parallel I/O Ports	
	8051 Assembly Programming: Assembly Language Programs, Assembler Directives, Assembly Language Programs, Time Delay Calculations	**05 Hours**
	8051 Parallel I/O Ports: Basic I/O Concepts, Port Operation, Interfacing Push Button Switches and LED's, Interfacing Matrix Keyboard, Seven-Segment Display, Liquid Crystal Display (LCD), Interfacing D/A and A/D Converter using Parallel Ports, Interfacing Stepper Motor. **(Programming in Assembly Language)**	**10 Hours**
	Module 3 8051 Interrupts, Timer/counters and Serial Communication	
	8051 Interrupts and Timer/counters: Basics of Interrupts, 8051 Interrupt Structure, timers and counters, 8051 Timers/Counters, Timer/Counter Operation Modes, Programming 8051 Timers. **(Programming in Assembly Language)**	**08 Hours**
	8051 Serial Communication:	**07 Hours**

	Data Communication, Basics of Serial Data Communication, 8051 Serial Communication, Serial Communication Modes, Serial Communication Programming, RS232 interface. **(Programming in Assembly Language)**	
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Write an Assembly Language Program to generate a square wave of 50 Hz frequency on pin P1.2 using without interrupt for timer in 8051. 2. Write an Assembly Language Program to generate a square wave of 1 KHz frequency on pin P1.0 using interrupt for timer in 8051. 3. Interface 16x2 LCD with 8051 microcontroller and write an Assembly Language Program to display "ELECTRONICS" on 16x2 LCD display using 8051 Microcontroller. 4. Write an Assembly Language Program to display "ELECTRONICS" on serial monitor display using serial communication in 8051 Microcontroller. 5. Interface Seven Segment Display to the 8051 Microcontroller and write an Assembly Language Program to display numbers from 0-9. 6. Interface 8 LED's to the 8051 Microcontroller and write an Assembly Language Program to alternately blink the LED's with 1 sec delay using timer delays. 7. Interface the stepper motor to the 8051 Microcontroller and write an Assembly Language Program to rotate the stepper motor in clockwise/ anticlockwise direction. 8. Interface ADC 0809 to the 8051 Microcontroller and write an Assembly Language Program to read ADC values. 9. Interface DAC 0808 to the 8051 Microcontroller and write an Assembly Language Program to produce Triangular waveforms. 10. Assume 1 Hz external clock is connected to I/P pin T0 (P3.4). Write an Assembly Program to display count on serial monitor.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. V Udayashankara and M. S Mallikarjunaswamy, '8051 Microcontroller Hardware Software and Applications'- Tata McGraw-Hill Publishing Company Limited, 2009. 2. M.A.Mazadi, J.G.Mazadi & R.D.McKinlay, 'The 8051 Microcontroller and Embedded systems',Prentice Hall, 2000. 3. Keneth Ayala, 'The 8051 Microcontroller' Third Edition, Delmar and Cengage Learning, 2005.	

Course Outcomes:	On completion of the course, students will be able to: 1. Develop good knowledge and core expertise in the field of 8051 microcontroller. 2. Understand key concepts of embedded systems like I/O, timers, interrupts, interaction with peripheral devices. 3. develop Assembly programs language for Timers/Counters and Serial Communication for 8051. 4. develop embedded systems in real world applications

Name of the Programme : B.Sc. Electronics
Course Code : ELE-301
Title of the Course : Power Electronics
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Basic knowledge of electronic components and circuits	
Course Objectives:	This course is intended to: 1. To introduce the various Power Electronic devices and its working principle 2. To design and implement triggering circuits and converters 3. To study the working principles of power electronics applications	
Content:	**Module 1 Power Semiconductor Devices and Protection**	
	Power Devices: Introduction to Power semiconductor devices, Types of Power electronic converters	**01 Hours**
	Power Diodes: Structure, Principle of operation, V-I characteristics	**01 Hours**
	Silicon Controlled Rectifier (SCR): Structure, Principle of operation, V-I characteristics, Two-transistor model of SCR, di/dt and dv/dt ratings, Turn–on methods of SCR.	**03 Hours**
	Triac: Structure, Principle of operation, V-I characteristics, Comparison between SCR and Triac.	**02 Hours**
	Power Transistor: Structure, Principle of operation and characteristics of Power BJT, Power MOSFET and IGBT, Comparison between Power BJT, Power MOSFET and IGBT.	**05 Hours**
	Protection of Power Semiconductor Devices: Overvoltage protection, overcurrent protection, over temperature protection, Gate protection using shielding and RF filters, Snubber circuit.	**03 Hours**
	Module 2 Power Converters, Inverters and Choppers	
	Thyristor Firing Circuits: Gate firing circuits: Resistive, Resistive- Capacitive, UJT firing circuit, PUT firing circuit, Synchronized UJT firing circuit, Pulse transformer firing circuit and Light Activated firing circuit, Application of Diac as a triggering device for a Traic.	**04 Hours**
	Power Converters: Single Phase Half wave-controlled rectifier with resistive load, Single Phase Half wave-controlled rectifier with inductive load, (qualitative study only), Effect of freewheeling diode**,** Single Phase Full wave-controlled rectifier: Mid-point configuration and Bridge configuration with resistive load, Full wave-controlled rectifier: Bridge configuration with inductive load.	**04 Hours**

	Power Inverter: Thyristor Turn-off Methods: Commutating circuits – Classes of commutation (Class A to F circuit diagram and working principle only), Introduction to inverter: Basic circuit diagram/block diagram and working principle of Voltage driven inverter, current driven inverter, Sine wave inverters, square wave inverter (Bridge inverter) and PWM inverter.	**04 Hours**
	Cycloconverters: Single phase to single phase – Midpoint and Bridge configuration (Circuit diagram and working principle)	**01 Hours**
	Choppers: Basic principles of Step-down, Step-up chopper, and Step Up-Down chopper	**02 Hours**
	Module 3 Poly Phase Circuits, Motors, and Applications	
	Poly Phase Circuits: Poly phase system, advantages of three phase system, interconnection of three phase sources and loads, Voltage, Current and Power in a Star connected system.	**02 Hours**
	DC Motors: Basics of DC Motors: Construction and working principle, Series dc motor and separately excited dc motor and their speed torque characteristics, Applications of DC motors.	**02 Hours**
	AC Motors: Basics of Induction Motor**:** Construction and working principle, understanding of the terms such of Poles, RMF (rotating magnetic field), MMF (magnetomotive force), Slip, synchronous speed and synchronous motor; applications of AC motors.	**02 Hours**
	Batteries: Types of batteries used for inverters, load calculation for batteries, connection of batteries and their Maintenance.	**02 Hours**
	Applications of Power Electronics: Servo controlled AC voltage Stabilizer (block diagram and working principle), Switch Mode Power Supply (block diagram and working principle), Uninterruptible Power Supply: Online, Offline & Line interactive (block diagram and working principle).	**07 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. I-V Characteristics of SCR 2. I-V Characteristics of IGBT 3. Half wave-controlled rectifier with resistive and inductive loads and importance of freewheeling diode 4. Full wave-controlled rectifier with resistive and inductive loads	

	5. SCR based Power Controller using Resistive and Resistive Capacitive firing circuit 6. SCR based Power Controller using UJT/PUT firing circuit 7. Triac based Illumination control using Diac (50V ac voltage) 8. Study of Bridge inverter and chopper circuit 9. Study of UPS, load calculation and connection of UPS for a given setup 10. Study of Stabilizer (Servo and Relay based) 11. Study of constructional features of DC Motors and AC motors and interconnection of star to delta connection of three phase motors.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation/Laboratory experiments	
References/ Readings:	1. Alok Jain, 'Power Electronics and its applications' Penram Intl. Pub. 3rd Edition 2. MD Singh, KB Khanchandani, 'Power Electronics', Tata McGraw 2nd Edition. 3. Muhammad H. Rashid, 'Power Electronics: Devices, Circuits, and Applications', Pearson Education, 4th Edition, 2017. 4. A.Shudakar & ShyamMohan S. Palli, 'Circuits and Networks: analysis and synthesis' McGraw Hill Education, 5th Edition, 2017 5. B. Theraja and A.K. Theraja, 'A Text Book of electrical Technology Vol II' S. Chand, 23rd Edition, 1959 6. Biswanath Paul, 'Power Electronics', Universities Press, 2019	
Course Outcomes:	On completion of the course, students will be able to: 1. Explain the working principle of Power Electronic devices 2. Develop necessary skills for designing various Power Converters 3. Explain the working principle of AC/DC Motors and Other applications of power electronics 4. Demonstrate practical skills in implementing circuits using power electronic devices	

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-302**
Title of the Course : **Operating System**
Number of Credits : **04 (3L+1P)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: 1. To understand the role, responsibilities, features and design of an operating system. 2. To analyze the various process scheduling algorithms for uniprocessor, multi-processor and real-time scheduling. 3. To evaluate the process deadlock handling techniques. 4. To increase knowledge in the design of real time kernels.	
Content:	**Module 1 Operating Systems and Processes**	
	Operating Systems Overview: Operating System Objectives and Functions, Evolution of operating systems, Major Achievements, Characteristics of Modern Operating System.	**05 Hours**
	Processes: Process states, Process description, Process control.	**07 Hours**
	Threads, SMP and Microkernels: Processes and Threads, Symmetric Multiprocessing, Microkernels.	**03 Hours**
	Module 2 Concurrency	
	Mutual Exclusion and Synchronization: Principles of Concurrency, Mutual Exclusion: Software approaches, Mutual Exclusion: Hardware support, Semaphores, Message passing.	**07 Hours**
	Concurrency: Deadlock and Starvation, Principles of Deadlock, Deadlock prevention, Deadlock avoidance, Deadlock detection, An integrated deadlock strategy, Dining philosopher's problem.	**08 Hours**
	Module 3 Scheduling and MicroC/OS – II	
	Uniprocessor Scheduling: Types of Processor Scheduling and Scheduling Algorithms.	**04 Hours**
	Multiprocessor and Real-time Scheduling: Multiprocessor Scheduling and Real Time Scheduling.	**06 Hours**
	The Real Time Kernel: Kernel Structure and Task Management.	**05 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Shell Programming to sort numbers. 2. Shell Programming to find the factorial of a number. 3. Shell Programming to identify if a number is prime or composite and generate the prime numbers specified for a particular range.	

