Khandesh College Education Society's

# Moolji Jaitha College, Jalgaon

An "Autonomous College" Affiliated to
KBC North Maharashtra University, Jalgaon

KNOWLEDGE IS POWER

ESTD. 1945

# SYLLABUS

MOOLJI JAITHA COLLEGE, JALGAON · DEPT. OF ELECTRONICS · AUTONOMOUS

# Electronics

## T.Y.B. Sc.

## (Semester V & VI)

**Under Choice Based Credit System (CBCS)**

**[w. e. f. Academic Year: 2021-22]**

Department of Electronics
Moolji Jaitha College, Jalgaon
(Autonomous)

# T.Y.B.Sc. Electronics (CBCS pattern)

**Program Specific Outcomes (PSO):**

- Students are expected to acquire core knowledge in electronics, including the major areas of operational amplifiers, power electronics, instrumentation, optoelectronics, embedded systems, digital system design, electronic communication, sensors and actuators, mechatronics and digital Machining, biomedical instrumentation, arduino introduction, python programming, Labview programming, process automation andp logic control.
- Students will show that they have learned laboratory skills enabling them to take measurements in a electronics laboratory and analyze the measurements to draw valid conclusion.
- Student will be able to develop research oriented skills.
- Students will be capable of oral and written scientific communication and will prove that they can think critically and work independently.

**Learning Objectives:**

- To acquaint the students with various disciplines of electronics.
- To articulate foundation and pillar level knowledge of electronics for the beneficiaries to apply them for advanced studies in the subject.
- To develop laboratory skills with a sound theoretical background.
- To apply the knowledge gained for higher education, research and profession of their choice.
- To analyse their interests among the various disciplines and implement them in their professional endeavours.

**Exam Pattern:**

- Each theory and practical course will be of 50 marks comprising of 10 marks internal and 40 marks external examination.

**External Theory Examination (40 marks):**

- External examination will be of two hours duration for each theory course. There shall be 4 questions each carrying equal marks (10 marks each) while the tentative pattern of question papers shall be as follows;
  - Q1 (A), Q2 (A) and Q3 (A), each will be of 6 marks (attempt any 2 out of 3 sub-questions).
  - Q1 (B), Q2 (B) and Q3 (B), each will be of 4 marks (attempt any 1 out of 2 sub-questions).
  - Q4 will be of 10 marks (attempt any 2 out of 3 sub-questions).

**External Practical Examination (40 marks):**

- Practical examination shall be conducted by the department at the end of the semester. Practical examination will be of minimum 3 hours duration and shall be conducted as per schedule. There shall be 05 marks for journal, 10 marks for *viva-voce*. Certified journal is compulsory to appear for practical examination.

**Internal Theory/ Practical Examination (10 marks):**

- Internal theory assessment of the student by respective teacher will be comprehensive and continuous, based on written test/ assignment. The written test may comprise of both objective and subjective type questions.
- Internal practical examination should be conducted by respective department as per schedule given. For internal practical examination student should perform at least one experiment and should have completed journal.

## Structure of T.Y.B.Sc. (Electronics) Curriculum Semester V

| Discipline | Course Type | Course Code | Course Title | Credits | Hours/ Week (Clock Hours) | Total Teaching hours | Marks | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int | Ext |
| DSC | Core I | ELE-351 | Operational Amplifiers and Applications | 3 | 3 | 45 | 10 | 40 |
| | Core II | ELE-352 | Design with Analog IC | 3 | 3 | 45 | 10 | 40 |
| | Core III | ELE-353 | Power electronics | 3 | 3 | 45 | 10 | 40 |
| | Core IV | ELE-354 | Embedded system | 3 | 3 | 45 | 10 | 40 |
| | Core V | ELE-355 | Sensor and Actuators | 3 | 3 | 45 | 10 | 40 |
| | Core VI | ELE-356(A) / ELE-356(B) | Instrumentation / Process Automation and Programmable Logic Control | 3 | 3 | 45 | 10 | 40 |
| SEC | Skill Based | ELE-350 | Programming with LabVIEW | 2 | 2 | 30 | 10 | 40 |
| DSC | Core (Practical) | ELE-357 | Laboratory-I | 2 | 4 / batch | 60 | 10 | 40 |
| | | ELE-358 | Laboratory-II | 2 | 4 / batch | 60 | 10 | 40 |
| | | ELE-359 | Project-I | 2 | 4 / batch | 60 | 10 | 40 |

## Structure of T.Y.B.Sc. (Electronics) Curriculum Semester VI

| Discipline | Course Type | Course Code | Course Title | Credits | Hours/ Week (Clock Hours) | Total Teaching hours | Marks | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Int | Ext |
| DSC | Core I | ELE-361 | Advance digital system design | 3 | 3 | 45 | 10 | 40 |
| | Core II | ELE-362 | Transmission Lines, Antenna and Wave Propagation | 3 | 3 | 45 | 10 | 40 |
| | Core III | ELE-363 | Optoelectronics | 3 | 3 | 45 | 10 | 40 |
| | Core IV | ELE-364 | Biomedical Instrumentation | 3 | 3 | 45 | 10 | 40 |
| | Core V | ELE-365 | Python Programming | 3 | 3 | 45 | 10 | 40 |
| | Core VI | ELE-366 (A) / ELE-366 (B) | Numerical simulation in electronics / Mechatronics and Digital Machining | 3 | 3 | 45 | 10 | 40 |
| SEC | Skill Based | ELE-360 | Introduction to ARDUINO | 2 | 2 | 30 | 10 | 40 |
| DSC | Core (Practical) | ELE-367 | Laboratory-I | 2 | 4 / batch | 60 | 10 | 40 |
| | | ELE-368 | Laboratory-II | 2 | 4 / batch | 60 | 10 | 40 |
| | | ELE-369 | Project:-II | 2 | 4 / batch | 60 | 10 | 40 |

**DSC:** Discipline Specific Core Courses/Core Practical; **SEC:** Skill Enhancement Course;
**Int :** Internal examination; **Ext :** External examination

## T.Y. B.Sc. (Electronics): Semester V
## Discipline Specific Core (DSC) Course
## ELE- 351: Operational Amplifiers and Applications

**Total Hours: 45** **Credits: 3**

**Course Objectives:**

- To understand various op-amp parameters and their importance in design
- To learn about basic op-amp configurations
- To introduce various op-amp application circuits.
- To introduce various timing circuits.

**Course outcomes:**

After successful completion of this course, students are able to:

- Have fundamental knowledge of operational amplifier.
- Can apply this knowledge for designing concept op-amp circuits.

**Unit-I: Basic Operational Amplifier** **(09 h)**

Concept of differential amplifier, block diagram of op-amp and its working, LM 741. OP-AMP parameters: Input offset voltage, input bias and offset currents, input and output impedance, common mode rejection ratio (CMRR), Slew rate, Open loop gain and frequency response.

**Unit-II: Op Amp Circuits:** **(12 h)**

Inverting and non-inverting amplifiers, summing and difference amplifiers, integrator and differentiator, voltage to current converter and current to voltage converter, Comparator, Level detector, Voltage limiters, Schmitt Trigger. Wein-bridge and phase shift oscillator, Square wave generator and triangle wave generator.

**Unit-III: Signal Conditioning Circuits:** **(12 h)**

Sample and hold (S/H) circuit, Its need/application, Active filters(1'st order): Low Pass Filter, High Pass Filter, Band Pass Filter, Band Stop Filter, bridge amplifier, log and antilog amplifiers

**Unit-IV: Timing Circuits:** **(12 h)**

Concept of multivibrator, three types of multivibrators, Op-amp based multivibrators, IC 555 – block diagram, multivibrator circuits, Applications

**References:**


- Clayton G. B., Winder S. (2003), Operational Amplifiers, 5th edition, Newnes.
- Gaykwad R. A., (2004), Op-Amp and Linear ICs, Prentice Hall.
- Millman J., Halkias C.C., (2001), Integrated Electronics, Tata McGraw-Hill.
- Malvino A.P., (2003), Electronic Principals,6th edition, Tata McGraw-Hill.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester V**
**Discipline Specific Core (DSC) Course**
**ELE-352: Design with Analog ICs**

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To understand design concepts of analog circuits.
- To design analog electronic circuit for given specifications.
- To learn the specifications and selection criterion for linear ICs.

**Course outcomes:**

After successful completion of this course, students are able to:

- Have fundamental knowledge of designing electronic circuits using IC
- Apply this designing knowledge for different special purpose ICs and their applications

**Unit-I: Amplifier:** **(12 h)**

Use of standard design procedures and applications of inverting amplifier, non-inverting amplifier, averaging amplifier, voltage follower, voltage sources; single supply operation, summing amplifier, difference amplifier, current amplifier, instrumentation amplifier and Transducer bridge amplifiers – temperature, strain gauge interfacing.

**Unit-II: Comparators and controls:** **(12 h)**

Use of standard design procedures and applications of Comparator, Schmitt trigger, IC Voltage comparators, Design of for UTP and LTP, zero-crossing detector with hysteresis, voltage level detectors, precision comparator, window detector, propagation delay measurement

**Unit-III: Applications of Op-amps and other linear ICs:** **(12 h)**

V to I converter, I to V converter, phase shifter, T to V and T to F converter circuits, V to f and f to V converters, clippers and clampers, Precision rectifiers, peak detectors, AC to DC converters, Sample and hold circuits

Design of Active filters- low pass, high pass, band pass and notch filters with -20, 40, 60 dB/decade, Voltage multipliers, Data converter ICs, Power supply design – single/ dual – fixed and variable

**Unit-IV: Design of signal generators using linear IC:** **(09 h)**

Design of - Multi-vibrators, triangular wave generators, saw tooth wave generators, quadrature oscillator, precision triangle/square wave generators, sine wave generators.

**References:**


- Coughlin R. F., Driscoll F. F., (2014), Operational amplifiers and linear integrated circuits, Prentice Hall of India.
- Franco S., (2009), Design with operational amplifiers & analog integrated circuits, Tata McGraw Hill.
- Gayakwad R. A., (2015), Operational amplifiers & linear integrated circuits, Pearson.
- David B., (2016), Operational amplifiers & linear integrated circuits, Oxford U. Press.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester V**
**Discipline Specific Core (DSC) Course**
**ELE-353: Power Electronics**

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To get introduce to basics of power electronics and familiar with Power Electronic devices, circuits and applications
- To learn about power devices and protections of devices
- To study various types of power circuits
- To study and design different power conversion circuit
- To study applications of power electronics

**Course outcomes:**

After successful completion of this course, students are able to:

- Have fundamental knowledge of semiconductor power electronic device
- Apply this knowledge for designing power electronic circuits

**Unit-I: Semiconductor Power Devices** **(18 h)**

Need for semiconductor power devices, Power diodes, Introduction to family of thyristors. Basic Structure, symbol, working, I-V Characteristics and Applications of SCR, DIAC and TRIAC. Ratings: Latching Current, Holding Current, dv/dt & di/dt rating, I2 t rating, surge current rating. List of applications of SCR. Methods of Triggering (SCR): Gate triggering, Voltage triggering, Thermal triggering and Radiation triggering, Triggering of SCR using UJT, Triggering of SCR using BJT. Turn off circuits- Natural & Forced Commutation, types of forced commutation (all classes).

**Unit-II: Controlled Rectifiers** **(09 h)**

Single Phase Circuits: Thyristor half wave Rectifier (Resistive load), Thyristor half wave Rectifier (Inductive load), Thyristor Full Converter (Resistive load), Thyristor Full Converter (Inductive load).

**Unit-III: Inverters and Converters** **(09 h)**

Inverters - Introduction, Industrial applications, types of inverters, Single Phase Bridge inverter, Single Phase Centre Tapped Inverter, Series Inverter.

Converters (choppers): Introduction, Principle of Stepdown Chopper (variable frequency and constant frequency control), Step up chopper, Chopper Classification, Chopper Configurations.

**Unit-IV: Applications of SCR and High frequency heating** **(09 h)**

Applications of SCR - Uninterruptible power supplies, over voltage protection, simple battery charger, fan regulator using DIAC and TRIAC. High frequency heating applications - Induction heating – principle, application as induction heater Dielectric Heating – principle, application in sterilization.

References:


- Rashid M.H., (2004), Power electronics: Circuits, Devices and Applications, 3rd edition, Pearson Education.
- Ned M., Undeland R., (2006), Power Electronics, 3rd edition, John Wiley & Sons.
- Arora O.P., (2007), Power electronics Laboratory: Theory, Practice & Organization, Narosa Publishing house.
- Sen P.C., (1998), Power Electronics, Tata Mc Graw Hill.
- Rai H.C., (2009), A Text Book on Power Electronic : Devices, Circuits, Systems and Applications, , 2nd edition Galgotia Publication, New Delhi, India.
- Mithal G.K., (1987), Industrial Electronics, Khanna Publishers.
- Ramamoorty M., (1991), Thyristor & Their Application, EWP.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester V**
**Discipline Specific Core (DSC) Course**
**ELE-354: Embedded System**

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To understand the Embedded system design issues.
- To learn Hardware and software components in Embedded System.
- To understand the Embedded OS environment.
- To learn embedded software development and testing process.