	4. Shell Programming to generate the Fibonacci series. 5. Shell Programming to calculate the sum and average of a given numbers using for loop and while loop. 6. Shell Programming to Display of Multiplication Tables for a given range. 7. Shell script using grep command. 8. Shell script using case construct. 9. Shell script using to find sum of a series. 10. Socket Programming 1- To transmit and receive a file. 11. Socket Programming 2- To Transmit a message, manipulate the data by counting the number of characters in the message. 12. RTOS programming.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. William Stallings, Operating Systems, Fourth Edition, Pearson Education, 2000. 2. Jean J. Labrosse, MicroC/OS – II, The Real Time kernel, Second Edition, CMP Books, 1998. 3. Silberschatz A., Galvin P. B., Operating Systems Principles, Fifth Edition, John Wiley & Sons, 2001.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the role, responsibilities, features and design of an operating system. 2. Analyze the various process scheduling algorithms for uniprocessor, multi-processor and real-time scheduling. 3. Evaluate the process deadlock handling techniques. 4. Understand the design of real time kernels.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-303
Title of the Course : Programming in Python
Number of Credits : 02 (1L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	NIL	
Course Objectives:	This course is intended to: 1. Understand fundamentals of the python language. 2. Implement usage of constructs. 3. Demonstrate the standard libraries of python.	
Content:	**Module 1 Python Programming essentials**	
	Python: Python Basic Syntax , Python identifiers, Reserved Words, Lines and indentation, Assigning Values to Variables, Multiple Assignment, Standard Data Types, Python Numbers, Python Strings, Python Lists, Python Tuples, Python Dictionary, Data Type Conversion	**04 Hours**
	Flow control and Loops: IF Statement, IF...ELIF...ELSE Statements, Nested IF Statements, Single Statement Suites, While Loop Statements, for Loop Statements, Nested loops, Loop Control Statements, break statement, continue Statement, pass Statement.	**06 Hours**
	Standard Python Libraries: Numpy, Pandas: Pandas Series, Panda dataframe, Matplotlib: Matplotlib pyplot, Matplotlib plotting Line plot, scatter plot, bar, Scikit-learn. Keras, Tensorflow.	**05 Hours**
	Module 2 Practical's	**30 Hours**
	Any seven from below: 1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon users choice. 2. Write a program to compare three numbers and print the largest one. 3. Write a program to print factors for a given range of numbers. 4. Write a program to display the first n terms of Fibonacci series. 5. Write a program to find the prime numbers from 2 to 100 using a nested for loop. 6. Write a program for manipulating numerical data using numpy. 7. Write a program for data handling using pandas. 8. Write a program to plot graphs using matplotlib. 9. Write a program to implement Deep learning with Keras.	

	10. Write a program to implement Deep learning with Tensorflow.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. T. Budd, 'Exploring Python', TMH, 1st Ed, 2011 2. Allen Downey, Jeffrey Elkner, Chris Meyers , 'How to think like a computer scientist : learning with Python' , Freely available online.2012 3. Cody Jackson, 'Learning to program using Python', 2nd Edition, CreateSpace, 2011.	
Course Outcomes:	On completion of the course, students will be able to: 1. Develop programmes using data types constructs and libraries. 2. Develop programming skills complex dataset 3. Develop programming skills using python libraries for pandas. 4. Develop programming skills using python libraries for Keras, Tensorflow.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-311
Title of the Course : Internet of Things & Application
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have the basic knowledge of Electronics circuits, Programming, Computer networking.	
Course Objectives:	This course is intended to: 1. Introduce the fundamentals of Internet of Things and its building blocks. 2. Understand the protocols and standards designed for IoT and the current research on it. 3. Provide the recent application domains of IoT in everyday life.	
Content:	**Module1 Fundamentals of IoT**	**15 Hours**
	Introduction, History of IoT, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, IoT frameworks, IoT and M2M, Open Source and Commercial Examples, Competing Standards for IoT.	
	Module2 Sensors Networks	**15 Hours**
	Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles, Wireless Sensor Networks, The node, Connecting nodes, Networking Nodes, WSN and IoT.	
	Module3 Wireless Technologies & Data Handling for IoT	**15 Hours**
	WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, LoRa, HART, ZWave, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, CoAP, MQTT. Edge connectivity and protocols.Data handling Technologies, Flow of data, Data acquisition, Data Storage Applications of IoT: Home Automation.	
	Module4 Practical's	**30 Hours**
	1. Traffic lights using Arduino board. 2. DHT 11 or DHT 22 interface with arduino for temperature & humidity sensing. 3. Implementation of IoT based security system using PIR sensor & buzzer. 4. Setting up Raspberry pi & blinking LED. 5. Capturing an image using Raspberry Pi. 6. To display real-time temperature data on a website (ThingSpeak). 7. To design and implement an IoT-enabled Gas Detector with Buzzer utilizing Arduino.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	

References/ Readings:	1. Internet of Things, Vasudevan, Nagrajanand and Sundaram, Wiley India. 2. Srinivasa K G "Internet of Things", Cengage Learning, India 2017. 3. David Hanes, Gonzalo Salgueiro, Patrick Grosstete, Robert Barton, Jerome Henry, IoT fundamentals: Networking Technologies, Protocols and uses cases for the Internet of things, 1st Edition, Pearson Education. 4. IOT Fundamentals, David Hence et al, Cisco press.
Course Outcomes:	On completion of the course, students will be able to: 1. Define the fundamental IoT, characteristics, and historical milestones. 2. Explain the architecture of IoT, 3. Differentiate physical and logical design, and grasp wireless communication principles. 4. Apply knowledge of IoT frameworks, implement development boards, and employ wireless protocols in practical IoT scenarios.

Name of the Programme : B.Sc. Electronics
Course Code : ELE-361
Title of the Course : Internship
Number of Credits : 02I
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have graduate level knowledge of Electronics	
Course Objectives:	This course develops concepts in industrial training and working on short term projects.	
Content:	**Module 1 Industrial training**	**30 Hours**
	A student has to undergo Industrial training equivalent to two credits for the period of minimum 2 months in the respective Electronics industries / Research Laboratory anywhere in India. Each student has to give a power point presentation on the industrial internship which they had undergone.	
Pedagogy:	Self-study/Projects/Presentation	
References/ Readings:	NIL	
Course Outcomes:	On completion of the course, students will be able to: 1. Handle different kinds of instruments in electronic industries. 2. Understand industrial management and make a documentation. 3. Understand industrial quality assurance and make a documentation. 4. Understand industrial schedules and make a documentation.	

Semester VI
Name of the Programme : B.Sc. Electronics
Course Code : ELE-304
Title of the Course : Embedded Systems
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Knowledge of programming with C and Basic Analog and Digital electronics	
Course Objectives:	This course is intended to: • To introduce Embedded systems and the architectural features of the Mixed Signal Ultra Low Power Microcontroller MSP430. • To present a comprehensive understanding of internal and external peripherals, including I/O Ports, Timers, and ADC, and demonstrate the interfacing of peripheral devices • Explain the MSP430 Clock system, Low power modes, Resets & interrupts as well as communication protocols. • To develop practical skills in programming and interfacing with the MSP430 microcontroller.	
Content:	**Module 1 Fundamentals of Embedded Systems**	
	Introduction to Embedded Systems Overview of Embedded Systems: Definition, characteristics, and applications; Distinction between general-purpose computers and embedded systems. Microcontroller Basics: Introduction to microcontrollers; Comparison between microcontrollers and microprocessors.	**04 Hours**
	MSP430 Architecture Introduction to MSP430 Microcontroller Family: Features and variants(Comparison between 2X, 4X & 5X variants of MSP430); Importance in embedded systems. MSP430 Architecture: CPU, memory, and peripherals; Memory organization.	**06 Hours**
	MSP430 Programming MSP430 Assembly Language Programming: Basics of assembly language and Addressing modes; Instruction format and Basic Instruction set: Arithmetic instructions, Logical and Register Control Instructions, Data instructions, Program flow instructions; Writing simple assembly programs to manipulate registers, perform basic operations and understand the various addressing modes.	**05 Hours**
	Module 2 MSP430 Peripheral Programming	
	GPIO Programming: MSP430 C Programming Basics: Introduction to integrated development environment (CCS compiler/IAR workbench), Introduction to C programming for MSP430; Writing and debugging simple C programs to perform basic arithmetic and logical operations.	**03 Hours**