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
- 2. Understand and develop the programs for microcontroller.
- 3. Understand the role of embedded systems in industry & house held application.
- 4. Understand the design concept of embedded systems.

**Unit-I: Introduction to Embedded Systems** **(05 h)**

Overview of Embedded Systems, Features, Requirements and Applications, Recent Trends in the Embedded System Design, Common architectures for the Embedded System Design, Embedded Software design issues. Introduction to microcontrollers, Overview of Harvard architecture and Von Neumann architecture, RISC and CISC microcontrollers

**Unit-II: AVR RISC Microcontrollers** **(16 h)**

Introduction to AVR RISC Microcontrollers, Architecture overview, status register, general purpose register file, IO ports, Memory, EEPROM, SRAM, timer, interrupt, UART, Watch down timer, power down modes, Instruction set, Data Transfer Instructions, Arithmetic and Logic Instructions, Branch Instructions, Bit and Bit-test Instructions, MCU Control Instructions.

**Unit-III: Real world interfacing** **(12 h)**

I/O Interface, Real world Interfacing, Some I/O interfacing: LEDs and LCD,DC Motor and Stepper Motor, Switches and Relays, HEX Keypad, ADC, Temperature Sensor, Seven segment display, Dot matrix display

**Unit-IV: Understanding Embedded Systems** **(12 h)**

Processor and memory Organization, Processor Selection for an embedded system, Memory types (RAM, ROM, EPROM, EEPROM, FLASH), Networked Embedded Systems, Memory selection, memory maps and addresses, I/O devices, Timer and counting devices, Watchdog Timer, Real Time Clock, Serial Communication Devices, parallel port devices, serial port devices, Interrupt Servicing mechanism, embedded system operating system (RTOS)

References:


- Kamal R., (2003), Embedded Systems – Architecture, Programming and Design, (2nd edition, McGraw Hill.
- Mazidi M.A., Naimi A., Naimi S., (2013), AVR Microcontroller and Embedded Systems: Using Assembly and C, 1st edition, PHI.
- Vahid F., Givargis T., (2002), Embedded system Design, John Wiley.
- Gadre D.V., (2017), Programming and Customizing the AVR Microcontroller. McGraw-Hill.
- Barrett S.F., Daniel J.P., (2012), Atmel AVR Microcontroller Primer: Programming and Interfacing, 2nd edition, Morgan & Claypool Publishers.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester V**
**Discipline Specific Core (DSC) Course**
**ELE-355: Sensors and Actuators**

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To study basic performance parameters of sensors.
- To understand various types of sensors along with their working principles and specifications
- To learn the principle, construction and working of various actuators.
- To study signal conditioning circuits and signal transmission

**Course outcomes:**

After successful completion of this course, students are able to:

- Have knowledge of different sensors and its parameters.
- Have knowledge of different actuators.
- Understand signal conditioning circuits and signal transmission

**Unit-I: Basics of Sensors** **(06 h)**

Need of sensors, Definition, Types of sensors, Classification, Principle, input-output parameters, Examples of devices, Specification and performance parameters: Accuracy, Resolution, Threshold, impedance, Sensitivity, Hysteresis, Linearity, Range, Reliability, Selectivity, Response time, Operating temperature, Calibration.

**Unit-II: Typical Sensors** **(16 h)**

Principle, Construction, Working, specifications of commercially available sensors and applications – Displacement, position/ Motion, Force, Torque, temperature, Pressure, level, flow, Humidity, pH sensors, load cells, smoke and chemical sensor, sound and light.

**Unit-III: Actuators** **(15 h)**

Actuators-principle, construction and specifications. Pressure controller, flow control actuators -(Valves), Power control devices, magnetic control device - Relay, Solenoid. Electromechanical: DC motor, AC motor, Stepper motor, Servomotors.

**Unit-IV: Signal conditioning and transmission** **(08 h)**

Conditioning: pneumatic signal conditioning, visual display conditioning, electrical signal conditioning and A-D conversion.

Signal transmission: Pneumatic transmission, analog transmission, digital transmission, D-A conversion and telemetry.

**References:**


- Patranabis D., (2008), Sensors and Transducers, 2nd edition, Prentice Hall Publication.
- Dunn W.C., (2005), Fundamentals of industrial instrumentation and process control, Mc Gaw Hill Publication.
- Shaligram A. D., (2013), Sensors and Transducers, Chintan Publication.
- Borse R. Y., (2012), Sensors & Transducers, Principles & Applications. Adhyan Pub.
- Silva C.W.D., (2016), Sensors and Actuators, 2nd edition, CRC Press, New York.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester V**
**Discipline Specific Core (DSC) Course**
**ELE-356 (A): Instrumentation**

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To study principles of various instrument & their importance in laboratory & industry.
- To understand errors in the calibration of various instruments..
- To study signal conditioning circuits and signal transmission in measuring instruments.
- To understand various types of sensors along with their working principles and specifications

**Course outcomes:**

After successful completion of this course, students are able to:

- Use sensors for measurement of various physical quantities.
- Understand the use of sensors in process control system.
- Construct signal conditioning circuit for various physical quantities & environment.
- Avoids errors in measurements of physical quantities.

**Unit-I: Basic Measurement Instruments** **(10 h)**

Specifications of instruments, their static and dynamic characteristics, Error(Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting.

PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system.

**Unit-II: Measurement of Resistance and Impedance** **(10 h)**

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

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

**Unit-III: Oscilloscopes and Signal Generators** **(10 h)**

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

**Signal Generators:**

Audio oscillator, Pulse Generator, Function generators.