	GPIO Programming: Basics of digital I/O operations; Various registers associated with I/O port programming; Programming exercises for interfacing with LEDs and switches.	
	Timers in MSP430: Introduction to MSP430 Timer Module and it's Modes of Operation; Programming in C generating delays using Timer, generating Pulse Width Modulation (PWM) using Timer Capture Mode.	**04 Hours**
	Analog-to-Digital Converter (ADC): Introduction to ADC module in MSP430; Programming in C for interfacing with analog sensor.	**04 Hours**
	External world interfacing: MSP430 Programming in C for interfacing with 4x4 keypad, 7 segment LED display, 16x2 Alphanumeric LCD display.	**04 Hours**
	Module 3 Advanced Topics and Communication	
	Clock system, Resets, Interrupts and Low power modes (LPM): Clock system in MSP430: Introduction to clock system in MSP430; Block diagram of clock system–sources and distribution Resets and interrupts: Introduction to resets and types of Reset Sources in MSP430; Handling interrupts in MSP430 Low Power Modes: Introduction to Low power design and Low power modes of MSP430; Power consumption characteristics	**6 Hours**
	Communication Protocols Serial Communication (UART): Basics of UART communication; Programming in C for Transmitting and receiving data over UART. I2C and SPI Communication: Basics of I2C and SPI protocols; Implementing I2C and SPI communication with MSP430 using C programming.	**9 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Blinking LED (assembly language) 2. Addressing modes (assembly language) 3. Port interrupts – button controlled LED (C language) 4. Timer interrupts - square wave generation (C language) 5. PWM with Timer (C language) 6. Analog-to-Digital Conversion – ADC (C language) 7. UART Communication (C language) 8. I2C Communication (C language) 9. SPI Communication (C language) 10. Interfacing 16x2 Alphanumeric LCD (C language) 11. Interfacing 4 x 4 keypad (C language) 12. Interfacing 7 segment LED (C language)	

	*** Software Platform: *Code Composer Studio (CCS) or IAR Workbench* *** Hardware Platform(Evaluation Board): *MSP430G2553 LaunchPad™ or Higher*	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation/Practical (Lab work)	
References/ Readings:	1. Chris Nagy, 'Embedded Systems Design using the TI MSP430', 3rd Edition, Elsevier Science – Newnes 2003. 2. John Davies, MSP430 Microcontroller Basics, , 1st Edition, Elsevier Science– Newnes, 2008. 3. Dan Harres, MSP430-Based Robot Applications: A Guide to Developing Embedded Systems, 1st Edition, Elsevier Science – Newnes, 2013 4. James Kretzschmar, Jeffrey Anderson and Steven F. Barrett "MSP430 Microcontroller Lab Manual" 1st Edition 2023 Springer International Publishing AG 5. Manuel Jiménez, Rogelio Palomera, Isidoro couvertier "Introduction to Embedded Systems: Using Microcontrollers and the MSP430" , 1st Edition 2014, Springer 6. Cem Unsalan (Author), H. Deniz Gurhan "Programmable Microcontrollers with Applications: MSP430 LaunchPad with CCS and Grace", 2013 McGraw-Hill Professional 7. User data manuals and Handbooks of TI MSP430 8. Websites: https://www.ti.com/video/series/precision-labs/ti-precision-labs-cpu-core.html https://www.ti.com/microcontrollers-mcus-processors/msp430-microcontrollers/overview.html	
Course Outcomes:	On completion of the course, students will be able to: 1. Define Embedded systems and explain the Architecture. 2. Explain the on-chip(internal) and external peripherals, including I/O Ports, Timers, and ADC, and demonstrate the interfacing of peripheral devices 3. Explain the MSP430 Clock system, Low power modes, Resets & interrupts as well as communication protocols. 4. Develop programs for configuring and using the various on chip peripherals.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-305
Title of the Course : Biomedical Instrumentation
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: • Introduce the fundamentals of transducers as applicable to physiology. • Explore the human body parameter measurements setups. • Make the students understand the basic concepts of biomedical measurement techniques.	
Content:	**Module 1 Medical Instrumentation and Bioelectric Signals and Electrodes**	
	Physiology system of body: Cardiovascular System, Respiratory System, Nervous system, Sources of Biomedical Signals, Basic Medical Instrumentation system, General constraints in design of medical instrumentation system.	**06 Hours**
	Bioelectric Signals and Electrodes: Origin of bioelectric potentials, Electrocardiogram, Electroencephalogram & Electromyogram, Recording Electrodes: Electrode Tissue Interface, Skin contact impedance, Electrodes for ECG, Electrodes for EEG, Electrodes for EMG, Electrical conductivity of electrodes jellies and creams, Microelectrodes: Glass micro capillary Electrode, Metal Micropipette.	**09 Hours**
	Module 2 Physiological Transducers and Non-Invasive Diagnostic Imaging	
	Physiological Transducers: Classification of Transducers, Performance Characteristics of Transducers: Static Characteristics and Dynamic Characteristics, Signals from Cardiovascular system, Signals from Respiratory system, Optical Fibre Sensors, Types of Optical Fibre Sensors, Various types of Transducers for biomedical Applications.	**08 Hours**
	Non-Invasive Diagnostic Imaging: Study of block diagram of X-Ray, Study of block diagram of CT, Study of block diagram of Nuclear Medical Imaging, Study of block diagram of Magnetic Resonance Imaging, Study of block diagram of Ultrasonic Imaging.	**07 Hours**
	Module 3 Bio-medical recorders	
	Electrocardiography: Block diagram of Electrocardiography, ECG Leads.	**02 Hours**
	Electroencephalography: Block diagram of Electroencephalography.	**02 Hours**

	Electromyography: Block diagram of Electromyography, Measurement of Heart rate, Measurement of Pulse rate.	**02 Hours**
	Blood Pressure Measurement: In-direct Blood Pressure measurement: Automatic Blood Pressure Measuring using Korotkoffs Method, Oscillometric Method.	**03 Hours**
	Measurement of Respiration rate: Thermistor Method, Pulse Oximeter.	**02 Hours**
	Blood Flow meters: Electromagnetic blood flow meter, Chamber plethysmography.	**02 Hours**
	C**ardiac Pacemaker**: Asynchronous cardiac pacemaker, demand type synchronous pacemaker, An atrial- synchronous cardiac pacemaker.	**02 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Study of Bio-Medical ECG. 2. Study of Bio-Medical EMG. 3. Study of Bio-Medical Electronics Pressure meter. 4. Study of Bio-Medical Glucometer. 5. Study of Cardiac Pacemaker. 6. Study of Oximeter. 7. Measurement of respiration rate using thermistor. 8. Construction of Hearing Aid. 9. Height measurement using ultrasonic sensor. 10. Construction of Pulse Rate Meter.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. R.S. Khandpur, Handbook of Biomedical Instrumentation, 3rd Edition, McGraw Hill Education (India) Private Limited, 2014. 2. John G. Webster, Medical Instrumentation- Application & Design, 4th Edition, John Wiley & sons, Inc., 2010. 3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, 2nd Edition, PHI, 1980.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the physiology of a biomedical system. 2. Analyse and measure the biomedical and physiological information. 3. Discuss the application of Electronics in diagnostics and therapeutic area. 4. Handon experience with various physiological signals.	

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-306**
Title of the Course : **Computer Networking and System Administration**
Number of Credits : **04 (3L+1P)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: • Develop the understanding of computer hardware, computer networks and communication basics. • Learn the design issues and services at different layers of reference models. • Describe and analyse related technical and administrative aspects of Windows Server 2012 R2. • Increase knowledge in IPAM Address management and DNS and name resolution in Windows Server 2012 R2. • Configure, install, manage and share resources in Windows Server 2012 R2.	
Content:	**Module 1 TCP/IP layers**	
	Introduction: Network hardware: Local area network, metropolitan area networks, Wide area networks, internetworks, OSI Reference model, TCP/IP Reference model.	**01 Hours**
	Physical layer:	**01 Hours**
	Transmission Media: Guided media- twisted pair cable, co-axial cable, fiber optic cable.	**01 Hours**
	Data link layer: Introduction to Data link Layer – Nodes and Links, Services, framing, flow control, error control, congestion control, two categories of links, two sublayers, link layer addressing and three types of addressing, DLC services – framing, Connection less and connection oriented. MAC – Random Access – CSMA/CD.	**03 Hours**
	Network Layer: Packetizing, Routing and forwarding, Packet switching, Datagram approach: connectionless service, Virtual -circuit approach: Connection-oriented service, IPv4 addresses-address space, classful addressing, classless addressing, DHCP, IPv6 addressing-representation and address space.	**03 Hours**
	Transport Layer: Introduction, Transport layer services, **transport layer protocol:** introduction, services, port numbers, **User datagram protocol:** User datagram, UDP services, **Transmission control protocol:** TCP services	**03 Hours**
	Application Layer:	**03 Hours**

	Introduction, **World Wide Web and HTTP:** World wide web and Hyper Text Transfer Protocol, **Domain Name System (DNS):** Namespace, DNS in the Internet, resolution, caching, resource records, registrars and DDNS.	
	Module 2 Windows Server 2012 R2 - I	
	Introduction and Basics terms of server: Introduction to the concepts of Users, Groups and Computer management, Group policy Infrastructures and Group Policy Settings, Authentication, Domain Controllers, Sites and Replication, Domains and Forests. Windows server editions, Desktop changes, active directory changes, Virtualization, network changes, management tools, file and print sharing, web-based services.	**03 Hours**
	Installation and upgrading to Windows 2012 R2 server: Installing the operating system, using server manager to configure services (using GUI only), installing a sample server network.	**04 Hours**
	Introduction to server core: Installing server core, initial configurations for server core.	**02 Hours**
	Windows server 2012R2 Networking enhancements: The journey to IPv6, Microsoft NIC teaming, Enhanced QoS.	**03 Hours**
	IP address management: IPAM: IPAM requirements, IPAM components, IPAM installation: installing the IPAM server feature, installing the IPAM client feature.	**04 Hours**
	Module 3 Windows Server 2012 R2 – II	
	DNS & Name resolution in windows server 2012 R2: Understanding the DNS Server role, Installing DNS, configuring standalone DNS server, integrating with other DNS servers, implementing zones to manage namespaces, understanding record types, Managing DNS clients and name resolutions – Managing DNS clients and name resolutions – host name resolution, updating DNS dynamically.	**05 Hours**
	Creating & managing user accounts: Creating local user accounts, creating domain user accounts.	**02 Hours**
	Group policy: Group policy concepts, Group policy basics, local policies and group policy objects.	**02 Hours**
	Files, folders and basic shares: Understanding the file and storage server roles, creating shares with server manager, managing permissions.	**02 Hours**
	Creating & managing shared folders: Creating shared folders, managing permissions.	**02 Hours**
	Sharing printers on windows server 2012 R2 networks: Print services overview, installing the print and document services role-adding the print and document services role.	**02 Hours**