**Unit-IV: Transducers and sensors** **(15 h)**

Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature

compensation and applications), Capacitive (Variable Area Type – Variable Air Gap), Inductive (LVDT ) and piezoelectric transducers.
Measurement of displacement. Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

**References:**


- Kalsi H. S., (2006), Electronic Instrumentation, Tata Mcgraw Hill.
- Cooper W.D., Helfrick A. D., (2005), Electronic Instrumentation and Measurement Techniques, Prentice-Hall
- Nakra B.C., Chaudary K., (2016) Instrumentation Measurement and analysis, 4$^{th}$edition, Tata Mcgraw Hill.
- Doebelin E.O., (2003), Measurement Systems: Application and Design, 5$^{th}$edition, Tata Mcgraw Hill.
- Carr J. J., (2005), Elements of Electronic Instrumentation and Measurement, Pearson Education.
- Bell D. A., (2013), Electronic Instrumentation and Measurements, Prentice Hall
- Oliver, Cage, (2009), Electronic Measurements and Instrumentation, Tata Mcgraw Hill.
- Morris A. S., (2008), Measurement and Instrumentation Principles, Elsevier Buterworth Heinmann.
- Sawhney A. K., (2007), Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons.
- Rangan C. S., Sarma G. R., Mani V. S., (1998), Instrumentation Devices and Systems, Tata Mcgraw Hill.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Electronics): Semester V
Discipline Specific Core (DSC) Course
ELE-356 (B): Process Automation and Programmable Logic Control

**Total Hours: 45** **Credits: 3**

**Course Objectives:**

- To study the automation process and PLC basics
- To learn the basics of Industrial control circuits
- To learn the PLC basics and programming
- To study the basics of SCADA and DCS

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand the automation process and PLC basics
- Design and use of Industrial control circuits
- Develop PLC programming
- Aware about SCADA and DCS

**Unit-I: Automation and Industrial Control Circuits** **(10 h)**

Introduction of automation and process automation. Need and benefit of automation. Input Devices: Push Button, Selector Switch, Limit Switch, Proximity Switch and Pressure Switch. Output Devices: Relay, Contactor, Solenoid Valve, Solid State Relay (SSR).
Different symbols used in industrial control circuits. Concept of control and power circuit diagram.
Motor control circuits: DOL Starting, Star – Delta Starter, Forward – Stop – Reverse control and random reversing of induction motor, Stop Starter. Typical control and power circuit diagrams of hoist control, conveyer control, lifting magnet and Mill & Extruders.

**Unit-II: PLC Fundaments and Programming**

**(A) PLC Fundaments :** **(10 h)**

What is PLC, concept of PLC, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer in market, Block diagram of PLC, Function of different parts of PLC such as CPU, Memory, Power Supply and IO Modules, Digital and Analog IO module, Special modules of PLC: Communication Module, PID Controller Module, PLC in market based on CPU type, number of IOs, speed and memory, Micro PLCs.

**(B) PLC Programming:** **(10 h)**

Binary system, Bit, Byte, Word, Logic Gates, Programming PLC using Ladder diagram, Components of ladder diagram, Program scan process applied to single rung, Ladder diagram for different logic gates, Relay type instructions: IF – CLOSED, IF – OPEN, Output Energize instructions, Basic Instruction: Latch, Master Control Self Holding relays, Timer Instruction: Retentive Timer, Resetting of Timers, Counter Instruction: UP, DOWN, UP-DOWN, resetting of counters, Arithmetic Instruction: ADD, SUB, DIV, MUL etc., MOV Instruction, RTC (Real Time Clock Function), Watch Dog Timer, Comparison Instruction: Equal, Not – Equal, Greater, Greater than equal, Less than, Less than equal etc.

**Unit-III: PLC Wiring Diagrams and Ladder Logic** **(08 h)**

Seal in Circuits using PLC, Ladder and Wiring diagram of DOL starter with OLR, Latching Relay using PLC, PLC based water level controller, Forward reverse control of 3 – phase Induction Motor using PLC, Temperature control ON / OFF, Stepper motor control, Bottle filling system, Traffic light control.

**Unit-IV: SCADA and DCS** **(07 h)**

SCADA (Supervisory Control and Data Acquisition) Overview.
Use of HMI (Human Machine Interface).
SCADA Architecture: Monolithic, Distributed and Networked.
Concept of DCS (Distributed Control System).

**References:**


- Eswar U.S, (2013), Handbook of Electrical Motor Control Systems, McGraw Hill Education, New Delhi.
- Bhattacharya S. K., Singh,B., (2006), Control of Machines, New Age International Publishers, New Delhi.
- Webb J.W., Reis R.A., (2003), Programmable Logic Controllers – Principles and Applications, PHI Learning Pvt. Ltd., New Delhi.
- Hackworth J.R., Hackworth F., (2015), Programmable Logic Controllers, Pearson Education, New Delhi.
- Petruzella F.D, (2016), Programmable Logic Controllers, McGraw Hill Education (India) Edition, New York.
- Bolton W., (2016), Programmable Logic Controllers, Elsevier India Pvt, Ltd. New Delhi.
- Dunning G., (2009), Introduction to PLC, Cengage India.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

## T.Y. B.Sc. (Electronics): Semester V
## Skill Enhancement Course (SEC)
## ELE-350: Programming with LabVIEW

**Total Hours: 30** **Credits: 2**

**Course objectives:**

- To know the basic introduction to virtual instrumentation.
- To familiar with the graphical interfacing Language.
- To familiar with measurement and automation.

**Course outcomes:**

After successful completion of this course, students are able to:

- Develop a program using LabVIEW.
- Work on data acquisition and controls with LabVIEW.

**Unit-I: Introduction to Virtual Instrumentation** **(03 h)**

Computers in Instrumentation, What is Virtual Instrumentation (VI), History of VI, LabVIEW and VI, Conventional and Graphical Programming, Distributed Systems.

**Unit-II: Basics of LabVIEW** **(15 h)**

Components of LabVIEW, Owned and Free Labels, Tools and Other Palettes Arranging Objects, Pop-Up Menus, Colour Coding, Code Debugging, Creating Sub-VIs, For Loop, While Loop, Loop Behaviour and Inter loop Communication, Local Variables, Global Variables, Shift Registers, Feedback, Auto indexing, Loop Timing, Timed Loops Sequence Structures, Case Structure, Formula Node, Event Structure, Arrays, Clusters, Inter-Conversion of Arrays and Clusters, Waveform Chart, Resetting Plots, Waveform Graph, Use of Cursors, X-Y Graph, introduction to a State Machine, Event Structures, The Full State Machine, File Formats, File I/O Functions, Path Functions.

**Unit-III: Basics of Data Acquisition** **(08 h)**

Classification of Signals, Real-World Signals, Analog Interfacing, Connecting the Signal to the Board. **Data Acquisition with LabVIEW:** Measurement and Automation Explorer, Waveform Data Type, Working in DAQmx, Working in NI-DAQ, Use of Simple analog and digital Vis, Continuous data acquisition, acquisition of data in bursts

**Unit-IV: Interfacing with DAQ assistant** **(04 h)**

DAQ Assistant, Analysis Assistant, Instrument Assistant, GPIB interfacing, standard command for programmable instrument.

**References:**


- Gupta S., John J., (2017), Virtual Instrumentation using LabVIEW, 2nd ed, TMH Pvt.
- Travis J., Kring J., (2006), LabVIEW for Everyone, 3rd edition, Prentice Hall.
- Johnson G.W., Jeninngs R.,(2006), LabVIEW Graphical Programming, McGraw Hill.
- Jerome J., (2010), Virtual Instrumentation Using Labview, Prentice Hall India
- Mihura B., (2001), LabVIEW for Data Acquisition, Prentice Hall.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester V**
**Discipline Specific Core (DSC) Course**
**ELE-357: Laboratory – I**

**Total Hours: 60** **Credits: 2**

**Course objectives:**

- To learn about basic op-amp configurations and various application circuits.
- To understand analog circuit design concepts.
- To provide practical exposure to handle power electronics device, circuits and application

**Course outcomes:**

After successful completion of this course, students are able to:

- Design various applications of op-amp.
- Understand and Design circuits using Analog IC.
- Understand and handle power electronics circuits.

| Sr. No. | Topic Particular | Hours |
|---|---|---|
| **Section A: Op-amp and application (Any 4)** | | |
| 1 | Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op-amp. | 04 |
| 2 | Study of log amplifier. | 04 |
| 3 | Designing of analog adder and subtractor circuit. | 04 |
| 4 | Study of clipper and clamper based on op-amp. | 04 |
| 5 | To study gain bandwidth product of inverting/ non-inverting amplifier | 04 |
| 6 | Designing of an integrator and differentiator using op-amp for a given specification and study its frequency response. | 04 |
| 7 | Designing of a First Order Low-pass and High pass filter using op-amp. | 04 |
| 8 | Designing of a RC Phase Shift Oscillator using op-amp. | 04 |
| 9 | Study of IC 555 as an astable multivibrator and monostable multivibrator | 04 |
| **Section B: Design with Analog IC (Any 4)** | | |
| 1 | Study of Precision rectifier. | 04 |
| 2 | Study square wave and triangular wave generator. | 04 |
| 3 | Study of Schmitt trigger. | 04 |
| 4 | Study of Sample and hold circuit. | 04 |
| 5 | Build and Study dual power supply. | 04 |
| 6 | Build and test T to F converter. | 04 |
| 7 | Build and Test V to I converter. | 04 |
| 8 | Design, Build and Test Low pass filter with 20 db/decade. | 04 |
| 9 | Design, Build and Test High pass filter with 20 db/decade | 04 |
| 10 | Design, Build and Test notch filter with 20 db/decade | 04 |
| 11 | Build and test AC to DC converter. | 04 |
| **Section C: Power electronics (Any 2)** | | |
| 1 | I-V characteristics of DIAC. | 04 |
| 2 | I-V characteristics of a TRIAC. | 04 |
| 3 | I-V characteristics of a SCR. | 04 |
| 4 | SCR as a half wave and full wave rectifiers with R and RL loads. | 04 |

| | | |
|---|---|---|
| 5 | DC motor control using SCR. | **04** |
| 6 | Designing of SMPS/IC 723 | **04** |
| 7 | Build and test DC to DC converter. | **04** |
| 8 | To study traic power control circuits used as a dimmer or to control the speed of fan. | **04** |

Perform total **ten experiments** altogether from all Sections. Any **Four** experiments from **Section (A) and ( B) each** and any **two** experiments from **Section (C).**

**References:**


- Gayakwad R.A., (2003), Op-Amps and Linear IC's, Pearson Education.
- Rashid M.H., (2004), Power electronics: Circuits, Devices and Applications, 3rd edition. Pearson Education.
- Rai H.C., (2009), A Text Book on Power Electronic: Devices, Circuits, Systems and Applications, 2nd edition. Galgotia Publication, New Delhi, India.
- Millman J., Halkias C.C., (2001), Integrated Electronics, Tata McGraw-Hill.


**Methods of Teaching:**

- Laboratory Method, Lecture cum demonstration methods

**T.Y. B.Sc. (Electronics): Semester V**
**Discipline Specific Core (DSC) Course**
**ELE-358: Laboratory – II**

**Total Hours: 60** **Credits: 2**

**Course objectives:**

- To provide hand on training to handle 8051 microcontroller and develop programming skills
- To provide awareness and practical exposure about sensors.
- To understand the measurement of physical quantities.

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand the hardware and software of embedded system.
- Understand the characteristics of sensors.
- Design embedded system for real life problems.

| Sr. No. | Topic Particular | Hours |
|---|---|---|
| **Section A: Experiments to be performed on AVR trainer kit (Any 6)** | | |
| 1 | Write a program to ON / OFF simple switch continuously. | 04 |
| 2 | Write a program to make LED ON and OFF continuously. | 04 |
| 3 | Write a program to Control ON/OFF action of LED using switch. | 04 |
| 4 | Interface display and Write a program to display hexadecimal numbers. | 04 |
| 5 | Write a program for decade counter and show on display. | 04 |
| 6 | Write a program to drive stepper motor continuously. | 04 |
| 7 | Write a program to control speed of stepper motor. | 04 |
| 8 | Write a program to drive stepper motor anticlockwise and clockwise direction continuously. | 04 |
| 9 | Write a program to generate square wave. | 04 |
| 10 | Write a program to display "Hello" on LCD. | 04 |
| 11 | Interface temperature sensor (LM 35) and write a program to read temperature. | 04 |
| 12 | Interface humidity sensor and write a program to read humidity. | 04 |
| **Section B: (Any 4)** | | |
| 1 | Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity. | 04 |
| 2 | To determine the Characteristics of LVDT. | 04 |
| 3 | To determine the Characteristics of Thermistors and RTD. | 04 |
| 4 | Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J-type, K-type. | 04 |
| 5 | To study the Characteristics of Photodiode/Phototransistor. | 04 |
| 6 | Measurement of unknown frequency (using Lissagious Figure) and phase difference using CRO. | 04 |
| 7 | Study of gas sensor. | 04 |
| **Section C: Process Automation and Programmable Logic Control (Any 4)** | | |
| 1 | Introduction to ladder programming & to implement basic logic gates. | 04 |

| | | |
|---|---|---|
| 2 | Develop, Simulate and Test Ladder diagram for Traffic Light Control System. | **04** |
| 3 | Develop and test PLC program for three phase motor in both direction | **04** |
| 4 | Detail study of PLC Hardware and its interfacing | **04** |
| 5 | Develop and test PLC program for Automatic Bottle Filling System | **04** |
| 6 | Develop and test PLC program for stepper motor control | **04** |

Perform total **ten experiments** altogether from all Sections. Any **Six** experiments from **Section (A)** and any **four** experiments from **Section (B or C) each.**

**References:**


- Mazidi M.A., Naimi A., Naimi S., (2013), AVR Microcontroller and Embedded Systems: Using Assembly and C.PHI.
- Webster J. G., (2008), Sensors and Signal Conditioning, 2nd edition, Wiley Inter Science.
- Cooper W.D., Helfrick A. D., (2005), Electronic Instrumentation and Measurement Techniques, Prentice-Hall.
- Sawhney A. K., (2007), Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons.
- Rangan C. S., Sarma G. R., Mani V. S., (1998), Instrumentation Devices and Systems, Tata Mcgraw Hill.