	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Study of network devices: repeater, hub, router, bridge, switch, gateway. 2. Study of IP networking and subnetting. 3. Crimping and punching of network cables (straight and crossed). 4. Setting up of a network in a lab. 5. Configuring Domain Controller. 6. Managing users, computers and groups on a domain controller Implementation of group policies. 7. Configuring DNS and DHCP roles. 8. Learn to use commands like TCP Dump, Netstat, Trace Route. 9. Study and configure functionalities of a router and switches (or by simulation). 10. Study of TCP/UDP performance using Simulation tool. 11. Simulation of error correction code (like CRC). 12. Switch configurations (Level1 and Level2).	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. A. Tennaunbaum, Computer Networks, 5th Edition, Pearson Education, 2010. 2. Mark Minasi, Darril Gibson, Aidan Finn, Wendy Henry, Byron Hynes, Mastering Windows Server® 2012R2, 1st Edition, Sybex, 2014.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the computer hardware, computer networks and communication basics. 2. Describe and analyse related technical and administrative aspects of Windows Server 2012 R2. 3. Understand the IPAM Address management and DNS and name resolution in Windows Server 2012 R2. 4. Configure, install, manage and share resources in Windows Server 2012 R2	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-307
Title of the Course : Project
Number of Credits : 04
Effective from AY : 2023-24

Pre-requisites for the Course:	Knowledge of Sensor, Embedded System, Instrumentation and Programming
Course Objectives:	This course is intended to: • Introduce the hand on experience with various electronics devices. • Designing System Design in Electronics. • Designing Circuit for Applications. • Exploring the possibility of application for Licensing/Technology Tranfer.
Content:	
Pedagogy:	Presentation/Tutorial/Circuit Designing/Programming
References/ Readings:	1. J-Gate 2. Indian Patent Office 3. US Patent Office 4. IEEE Explorer 5. Elsevier Publications
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the concept of System design. 2. Learn the idea of designing Circuit. 3. Troubleshooting the circuit under design. 4. Design an embedded system for any application

Name of the Programme : B.Sc. Electronics
Course Code : ELE-312
Title of the Course : Programming with MATLAB
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Graduate level understanding in basics of Programming	
Course Objectives:	This course is intended to: • To learn to use the command window for creating Arrays and basic mathematical operations. • To acquire the skill to visualize data using plotting functions and create a user defined functions. • To use the control structures such as loops and conditional statements. • To understand the fundamental principles behind Simulink, such as block diagrams, model hierarchies, and solver settings.	
Content:	**Module 1 Matlab Programming Essentials**	
	Introduction to MATLAB: Arithmetic Operations With Scalars: Order of Precedence, Display Formats, Elementary Math Built-In Functions, Defining Scalar Variables: The Assignment Operator, Rules About Variable Names, Predefined Variables.	**04 Hours**
	Creating arrays: Creating a one-dimensional array (vector), Creating a two-dimensional array (matrix): The zeros, ones and eye Commands, Notes about variables in MATLAB, The transpose operator, **Array addressing:** vector & matrix, Using a colon: in addressing arrays, Adding elements to existing variables, Deleting elements, Built-in functions for handling arrays, Strings and strings as variables.	**06 Hours**
	Mathematical operations with arrays: Addition and subtraction, Array multiplication, Array division, Element-by-element operations, Using arrays in MATLAB built-in math functions, Built-in functions for analyzing arrays, Generation Of Random Numbers	**04 Hours**
	Script files: Input to a script file, **Output commands:** The disp Command & The fprintf command.	**01 Hour**
	Module 2 Functions and programming construct	
	Two-dimensional plots: **The Plot Command:** Plot of Given Data & Plot of a Function, the fplot command, Plotting Multiple Graphs In The Same Plot: Using the plot Command & Using the hold on, hold off Commands Using the line Command, **Formatting A Plot:** Formatting a Plot Using Commands & Formatting a Plot Using the Plot Editor, Histograms.	**05 Hours**
	Functions and function files:	**05 Hours**

	Creating a function file, **Structure of a function file:** Function Definition Line, Input and Output Arguments, The H1 Line and Help Text Lines, Function Body, Local and global variables, Saving a function file, Using a function file, Examples of simple function files, Comparison between script files and function files	
	Programming in matlab: Relational and logical operators, **conditional statements:** The if-end Structure, The if-else-end Structure, The if-elseif-else-end Structure, The switch-case statement, loops**:** for-end loops, while-end loops, Nested loops and nested conditional statements, The break and continue commands.	**05 Hours**
	Module 3 Simulink	**15 Hours**
	Introduction to Simulink, Blocks in the Simulink, Signals in the Simulink, Subsystems, Solving mathematical equations in the Simulink, multiple modelling of systems in the Simulink, Controlling subjects, Continuous, discrete and Hybrid system simulation, Relationship between MATLAB and Simulink, Methods of solving problems in the Simulink.	
	Module 4 Practical's	**30 Hours**
	1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon users' choice. 2. Write a program to print factors of a given number. 3. Write a program to display the first n terms of Fibonacci series. 4. Write a program to perform Matrix addition, subtraction and Multiplication for [n x n] matrix. 5. Write a program using switch-case statement. 6. Write a program for some operation involving all three-dimension data in 3-D data. 7. Simulating demonstrating Sine/Cosine waves their sum, subtraction multiplication and using Simulink for five signals. 8. Simulating low Pass and High Pass filter using Simulink. 9. Simulating Ring counter using Simulink.	
Pedagogy:	Lectures/Practical	
References/ Readings:	1. Amos Gilat, MATLAB: An Introduction with Applications, 2nd edition, Wiley, 2004, 2. C.B. Moler, Numerical Computing with MATLAB, SIAM, 2004. 3. Agam Kumar TYagi, 'MATLAB and Simulink for beginners', Oxford University Press, 2011	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the basics of collaborative MATLAB programming. 2. Apply the knowledge in creating Arrays and basic mathematical operations using MATLAB.	

	3. Analyze data and identify patterns using MATLAB's plotting functions and evaluate the control structures, such as loops and conditional statements in solving specific problems. 4. Build basic Simulink models to simulate and Analyze simple Electronics circuits.

Semester VII
Name of the Programme : B.Sc. Electronics
Course Code : ELE-400
Title of the Course : Augmented Reality and Virtual Reality
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Basic Knowledge of Computer Programming	
Course Objectives:	This course is intended to: • Understand the fundamental definitions, differences, and similarities between Augmented Reality (AR) and Virtual Reality (VR) and explore the diverse applications of AR and VR across industries. • Examine and use VR development tools, such as Unity and Unreal Engine for designing user interfaces in VR. • Explore AR development tools and SDKs for creating AR experiences. • Develop proficiency in programming languages and frameworks for AR/VR application development.	
Content:	**Module 1 Foundations of AR and VR**	
	Introduction to AR and VR Overview of AR, VR and MR, Definitions, differences, and similarities, Applications across industries, Market trends and growth, History and Evolution, Milestones in AR and VR development, Key technological advancements and breakthroughs	**06 Hours**
	Basics of Virtual Reality Fundamental Concepts, Immersion, presence, and interaction, Hardware components: Headsets, controllers, sensors; VR Development Platforms, In-depth exploration of popular VR platforms	**04 Hours**
	Basics of Augmented Reality AR Core Concepts, overlaying digital content on the real world, Marker-based vs. marker-less AR, understanding spatial mapping and tracking in AR, AR Development Platforms, In-depth exploration of popular AR platforms	**05 Hours**
	Module 2 Development Tools and Techniques	
	VR Development Tools and Interaction Design Detailed examination of VR development tools and engines (e.g., Unity, Unreal Engine), VR Interaction Design, Principles and guidelines for designing user interfaces in VR, exercises in VR interaction design	**06 Hours**
	AR Development Tools and Interaction Design Detailed examination of AR development tools and SDKs, (e.g., Vuforia) AR Interaction Design, Principles, and guidelines for designing user interfaces in AR, exercises in AR interaction design	**06 Hours**
	AR and VR Technologies	**03 Hours**