**Methods of Teaching:**

- Laboratory Method, Lecture cum demonstration methods

**T.Y. B.Sc. (Electronics): Semester V**
**Discipline Specific Core (DSC) Course**
**ELE-359: Project – I**

**Total Hours: 60** **Credits: 2**

**Course objectives:**

- To develop technical skills to perform experiments in details.
- To encourage research and development activities.
- To develops students understanding and thinking for developing techniques for understanding physics and its applications.

**Course outcomes:**

After successful completion of this course, students are able to:

- Aware of various techniques to perform physics experiments in detail.
- Successfully carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines

Student should perform the following activities. He/She should prepare a progress report and submit it to the guide for the internal assessment.

1. Project Selection
2. Literature Survey
3. Literature Review
4. Project Planning.
5. Experimental work (30 to 40 %)

**Instructions:**

1. Student should prepare the project report for the examination of first term and it should be produced to the examiner of second term also.
2. The internal as well as external assessment of the student will be done on the basis of seminar/power point presentation given by him/her on the above topics using LCD projector and the actual project work done by him/her.
3. Once the internal and external project examination of first term is over, student should continue the same topic for the examination of final semester. He/she cannot change the topic of the project in any circumstances.

**Scheme of marking at end-semester examination:**

| Sr. No. | Performance Criteria | Max. Marks |
|---|---|---|
| 1 | Selection of Project | 5 |
| 2 | Planning and implementation | 10 |
| 3 | Project outcomes | 5 |
| 4 | Regularity of Work | 5 |
| 5 | Report Writing Skills | 5 |
| 6 | Self Expression, Communication Skill and Presentation | 5 |
| 7 | Viva -Voce | 5 |
| | **Total** | **40** |

**T.Y. B.Sc. (Electronics): Semester VI**
**Discipline Specific Core (DSC) Course**
**ELE-361: Advanced Digital System Design**

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To familiarize students with designing techniques of combinational and sequential circuits
- Introduction of VHDL to students for different combinational and sequential circuits
- To know designing of combinational and sequential logic circuits using VHDL.

**Course outcomes:**

After successful completion of this course, students are able to:

- Design digital circuits.
- Write VHDL code for digital circuit with the help of different modeling style.

**Unit-I: Combinational Logic Circuits** **(07 h)**

Introduction to combinational circuits, Revision of K-Map, Combinational logic example (half and full adder, full subtractor, four-bit binary adder, multiplexer and demultiplexers, any combinational circuits up to 3 input). Idea of seven segment display (Common anode, common cathode) and designing of BCD to seven segment decoder.

**Unit-II: Sequential Logic Circuits** **(08 h)**

Introduction to R-S, J-K, T and D flip flops, Excitation table of flip flops, flip flop conversions: R-S to J-K, S-R to T, J-K to D and T to Applications of Flip flops.

**Unit-III: Sequential Logic Design** **(12 h)**

State table, state diagram, state equation and state reduction in sequential logic design, Brief revision of counters: Design of Asynchronous counters - Design of Mod-6 counter using T flip flop, Design of Mod-10 counter using T flip flop. Design of Synchronous counters- Design of synchronous 3 bit up-down counter using J-K flip flop, Design of synchronous 3 bit up counter, Design of synchronous 3 bit down counter, Design of synchronous Mod-10 bit up-down counter using T flip flop, Design of synchronous modulo 6 Grey code counter.

**Unit-IV: Introduction to VHDL Programming** **(18 h)**

Introduction, library, entity, architecture, modeling style, concurrent and sequential statements, data object and data types, attributes.

VHDL Programming: half and full adder, full subractor, four bit binary adder, multiplexer and demultiplexers, Flip flops S-R, D, J-K, J-K master Slave and T, Mod-6asynchronous counter, 3 bit up-down counter.

**References:**


- Palan N. G., (2014), Digital Electronics and Logic Design, Technova Publications.
- Kumar A. A., (2014), Fundamentals of Digital Circuits, Prentice Hall India.
- Mono M M., (1979) , Digital Logic and Computer Design, 1st edition, Pearson India.
- Mano M. M., Ciletti M. D., (2008), Digital Design, 4th edition, Pearson India.
- Jain R. P., (2003), Modern Digital Electronics, 3rd edition, Tata McGraw Hill Publishing.

- Shalivahanan S., Arivazhagan S., (2013) Digital Circuits and Design, 4th edition, Vikas Publishing House.
- Bhaskar J., (2015), VHDL Primer, 3rd edition, Pearson education, India.
- Perry D. L, (2002), VHDL Programming by Example, 4thedition, McGraw Hill Education.
- Brown S., Vranesic Z., (2017), Fundamentals of Digital Logic with VHDL Design,3rdedition, McGraw Hill Education.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

## T.Y. B.Sc. (Electronics): Semester VI
## Discipline Specific Core (DSC) Course
## ELE-362: Transmission Lines, Antenna and Wave Propagation

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To understand the basic properties of Plane wave propagation in different medium.
- To learn EM wave propagation in transmission line.
- To know the fundamentals of antenna and its characteristics.
- To understand radio wave propagation phenomena in communication system.

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand in-depth study of transmission lines which play an important role in high-speed digital communication.
- Analyze the fundamentals of antenna theory.
- Understand the different types of antennas and the radiation mechanism.
- Identify the atmospheric and terrestrial effects on radio wave propagation

**Unit-I: Electromagnetic Wave Propagation** **(10 h)**

Propagation in Good Conductors, Skin Effect, Reflection of uniform Plane Waves at normal incidence, Plane Wave reflection at Oblique Incidence, Wave propagation in dispersive media, concept of phase velocity and group velocity.

**Unit-II: Transmission Lines** **(10 h)**

Typical Transmission lines- Co-axial, Two Wire, Microstrip, Coplanar and Slot Lines, Transmission Line Parameters, Wave propagation in Transmission lines, low loss, lossless line, Distortion less line, Input Impedence, Standing Wave Ratio ,Power. And lossy lines, Shorted Line, Open-Circuited Line, Matched Line, Transmission Line Applications.