	Hardware Overview, Types of AR and VR devices, understanding of sensors, displays, and input devices, Tracking and Calibration, Advanced concepts in spatial tracking in AR and VR, Calibration techniques for precise user experiences	
	Module 3 Advanced Development and Future Trends	
	Advanced Programming and Application Development Programming languages and frameworks for AR and VR development (e.g., C#, Python), coding exercises, Building AR Applications, Integration of AR features (e.g., computer vision, object recognition), Building VR Applications, Integration of VR features (e.g., locomotion techniques, advanced interactions)	**10 Hours**
	Challenges and Future Trends Challenges in AR and VR, Technical challenges and limitations, Ethical and social considerations, Emerging Technologies, Exploration of emerging technologies influencing AR and VR, Predictions, and trends for the future	**05 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Analysis of Industry applications of AR/VR 2. Demonstration and explanation of various AR and VR devices 3. Setting up VR hardware (headsets, controllers) and calibrating sensors 4. Installation and setting up of Unity 5. Use Unity to design a simple VR environment 6. Incorporate 3D models, textures, and basic interactions in a VR environment 7. Develop a VR user interface prototype for a specific application 8. Installation and setting up of Vuforia for developing AR applications 9. Develop an AR application using Vuforia and Unity. 10. Set up a simple VR application using Unity and C# 11. Design and implement a user interface for a VR application using C# 12. Develop a basic AR application using Unity and C#	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation/Laboratory work	
References/ Readings:	1. Dieter Schmalstieg, Tobias Hollerer, 'Augmented Reality: Principles and Practice', Pearson Education India, 2016 2. Jonathan Linowes, 'Unity Virtual Reality Projects', Packt Pub Ltd, 2015 3. Tony Parisi, 'Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile', Shroff/O'Reilly, 2015	

	4. Paul Mealy, 'Virtual & Augmented Reality For Dummies', Wiley, 2018 5. Erin Pangilinan, Steve Lukas, Vasanth Mohan, 'Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing', Shroff/O'Reilly, 2019 6. Indika Wijesooriya, 'Mastering Augmented Reality Development with Unity: Create immersive and engaging AR experiences with Unity', bpb, 2023 7. Dr. Nilesh T. Deotale, 'Augmented and Virtual Reality', TechKnowledge Publications, 2023 8. Jesse Glover, Jonathan Linowes, 'Complete Virtual Reality and Augmented Reality Development with Unity: Leverage the power of Unity and become a pro at creating mixed reality applications' Packt Publishing Limited, 2019 9. Robert Scoble, Shel Israel, 'The Fourth Transformation', Patrick Brewster Press, 2017 10. Allan Fowler, 'Beginning iOS AR Game Development', APRESS, 2019 11. Harrison Ferrone, 'Learning C# by Developing Games with Unity 2021, Packt Publishing Limited, 2021
Course Outcomes:	On completion of the course, students will be able to: 1. Demonstrate an understanding of the foundational concepts of Augmented Reality (AR) and Virtual Reality (VR). 2. Apply development tools and engines for both Virtual Reality (VR) and Augmented Reality (AR). 3. Write code using programming languages such as C# or Python for AR and VR application development. 4. Set up hardware, configure development environments, and design and implement both VR and AR applications

Name of the Programme : B.Sc. Electronics
Course Code : ELE-401
Title of the Course : Artificial Intelligence
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Data Structures, Probability	
Course Objectives:	This course is intended to: 1. Introduces the variety of concepts in the field of artificial intelligence. 2. Describe the variety of model which can be used to model a new problem. 3. Discuss the perceptron algorithms and practical application of Natural Language Processing.	
Content:	**Module 1 Introduction**	
	Foundation of Artificial Intelligence: Philosophy (428 B.C.-present), Mathematics (c. 800-present), Psychology (1879-present), Computer engineering (1940-present), History of Artificial intelligence,	**03 Hours**
	Intelligent Agents: How agents should act? Structure of intelligent agents – Agent programs, simple reflex agents, Goal based agents, Utility based agents, Iterative improvement algorithms.	**03 Hours**
	Problem-solving: Solving problem by searching, Informed search methods, Game Playing.	**05 Hours**
	Knowledge and reasoning: First order logic, Interference in first-order logic, Logical Reasoning System, Probabilistic Reasoning, Making Simple Decision.	**04 Hours**
	Module 2 Learning	
	Learning from observations: A general model of learning agents, inductive learning, learning decision trees, accessing the performance of learning algorithms, current-best hypothesis search.	**05 Hours**
	Learning Neural and Belief Network: Neural Network, Perceptrons, Multilayer Feed Forward Network, Application of Neural Networks, Bayesian methods for learning Belief Network.	**06 Hours**
	Reinforcement Learning: Passive learning in known environment, unknown environment, Generalization in Reinforcement learning, Genetic Algorithms	**04 Hours**
	Module 3 Communicating, perceiving and acting	
	Agents that communicate: Communication as action, types of communicating agents, Augmenting a Grammar, Semantic Interpretation	**03 Hours**

	Practical Natural Language Processing: Machine Translation, Efficient Parsing, Scaling Up the Lexicon, Scaling Up the Grammar, Handling agrammatical strings, ambiguity.	**06 Hours**
	Perception: Image formation, Image processing operations for early vision, Extracting 3D information from vision, Object representation and recognition, Speech recognition, Signal processing.	**06 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Implementation of breadth-first search. 2. Implementation of depth first search. 3. Implementation of toy problem. 4. Implementation of hill climbing search 5. Implementation of decision tree 6. Implementation of reinforcement learning algorithm 7. Implementation of convolutional neural network algorithm 8. Implementation of Multilayer feed forward neural network algorithm 9. Implementation of handwritten character recognition	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition, Prentice-Hall, 2009. 2. Patrick Henry Winston, Artificial Intelligence, Third Edition, Addison-Wesley Publishing Company, 2004 3. Ian GoodFellow, Yoshua Bengio & Aaron Courville, Deep Learning, MIT Press, 2016. 4. George F Lugar, Artificial Intelligence: Structure and strategies for complex, Problem Solving, 6th Edition, Pearson, 2021.	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the iterative and informed problem types and apply search strategies to solve them. 2. Apply Neural Network and Reinforcement learning algorithms in various applications. 3. Use Natural Language Processing in practice and development of various perceptron algorithm.\ 4. Implement different search algorithms and neural network algorithms for many applications.	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-402
Title of the Course : Fundamentals of Signal processing
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have the basic knowledge of Mathematics	
Course Objectives:	This course is intended to: 1. Understand mathematical description and representation of continuous and discrete time signals and systems. 2. Understand the signals in frequency domain using Fourier series. 3. Discuss different types of analog and Digital filters	
Content:	**Module 1 Fundamentals of Discrete- Time Systems**	
	Fundamentals of Discrete- Time Systems: Basic Definitions of Continuous-time signal and Periodic discrete-time signal. Important Discrete- time Signals: Unit-sample sequence, Unit step sequence, Real-exponential sequence, Sinusoidal sequence, Unit ramp sequence. Basic operations on Signals: Amplitude scaling, Addition and Subtraction, Multiplication, Folding or time reversal, Shifting.	**07 Hours**
	Discrete-Time Systems (DTS): Linear system and Shift-invariant system. Convolution theorem: Commutativity, Associativity, Distributivity over sequence addition. Bounded input- bounded output stability of a discrete time system, Casuality: Casual and non-casual sequences. Static and dynamic systems. Finite Impulse (FIR) and Infinite Impulse Response (IIR) Systems: FIR system and IIR system	**09 Hours**
	Module 2 Discrete Fourier Transform and Fast Fourier Transform	
	Frequency Domain Representation of Discrete-Time Signals Discrete- Time Fourier Series, Discrete- Time Fourier Transform (DTFT), Fourier Transform of Some Standard signal: Unit impulse, Unit- step sequence, Single sided exponential pulse, left-handed exponential signal, double sided signal, rectangular pulse. Properties of Fourier Transform: Periodicity, Linearity, Time shifting, Frequency shifting, Time reversal, Convolution property, Differentiation in frequency, Correlation theorem, Multiplication of two sequences (Multiplication Theorem), Modulation theorem, Sampling Process: Sampling theorem, Nyquist rate, Frequency spectrum of sampled signals, Aliasing effect.	**07 Hours**
	Discrete Fourier Transform and Fast Fourier Transform:	**08 Hours**

	Continuous- Time Fourier Series, Discrete- Time Fourier Series, The DFT, Properties of DFT: Linearity, Periodicity, Circular symmetries of a sequence, Circular convolution, Multiplication of two sequences. Computation of DFT, Fast Fourier Transform (FFT), Inverse DFT Computation	
	Module 3 Design of Analog and Digital Filters	
	Design of Analog Filters: Butterworth Filters, Chebyshev Filters: Type-I Chebyshev Filters, Type-II Chebyshev Filters, Elliptical Filters.	**06 Hours**
	Digital Filter Design: Fundamentals of Digital Filters: Advantages of Digital filters, Limitations of digital filter, Design of IIR Filters, Design of FIR Filters, Design of FIR Filters using Windows: Rectangular Window, Hanning window, blackman window Kaiser window, Design of FIR filters using the Frequency Sampling Approach.	**09 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: Develop MATLAB/other mathematical simulation software simulations of various signals. 1. Generation of Signals: continuous time and discrete time 2. Convolution of Signals 3. Fourier series representation of continuous time signals and Discrete- time signals. 4. Fourier transform of continuous time signals and Discrete- time signals. 5. Fast Fourier Transform 6. Design of a Butterworth analog low pass filter. 7. Design of a Chebyshev type I analog high pass filter. 8. Design of FIR low pass filter using the hanning window. 9. Design of FIR band pass/ band stop filter using the blackman window. 10. Design of FIR high pass filter using the Kaiser window.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Sanjit K Mitra, 'Digital Signal Processing: A computer Based Approach, 3rd Edition, Tata MacGraw-Hill, 2011 2. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education (2007) 3. W. Y. Young, Signals and Systems with MATLAB, Springer (2009) 4. Richard G. Lyons, 'Understanding Digital Signal Processing', Pearson, 2022. 5. Dilip S. Mali, 'Digital Signal Processing: Simplified', Penram, 2013.	
Course Outcomes:	On completion of the course, students will be able to: 1. Describe various types of continuous-time and discrete-time signals 2. Understand Discrete-Time Fourier Series, Discrete Fourier Transform and Fast Fourier Transform.	

	3. Designing of various Analog filters. 4. Learn different structural representation of FIR and IIR digital filters

Name of the Programme : B.Sc. Electronics
Course Code : ELE-403
Title of the Course : Optoelectronics
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Fair understanding of Semiconductor Physics	
Course Objectives:	This course is intended to: • Understand the basic Physics behind Optoelectronic devices. • Acquire basic understanding of Primary devices of Optoelectronics i.e. display devices and photodetectors. • To provide adequate knowledge about Laser fundamentals and the basics of optical Fibers and their properties.	
Content:	**Module 1 Elements of Optics**	
	Nature of light: Electromagnetic spectrum, wave nature of light, standing waves, Blackbody radiation, colour temperature, units of light: radiometric and photometric units, Plane waves in homogeneous media, concept of spherical and cylindrical waves. Reflection and transmission at an interface, total internal reflection, refractive index, dispersion.	**03 Hours**
	Interference: Principle of superposition, Concept of coherence, Superposition of waves of same frequency, Interference by division of wave front and division of amplitude, Young's double slit, thin film interference, Newton's rings, Michelson interferometer.	**05 Hours**
	Diffraction: Huygens Fresnel Principle, Fresnel and Fraunhoffer diffraction. Fraunhoffer diffraction by a single slit, double slit, N slit - diffraction grating; Resolving power: The Rayleigh criterion. resolving power of telescopes.	**04 Hours**
	Polarization: Linear, circular and elliptical polarization, polarizer-analyser, Malus' law, Brewster's Law. Double refraction, Nichol prism, Retardation plates, optical activity.	**03 Hours**
	Module 2 Display devices and optical detectors	
	Display devices: Luminescence, Cathode ray tube, Electroluminescence; Light Emitting Diodes: Construction, materials and operation. Response time; Liquid Crystal displays: Principle, types and applications, advantages over LED displays, Plasma displays	**07 Hours**
	Photodetectors: Detector performance and parameters, Bolometer, Photomultiplier tube, Charge Coupled Device, Photodiodes (p-i-n and avalanche), photo transistors,	**08 Hours**

	photodiode response time, Photovoltaic Devices, Solar cells , recent photo detectors, optocoupler and opto-isolator.	
	Module 3 Lasers and Optical Fibers	
	Lasers: Interaction of radiation and matter, Einstein coefficients, Condition for amplification, laser cavity, population inversion, threshold for laser oscillation, line shape function, Classes of lasers, He-Ne laser, CO_2 laser, semiconductor laser diode, laser properties and applications.	**06 Hours**
	Fiber Optics: Optical waveguide, evolution of fiber optic system, fiber construction, fiber cables, types of couplers, characteristics of fiber, operation of fiber, advantages and disadvantages of optical fiber, losses in fibers, modes of fiber and types of fiber.	**07 Hours**
	Fiber Optic Link: Point to point optical link, WDM Concepts and Components, SONET.	**02 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Determination of wavelength of sodium light using Newton's Rings. 2. Determination of the resolving power and Dispersive power of Diffraction Grating. 3. Study Brewster's law and verification of law of Malus for plane polarized light. 4. Diffraction experiments using a laser. 5. To determine characteristics of LEDs (Radiation pattern, Power Vs. Current) 6. Photodiode responsivity characterization and Photo detector circuit using OP-amp 7. Measurement of the numerical aperture of an optical Fiber. 8. Construction of an analogue and digital link using optical Fiber. 9. Fiber optic communication system	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Ajoy Ghatak, Optics, Tata McGraw Hill, New Delhi, 2005 2. Subrahmanyam N, A Textbook of Optics, S. Chand & Co Ltd, India, 25th Revised Ed., 2012 3. J. Wilson and J. F. B. Hawkes, Optoelectronics: An Introduction, Prentice Hall India,1996 4. S. O. Kasap, Optoelectronics and Photonics: Principles and Practices, Pearson Education, 2009 5. A. Yariv and P. Yeh, Photonics: Optical electronics in Modern Communications, 6th Ed. Oxford University Press, 2007	

Course Outcomes:	On completion of the course, students will be able to: 1. Understand the basic working mechanism of the Optoelectronic devices 2. Predict the most fundamental performance characteristics of a given optoelectronic device design 3. Choose the most appropriate optoelectronic device for a specific application and understand possibilities and limitations offered by that particular device 4. Understand the basic lasers operations and fiber devices.

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-411**
Title of the Course : **Mobile App Development s**
Number of Credits : **04 (3L+1P)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Should have the basic knowledge of Programming	
Course Objectives:	This course is intended to: • Develop understanding about basic concepts of building mobile application. • Apply android services, layouts, graphic resources, data management, user interface event concepts to mobile app development. • Design and develop mobile application.	
Content:	**Module 1 Mobile application development environment**	
	Introduction: What is Mobile Application Programming, Different Platforms, Architecture and working of Android and iOS, comparison of Android and iOS.	**01 Hours**
	Android Development Environment: What is Android, Advantages and Future of Android, Tools and about Android SDK, Installing Java, Eclipse, and Android, Android Software Development Kit for Eclipse, Android Development Tool: Android Tools for Eclipse, AVDs: Smartphone Emulators, Image Editing.	**05 Hours**
	Android Software Development Platform: Understanding Java SE and the Dalvik Virtual Machine, Directory Structure of an Android Project, Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes, Launching Your Application: The AndroidManifest.xml File, Creating Your First Android Application.	**09 Hours**
	Module 2 Android Framework	
	Android Framework Overview: The Foundation of OOP, The APK File, Android Application Components, Android Activities: Defining the User Interface, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications, Content Providers: Data Management, Android Intent Objects: Messaging for Components, Android Manifest XML: Declaring Your Components.	**03 Hours**
	Screen Layout Design: Views and Layouts.	**02 Hours**
	UI Design: Buttons, Menus, and Dialogs.	**02 Hours**
	Graphics Resources in Android: Introducing the Drawables**,** Implementing Images**,** Core Drawable Subclasses, Using Bitmap, PNG, JPEG and GIF Images in Android, Creating Animation in Android.	**03 Hours**
	Handling User Interface (UI) Events:	**05 Hours**

	An Overview of UI Events in Android, Listening for And Handling Events, Handling UI Events via the View Class, Event Call-back Methods, Handling on Click Events, Touchscreen Events, Keyboard Events, Context Menus, Controlling the Focus.	
	Module 3 Understanding Content Providers and Intents	
	Content Providers: An Overview of Android Content Providers, Defining a Content Provider, Working with a Database.	**07 Hours**
	Intents and Intent Filters: Intent, Implicit Intents and Explicit Intents, Intents with Activities, Intents with Broadcast Receivers.	**07 Hour**
	Advanced Android: New Features in Android.	**01 Hour**
	Module 4 Practical's	**30 Hours**
	Any seven from below: Remove the sentences everywhere 1. Create "Hello World" application. That will display "Hello World" in the middle of the screen in the emulator. Also display "Hello World" in the middle of the screen in the Android Phone. 2. Create 4 buttons which displays four values. 3. Create an application with login module. (Check username and password). 4. Create spinner with strings taken from resource folder (res >> value folder) and on changing the spinner value, Image will change. 5. Create a menu with 5 options and and selected option should appear in text box. 6. Create a list of all courses in your college and on selecting a particular course teacher-in-charge of that course should appear at the bottom of the screen. 7. Create an application with three option buttons, on selecting a button color of the screen will change. 8. Create and Login application. On successful login, pop up the message. 9. Mobile app development with database	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Wallace Jackson, Android Apps for Absolute Beginners, Apress Publication. 2. Reto Meier, Professional Android 4 Application Development, Wrox	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the basic concepts of Apps Development. 2. Apply Android Services, Layouts, Graphic Resources, Data Management Concepts to Mobile App Development. 3. Design and Develop Mobile Apps for specific applications. 4. Design and Develop Mobile Apps with database.	

Name of the Programme : **B.Sc. Electronics**
Course Code : **ELE-404**
Title of the Course : **REMOTE SENSING IN AGRO-ELECTRONICS s**
Number of Credits : **04 (3L+1P)**
Effective from AY : **2023-24**

Pre-requisites for the Course:	Should have the basic concepts of digital signal processing	
Course Objectives:	This course is intended to: • To introduce the principles and basic concepts of Remote Sensing and GIS • To introduce the remote sensing systems, data products and analysis • To introduce the spatial data models, analysis and presentation techniques • To study the applications of Remote Sensing and GIS in agriculture, soil and water resources	
Content:	**Module 1 REMOTE SENSING AND ANALYSIS**	
	CONCEPTS OF REMOTE SENSING AND SATELLITES Definition- Historical background - Components of remote sensing – Energy source, electromagnetic spectrum, radiation principle, platforms and sensors - Active and passive remote sensing interference - Atmospheric effects on remote sensing – Energy interaction with earth surface feature - Data acquisition - Reflectance, spectral signatures for water, soil and vegetation.- Satellites - Types - Sun synchronous - Geo synchronous remote sensing satellites - LANDSAT,SPOT & IRS - Resolution - Spectral, spatial, radiometric and Temporal resolution - Recent satellites with its applications	**8 Hours**
	DATA PRODUCTS AND IMAGE ANALYSIS Data products –based on level of processing- o/p – scale – area/coverage – data availability – data ordering- data price - Image interpretation – Visual interpretation elements – interpretation key. Digital image processing – Image enhancement – image classification – Supervised and unsupervised – Vegetation Indices.	**7 Hours**
	Module 2 DATA PRODUCTS AND IMAGE ANALYSIS AND GIS	
	Data products based on level of processing- o/p – scale – area/coverage – data availability – data ordering- data price - Image interpretation – Visual interpretation elements – interpretation key. Digital image processing – Image enhancement – image classification – Supervised and unsupervised – Vegetation Indices	**8 Hours**
	CONCEPTS OF GIS Definition – Map and their influences – Characteristics of Maps – Elements – Map scale, Projection, Coordinate systems	**7 Hours**