**Unit-III: Waveguides and Waveguide Devices** **(10 h)**

Wave propagation in waveguides, Parallel plate waveguides, TEM, TM and TE modes, Rectangular waveguides, circular waveguides, Power transmission and attenuation, Rectangular cavity resonators, directional couplers, isolator, circulator.

**Unit-IV: Radiation of electromagnetic waves** **(15 h)**

Concept of retarded potentials, Antenna Parameters: Radiation Mechanism, Current Distribution on a Thin Wire Antenna, Radiation Pattern, Radiation Power Density, Radiation Intensity, Beamwidth, Directivity, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance, Antenna Radiation Efficiency.

**Types of Antenna:**

Hertzian dipole, Half wave dipole, Quarter-wave dipole, Yagi-Uda, microstrip, Parabolic antenna, Helical antenna, Antenna array.

**References:**


- Sadiku M. N. O., (2001), Principles of Electromagnetics, Oxford University Press.
- Longren K.E., Savov S.V., Jost R.J., (2012), Fundamentals of Electromagnetics
- with MATLAB, 2nd edition, SciTech Publishing Inc.

- Hayt W.H., Buck J.A, (2006), Engineering Electromagnetics, Tata McGraw Hill.
- Cheng D.C., (2001), Field and Wave Electromagnetics, Pearson Education.
- Edminster J.A., (2006), Electromagnetics, Schaum Series, Tata McGraw Hill.
- Rao N. N., (2006), Elements of Engineering Electromagnetics, Pearson Education.
- Raju G.S.N., (2001), Antennas and Propagation, Pearson Education.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

## T.Y. B.Sc. (Electronics): Semester VI
## Discipline Specific Core (DSC) Course
## ELE-363: Optoelectronics

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To understand Different type of Light Sources
- To learn Light Emitting Diodes and Lasers Diodes
- To study Photo-detectors
- To learn Optical Fiber

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand the basic concept of optoelectronics.
- Understand design and operation of light emitting diodes and LASER
- Understand detailed knowledge of optical fiber.

**Unit-I: Introduction to Light and solid state physics** **(12 h)**

Nature of Light, Basic Interaction of light with Solid Materials, polarization, interference, diffraction, light sources, Review of some quantum mechanical concept, Energy bands in Solid s, Review of Semiconductor Physics, Optical process in semiconductor, electron hole pair formation and recombination, Modulation of light: Birefringence or Double Refraction, Electro optic effects, Magneto-optic effect, Acousto-optic devices.

**Unit-II: Display Devices** **(12 h)**

**Light Emitting Diode:** LED materials, LED Structural design and efficiency, Special class of LEDs, LED performance and Spectral Response, Plasma display, Liquid Crystal Display, Numeric Display

**LASER:** Interaction of radiation and matter, Einstein coefficients, Condition for amplification,

laser cavity, threshold for laser oscillation, optical feedback, line shape function, LASER modes, Examples of common lasers. The semiconductor injection laser diode.

**Unit-III: Photodetector:** **(11 h)**

Introduction, Responsivity and Quantum Efficiency of photodetector, material selection for photodetector, photoconductive photodetector, photodiode, PIN, APD, Optocoupler

**Unit-IV: Optical Fiber** **(10 h)**

Total Internal Reflection, Design of Optical Fiber, Mode of Optical Fiber, Signal Distortion in optical Fiber, signal loss in Optical Fiber, Fiber material and manufacture, Fiber cable

**References:**


- Wilson J., Hawkes J.F.B., (1996), Optoelectronics: An Introduction, 3rd edition. Prentice Hall India.
- Ghatak A., (2005), Optics, Tata McGraw Hill, New Delhi.
- Kasap S.O., (2009), Optoelectronics & Photonics, Pearson Education.
- Senior J., (2001), Optical Fiber Communication Principle and Practice, 2nd ed, PHI.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester VI**
**Discipline Specific Core (DSC) Course**
**ELE-364: Biomedical Instrumentation**

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To introduce field of biomedical instrumentation.
- To provide knowledge of electrical signals present in human body and their measurement.
- To understand the measurement and analysis techniques for physiological parameters

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand and measure biological signals present in human body
- Aware various blocks of biomedical sensors
- Understand the working principles of various therapeutic and monitoring systems
- Understand the patient imaging and monitoring systems.

**Unit-I: Introduction to Medical Instrumentation (12 h)**

Block diagram of Medical Instrumentation System, Physiological system of human body, operational modes, Medical measurement constraints, Classification of Biomedical Instrumentation, Biostatistics, Static characteristics, dynamic characteristics, Design Criteria. Interfacing the computer with medical instruments. Biomedical instruments.

**Unit-II: Biomedical signals & Physiological transducers (11 h)**

**Biomedical Signal and recorder:** Source of biomedical signal, Origin o bioelectric signals, recording electrodes, Electrodes for ECG, EMG & EEG. Biomedical recorders: ECG, EEG & EMG.

**Unit-III: Biomedical instruments (15 h)**

**Patient Monitoring systems and measurements**: Cardiac monitor, Bedside patient monitor, measurement of heart rate, pulse rate, blood pressure, temperature & respiration rate. Cardio to cograph, oximeter, blood flow meter, spirometer, blood gas analyzer, blood gas counter, Audiometer

**Modern Imaging systems:** Introduction, Basic principle & Block diagram of x-ray machine, x- ray Computed Tomography (CT), Magnetic resonance imaging system (MRI), Nuclear Medical Imaging system, ultrasonic imaging system. Eco-Cardiograph, Eco Encephalography

**Therapeutic Equipment's:** Cardiac pacemakers, cardiac defibrillators, Hemodialysis machine, surgical diathermy machine.

**Unit-IV: Patients safety and electrical safety in Biomedical instruments (07 h)**

Physiological effect of electrical current, electrical shock hazards, safety codes for electromedical equipment, Electric safety analyzer, Testing of biomedical equipment,

References:


- Khandpur R. S., (2004), Handbook of Biomedical Instrumentation, 2nd edition, McGraw Hill Profession.
- John G., Webster J.G., (2009), Medical Instrumentation-Application and Design, 4th edition, John Wiley &sons.
- Cromwell L. Weibell F. J., Pfeiffer, E.A. (1990), Biomedical Instrumentation and Measurements, 2nd edition, PHI.
- Carr J.J., John M., Brown J.M. (1997), Introduction to Biomedical Equipment Technology, 3rd edition, Pearson.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester VI**
**Discipline Specific Core (DSC) Course**
**ELE-365: Python Programming**

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To provide Basic knowledge of Python.
- To learn how to design and program Python applications.
- To develop problem solving skills and their implementation through Python.

**Course outcomes:**

After successful completion of this course, students are able to:

- Explain basic principles of Python programming language
- Apply the best features of mathematics, engineering and natural sciences to program real life problems.