	– Sources of spatial data – History and development of GIS – Definition – Components – Hardware and Software.	
	Module 3 APPLICATION OF RS AND GIS	
	DATA INPUT AND ANALYSIS Definition – Map and their influences – Characteristics of Maps – Elements – Map scale, Projection, Coordinate systems – Sources of spatial data – History and development of GIS – Definition – Components – Hardware and Software.	**7 Hours**
	APPLICATION OF RS AND GIS Crop Acreage estimation - Estimation of Crop Water Requirement – Crop condition - Soil mapping – classification of soil with digital numbers – soil erosion mapping- reservoir sedimentation using image processing - Inventory of water resources – water quality assessment - Application of Remote Sensing and GIS in Precision Agriculture - Monitor Crop Health - Management Decision Support Systems	**8 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Measurement of relief displacement using parallax bar 2. Stereoscopic vision test 3. Aerial photo interpretation - visual 4. Satellite images interpretation – visual 5. Supervised classification practice 6. Unsupervised classification practice 7. Database Management Systems 8. Spatial data input and editing - Digitising 9. Raster analysis problems – Database query 10. GIS applications in DEM and its analysis 11. GIS application in watershed analysis 12. GIS application in rainfall-runoff modelling 13. GIS application in soil erosion modelling	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Anji Reddy. M, Remote Sensing and Geographical Information Systems, BS Publications, Hyderbad, 2001 2. Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000. 3. Bettinger, P., and Michael, G.W., "Geographical Information System: Applications in Forestry and Natural Resources Management," Tata McGraw–Hill Higher Education, New Delhi, 2003 4. Ian Heywood., "An Introduction to GIS", Pearson Education, New Delhi, 2001. 5. Jeffery Star and John Estes, "Geographical Information System – An Introduction," Prentice Hall India Pvt. Ltd., New Delhi, 1998. 6. Patel A.N & Surendra Singh, "Remote sensing principles & applications", Scientific Publishers , Jodhpur 1992	

Course Outcomes:	On completion of the course, students will be able to: 1. Understand the remote sensing principles and systems. 2. Know the concept of GIS and its tools. 3. Have knowledge on data input and analysis techniques. 4. Utilize these advanced techniques in addressing the real world problems like Agriculture

Name of the Programme : B.Sc. Electronics
Course Code : ELE-405
Title of the Course : Digital Image Processing s
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have the basic concepts of digital signal processing	
Course Objectives:	This course is intended to: • To develop understanding of the fundamentals of spatial data representation. • To impart the knowledge of the fundamentals of digital image processing. • To develop skills in image processing techniques	
Content:	**Module 1 Introduction and Image enhancement in spatial domain**	
	Digital image fundamentals: Visual perception, image sensing and acquisition, sampling and quantization, basic relationship between pixels and their neighbourhood properties.	**05 Hours**
	Image enhancement in spatial domain: Gray-level transformations, histogram equalization, Spatial filters- averaging, order statistics; Edge detection: first and second derivative filters, Sobel, Canny, Laplacian and Laplacian-of Gaussian masks.	**10 Hours**
	Module 2 Image enhancement in frequency domain and Image restoration	
	Image filtering in frequency domain: One and two-dimensional DFT, properties of 2-D DFT, periodicity properties, convolution and correlation theorems, Fast Fourier Transforms, Smoothing and sharpening filtering in frequency domain.	**08 Hours**
	Image restoration: Degradation/ restoration process, noise models, restoration in presence of noise-only spatial filtering, linear position-invariant degradations, estimating the degradation function, inverse filtering, Wiener filtering, constrained least squares filtering, geometric transformations.	**07 Hours**
	Module 3 Color Image processing, Morphological Image Processing, and Image segmentation.	
	Color image processing: Color models RGB, HSI, YUV, pseudo-color image processing, full-color image processing, color transformation, color segmentation, noise in color images.	**07 Hours**
	Morphological Image Processing: Basic operations- dilation, erosion, opening, closing, Hit-Miss transformations, Basic morphological algorithms- boundary extraction, region filling.	**04 Hours**

	Image segmentation: : Edge linking and boundary detection, global and adaptive thresholding, Region based segmentation, Segmentation by morphological watersheds, motion-based segmentation.	**04 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. Display of gray scale images 2. Histogram Equalization 3. Design non-linear filtering 4. Determination of edge detection using operators 5. 2-D DFT and DCT 6. Filtering in Frequency domain 7. Display of colour images 8. Conversion between colour spaces 9. DWT of images 10. Segmentation using watershed transform	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Jain A.K, "Fundamentals of Digital Image Processing", 4th Edition, Prentice hall of India, 2004. 2. Rafael.C,Gonzalez, Richard E Woods, "Digital Image Processing", 3rdEdition, Pearson India, 2013. 3. Gonzalez, Woods, Eddins, "Digital Image Processing using MATLAB", 2nd Edition, Gatesmark Publishing,2009. 4. B.Chanda, D. DuttaMajumder, "Digital Image Processing and Analysis", 2ndEdition, Phi learning, 2011. 5. William K Pratt, "Digital Image Processing", 4th Edition, Wiley, 2012. 6. Dr. Sanjay Sharma,"Fundamentals of Digital Image Processing", S.K. Kataria & Sons, 4th Edition, 2008.	
Course Outcomes:	On completion of the course, students will be able to: 1. Explain the fundamentals of Digital Image and Image enhancement in the spatial domain. 2. Explain the concepts of Image enhancement in frequency domain and Image restoration. 3. Explain the concepts of Color Image processing, Morphological Image Processing, and Image segmentation techniques. 4. Implementing image processing concepts using time and frequency concept	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-406
Title of the Course : VLSI Design
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Nil	
Course Objectives:	This course is intended to: • Introduce to the VLSI Technology, various fabrications processes involved in IC design • To understand Electrical and Electronics analysis of few circuits, Some Design examples of VLSI circuits. • To analyse Circuit Optimization techniques, Advance circuits designs examples of Memory, Registers, Synchronous circuits etc.	
Content:	**Module 1 MOS technology**	
	MOS transistor: Structure, MOS system under external bias, operating regions, threshold voltage, MOSFET I-V characteristics.	**02 Hours**
	MOSFET Scaling and small geometry effects: Full scaling, constant voltage scaling, short channel effects, narrow channel effects, MOSFET capacitances.	**03 Hours**
	Spice Modeling: Modeling of MOS transistor using SPICE Level1 model equations.	**03 Hours**
	Inverters: Passive and Active load MOS inverters, CMOS Inverter - Design, DC characteristics, Noise Margin, Power and Area considerations.	**05 Hours**
	CMOS Layout: Design rules, stick diagrams.	**02 Hours**
	Module 2 Logic Electronics Interface	
	Combinational MOS Logic circuits: CMOS NOR, NAND Logic circuits, Complex logic circuits, Euler's path, Adder circuits, Transmission gates.	**04 Hours**
	Sequential MOS Logic Circuits: Latches, flip-flops, registers.	**03 Hours**
	CMOS technology: Basic n-well and p-well CMOS process fabrication steps.	**04 Hours**
	Validation and testing: Design for Testability (DFT), Scan – Based Test, Boundary Scan Design, Built in self test(BIST),Built in Logic Block Observer (BILBO), Linear Feedback Shift Register (LFSR), Automatic Test-Pattern generation (ATPG), fault models.	**04 Hours**
	Module 3 VHDL Programming	
	VHDL: Introduction, Basic language elements - identifiers, data objects, data types, entity, architectures, signals and variables.	**05 Hours**
	Modeling styles:	**08 Hours**

	Behavioral modeling. Sequential processing statements. Dataflow modeling, on current signal assignment and conditional signal assignment statements. Structural modeling, Component declaration, instantiation. Generics, Attributes, Configuration, Packages, Libraries.	
	VHDL Simulation: Simulation delta, transport and inertial delay models, test bench**.** VHDL Synthesis.	**02 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: 1. CMOS Inverter : a. Design and verify the circuit (using 180 nm techonology) using transient analysis. b. Obtain VTC curve and threshold voltage of inverter for a specific parameter, verify with the value of threshold voltage obtained using formula. c. Create symbol of this inverter for further application. 2. Design NAND and NOR gate using 180 nm technology perform all the analysis using. 3. Design XOR gate by using NAND and NOR gate. Perform transient analysis. 4. Design 1-bit half adder using 90 nm technology and verify the circuit using transient analysis. 5. Design Full adder using 90 nm technology and verify the circuit using transient analysis. 6. Design a multiplexer using 90 nm technology and perform all the analysis to verify its characteristics. 7. Design a MOS based SRAM cell using 90 nm technology and verify its characteristics. 8. Design NOR gate using Domino logic CMOS inverter and verify its characteristics. 9. Design CMOS transmission gate and perform all the analysis to verify its characteristics. 10. Design XOR and XNOR gate using dynamic CMOS logic circuits and verify its characteristics. 11. Design Layout of CMOS inverter and perform post layout analysis, Monte Carlo analysis, Corner analysis and etc.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and design, 3rd edition, Tata McGraw Hill Publication. 2. Douglas Pucknell, Kamran Eshraghian, Basic VLSI Design, 3rd edition, Prentice-Hall of India. 3. Jan M. Rabaey , Digital Integrated Circuits, Prentice Hall India 4. J. Bhaskar, "VHDL Primer	

	5. Douglas Perry ,"VHDL Programming by Example " Tata McGraw Hill Publication 6. DebaprasadDas ," VLSI Design "Oxford University Press
Course Outcomes:	On completion of the course, students will be able to: 1. Understand modern CMOS Technology. 2. Apply CMOS integrated circuit concepts in VLSI design. 3. Analyse CMOS logic electronics interface. 4. Design VLSI circuits.

Name of the Programme : B.Sc. Electronics
Course Code : ELE-407
Title of the Course : Industrial Automation
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	**Basic knowledge of Mathematics and Microcontrollers**	
Course Objectives:	This course is intended to: 1. To introduce control system using mathematical concepts 2. To design and develop ladder logic programming 3. Understand the working principle of SCADA system	
Content:	**Module 1 Control system**	
	Introduction Introduction to control systems, Examples of control systems, types of control systems: basic concept of open-loop and closed-loop control systems, Mathematical models of control systems, Mechanical translational systems, Mechanical rotational systems, Electrical analogous of mechanical translational systems (force-voltage analogy and force current analogy), Block diagrams and graph signals,	**10 Hours**
	Controllers: P- Controller, PI- Controller and PID controller.	**05 Hours**
	Module 2 PLC Programming	
	Introduction to Process Control: Process Control Systems, Process control block diagram, Process control Evaluation, ON/OFF control, Analog Control, Digital Control. 2hrs	**02 Hours**
	Programmable Logic Controller (PLC): Definition, Advantages of a PLC, Characteristics function of a PLC, Types of PLC's, Block diagram of a PLC, Processor Software, Ladder language, PLC input & Output symbols, Numbering system of Inputs and outputs, Input field devices, Output field Devices, Classification of I/O modules, I/O system overview.	**03 Hours**
	PLC Programming: Introduction to ladder logic design (AND, OR, NOT, NAND, NOR, Multiplexer, Demultiplexer, De Morgan's Theorem etc.).	**02 Hours**
	PLC Timers and Counters: Definition and Classification of a Timer, Characteristics of a PLC Timer, Classification of a Timer: ON-Delay and OFF delay Timer, Retentive and Non-Retentive Timer, PLC Counter, Operation of a PLC counter, Counter Parameters, Counter Instructions. ladder diagram designs using Timers and Counters, PLC scanning.	**03 Hours**
	PLC Advanced Instructions: Introduction, Comparison instructions, Addressing Data files, Format of logical address, Different Addressing Types,	**05 Hours**

	Data movement instructions, Logical instructions, Mathematical instructions, PID instruction, Large process Ladder diagram construction, Introduction to structured text programming, Sequential Function Chart Programming and Function Block diagram Programming (in short), Selection of PLC's.	
	Module 3 SCADA	
	Industrial Automation: Introduction, Utility of Automation, General structure of an Automated Process, Industrial Automation vs Information Technology, Industrial Automation Hierarchy,	**05 Hours**
	Industrial automation Components: Smart sensors, PLC, DCS and SCADA . Introduction of SCADA, Basic components of SCADA, SCADA block diagram, SCADA systems structured, System concepts, Fundamental principles of modern SCADA systems, SCADA software and hardware, Communication in SCADA, SCADA and Local Area Networks, Distributed Control Systems (DCS), Functionality of SCADA, System Configuration, Consideration and Benefits of SCADA system, RTU, Comparison between DCS and SCADA, SCADA Applications, SCADA protocols: IEC 60870-5-101 and DNP3 (in short).	**10 Hours**
	Module 4 Practical's	**30 Hours**
	Any seven from below: (Min 4 from PLC and 3 from SCADA) **PLC PRACTICALS:** 1. PLC ladder Program for logic functions: AND, OR, NAND, NOR and XOR. 2. PLC ladder Program to prove De Morgan's theorem. 3. PLC ladder Program to apply timer function to process control. 4. PLC ladder Program to apply counter function to process control. 5. PLC ladder Program to control VFD (Variable Frequency drive). 6. PLC based application program for automatic indication for water tank level. 7. PLC based application program for traffic light indication. 8. PLC based application program for controlling Robotic arms. 9. PLC based application program for interfacing digital input and output devices. 10. PLC based application program for interfacing analog input and output devices. **SCADA PRACTICALS:**	

	1. Use of slider as TAG and different TAG generation. 2. Creating simple START STOP logic using a script. 3. Creating mimic for bottle filling plant. 4. Creating and understanding alarms. 5. Password setting and security in SCADA. 6. Use of real time and historical trend for real time application. 7. SCADA based acquiring PLC data through communication. 8. Controlling PLC output through SCADA to run ac induction motor.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. A. Nagoor Kani, "Control System", RBA Publications, No.58, Seshachalam Street, Saidapet, Chennai, 600 015, Third edition, 2017. 2. Madhuchhanda Mitra and Samarpit Sengupta, "Programmable Logic Controllers and Industrial Automation", Penram International Publisher, 2nd edition, 2017 3. Jitender Singh and Monika Deswal, "PLC and SCADA", University Science Press, 1st Edition 2015. 4. Prof. Rajesh Mehra and Er. Vikrant Vij, "PLCs & SCADA Theory and Practice", University Science Press, First Edition 2018. 5. Curtis D. Johnson "Process Control Instrumentation Technology", Pearson education , 7th Edition, 2017. 6. Jon Stenerson "Programming ControlLogix Programmable Automation Controllers", CENCAGE Learning, 1St Edition 2019 7. Farid Golnaraghi and Benjamin C. Kuo " Automatic Control Systems" Wiley 9th student edition, 2021 8. John W. Web, Ronald A. Reis, "Programmable Logic Controllers" 5th Edition, PHI, 2007	
Course Outcomes:	On completion of the course, students will be able to: 1. Understand the working of control systems using mathematical models 2. Understand the working principle of PLC 3. Understand the working principle of SCADA 4. Develop and implement industrial based applications using PLC and SCADA	

Name of the Programme : B.Sc. Electronics
Course Code : ELE-412
Title of the Course : Pharmaceutical Instrumentation
Number of Credits : 04 (3L+1P)
Effective from AY : 2023-24

Pre-requisites for the Course:	Should have the basic knowledge of analog and digital electronics	
Course Objectives:	This course is intended to: • To develop understanding of the concepts of Electroanalytical methods, Spectrometric, Separative Methods and Microscopy. • To develop skill in the usage of analytical instruments used in pharmaceutical industries and laboratories. • To impart the knowledge calibration and basic troubleshooting of analytical instruments.	
Content:	**Module 1 Introduction and Spectrometric methods-I**	
	Introduction to Chemical Instrumental Analysis: Advantages over classical methods, classification, various units used in chemical analysis. Introduction to Electroanalytical methods, potentiometry, voltammetry, coulometry, pH meter.	**07 Hour**
	Spectrometric Methods-I: Laws of Photometry, Instrument components, UV-visible instrument component, photo colorimeters, single and double beam instruments, various types of UV-visible spectrophotometers. Atomic absorption spectrophotometer: Principle, working, hollow cathode lamp, atomizer, back-ground correction.	**08 Hours**
	Module 2 Spectrometric methods-II and Spectrometric methods-III	
	Spectrometric Methods-II IR spectroscopy: Principle, IR sources, IR detectors, dispersive and Fouriertroscopy. Atomic Emission Spectroscopy: Principle, types, Flame photometer, DC arc and AC arc excitation, plasma excitation. X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffractometer: Bragg's law.	**07 Hours**
	Spectrometric Methods-III: Fluorimeters and Phosphorimeters: Principle, spectrofluorimeters, spectrophosporimeter, Raman effect, Raman spectrometer, Nuclear Magnetic Resonance (NMR) spectrometry: Chemical shift, principle, working of NMR, FT-NMR Miscellaneous Instruments: Gas analysers: CO, CO2, Hydrocarbons, O_2, NOx	**08 Hours**
	Module 3 Separative Methods and microscopy	
	Separative Methods: Chromatography: Classification, Gas chromatography: principle, constructional details, GC detectors, High	**08 Hours**

	Performance Liquid Chromatography (HPLC): principle, constructional details, HPLC detectors.	
	Electron microscopy: TEM & SEM- principles, instrumentation and analysis, scanning tunneling microscopy, atomic force microscopy, principles, instrumentation and analysis- applications.	**07 Hours**
	Module 4 Practical's	**30 Hours**
	1. Construction of Analog pH Meter using Opamp. 2. Demonstration of FT-IR spectrophotometer in identifying spectra of drugs. 3. Estimation of dextrose by colorimetry and its calibration. 4. Determination of absorbance of a solution by UV Visible- Spectrophotometry. 5. Demonstration experiment on HPLC and its basic troubleshooting. 6. Demonstration experiment on Gas Chromatography and its basic troubleshooting. 7. Filed visit for demonstration of SEM.	
Pedagogy:	Lectures/Tutorial/Assignments/Presentation	
References/ Readings:	1. Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, 7th edition, CBS Publishers & Distributors, New Delhi, 2004. 2. Galen W. Ewing,Instrumental Methods of Chemical Analysis, 5th edition, McGraw-Hill Book Company, 1985. 3. Robert D. Braun, Introduction to Instrumental Analysis, 2nd edition, Pharma Med Press, 2016. 4. Skoog, Holler, Crouch, Principles of Instrumental Analysis, 7th edition, Cengage Learning Asia Pte Limited, 2018.	
Course Outcomes:	On completion of the course, students will be able to: 1. Explain the spectroscopng methods, principles and working. 2. Explain the principles and working of electron microscopy 3. IR, Atomic emission and X-ray spectrometry. 4. Explain the principles and working of chromatography and electron microscopy.	