**Unit-I: Basic of Python Programming** **(15 h)**

Introduction to Python, History of Python, Version of Python, Need, Features of Python, Applications of Python, Installing Python on Linux and Windows, Installing Python IDE, Python Identifiers, Variables and Keywords, Putting Comments, Expressions and Statements, Standard Data Types – Basic, None, Boolean, Numbers. Type Conversion Function, Operators in Python, Operator Precedence, Accepting Input and Displaying Output Flow Control Statements, Conditional Statements, Looping Statements, break, continue, pass Statements

**Unit-II: Python Strings** **(10 h)**

Introduction to String, String Literals, Assign String to a Variable, Multiline Strings, Operations on Strings, Index Operator: Working with the Characters of a String, String Methods, Length, The Slice Operator, String Comparison, Concepts of Python Lists: Creating, Initializing and Accessing elements in lists, Traversing, Updating and deleting elements from Lists. List Operations: Concatenation, List Indexing, Slices, Built- in List functions and methods, Aliasing, Cloning Lists

**Unit-III: Python Tuples and Dictionary** **(10 h)**

Introduction to Tuples, Creating Tuples, Deleting Tuples, Accessing elements in a Tuple, Tuples Operations: Concatenation, Repetition, Membership, Iteration, Built- in Tuples functions and methods Introduction to Dictionary, Dictionaries: Concept of key-value pair, Creating, Initializing and Accessing elements in a Dictionary, Traversing, Updating and Deleting elements in a Dictionary, Built- in Dictionary functions and methods

**Unit-IV: Python Functions and Modules** **(10 h)**

Introduction to Functions, Defining a Function (def), Calling a Function, Function Arguments - Required arguments, Keyword arguments, Default arguments, Variable-length arguments, Scope of Variables, Void functions and function returning values, Recursion, Advance Function Topics: Anonymous Function Lambda, Mapping Functions, Functional Programming Tools: filter and reduce Introduction to Modules, Creating Modules and Packages, Importing Modules, Using the dir() Function, Built-in Modules

References:


- John V Guttag (2013), Introduction to Computation and Programming Using Python, Prentice Hall of India.
- Norton P.C., Samuel A. and others, (2005), Beginning Python||, Wrox Publication.
- Rao N.R., (2016), Core Python Programming, Dreamtech Press.
- Chun W. J. (2006), Core Python Programming - Second Edition, Prentice Hall.
- Goodrich M.T., Tamassia R. Goldwasser M.H., (2013), Data Structures and Algorithms in Pyhon", Wiley.
- Lambert K.A., (2011), Fundamentals of Python – First Programs, CENGAGE Publication.
- Sneeringer L., (2015), Professional Python, Wiley Inc.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

## T.Y. B.Sc. (Electronics): Semester VI
## Discipline Specific Core (DSC) Course
## ELE-366 (A): Numerical Simulation in Electronics

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To aware numerical methods in electronics.
- To use numerical methods to solve problems.

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand the numerical method in electronics
- Solve the numerical problem in electronics

**Unit-I: Solution of Transcendental and Polynomial Equations f(x)=0** **(14 h)**

Bisection method, Regula Falsi Methods, Newton Raphson method, Rate of convergence, Method for Complex Roots Examples

**Unit-II: Interpolation and Curve fitting** **(12 h)**

**Interpolation**:

Interpolation, Finite difference, Interpolation for equal interval Langrange Interpolation, Newton Divided Difference Interpolation (forward and backward difference formulae), Truncation errors. Examples

**Curve Fitting:** Least square fitting, Curve fitting, Interpolation by Spline functions, Examples

**Unit-III: Numerical Differentiation and Integration** **(12 h)**

**Numerical Differentiation**: Finite difference method and Examples

**Numerical Integration**: Trapezoidal Rule, Simpson's Rules, Error of Simpson's rule, Examples

**Unit-IV: Numerical solution of differential equations:** **(07 h)**

Euler's Method, Modified Euler's method Runge-Kutta Method, Boundary value problems, Examples

**References:**


- Sastry S.S., (2012), Introduction to Numerical Analysis, Prentice Hall India.
- Rao S.B, Shantha C. K. (2004), Numerical Methods. University Press.
- Jain M.K., Iyengar S.R.K. , Jain, R.K., (2007), Numerical Methods: Problems and Solutions, New Age International.
- Grewal B.S., (2012). Numerical Methods in Engineering and Science with Programs in C andC++, (11th ed). Khanna Publishers.
- Rajaraman V., (1993), Computer Oriented Numerical Methods, 3rd edition, Prentice Hall India.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

## T.Y. B.Sc. (Electronics): Semester VI
## Discipline Specific Core (DSC) Course
## ELE-366(B): Mechatronics and Digital Machining

**Total Hours: 45** **Credits: 3**

**Course objectives:**

- To study the basics of Mechatronics
- To learn Electrical Drives, Pneumatics and Hydraulics
- To study the basic concepts of Signal Conditioning and Data Representation
- To study the Microprocessor and Microcontroller based control systems
- To study the basics of CNC Machining

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand the basics of Mechatronics
- Learn the working and use of electrical drives, pneumatics and hydraulics
- Understand the basic concepts of Signal Conditioning and Data Representation
- Design and use various microprocessor and microcontroller based control systems
- Study CNC Machining and programming

**Unit-I: Introduction to Mechatronics** **(07 h)**

Introduction to Mechatronic systems, elements, advantages; practical examples of Mechatronic systems. Sensors and Transducers: Various types of sensors and transducers used in Mechatronic system such as pressure sensors, temperature sensors, velocity sensors, Acceleration sensors, proximity sensors, position sensors, force sensors, Optical encoders, Capacitive level sensor, tactile sensors, Selection of sensors.

**Unit-II: Drives** **(12 h)**

1. **Electrical Drives:** Types of Electrical Motors, AC and DC motors, DC servomotors, Stepper motors, linear motors, etc.
2. **Pneumatics and Hydraulics:** Components of Pneumatic systems, actuators, direction control valves, pneumatic air preparation, FRL unit, methods of actuation of valves, Sequencing of Pneumatic cylinders using Cascade and shift register methods. Electropneumatic valves, Electro- pneumatic circuits using single and double solenoid methods. Hydraulic cylinders, design of cylinder, Design of Piston and piston rod, Valves, poppet valve, house pipes and design of tubing, Meter-in and Meter-out circuits.

**Unit-III: Control Systems** **(12 h)**

Open and closed loop system; block diagram manipulation/reduction, Transfer function, modeling of Mechanical Systems using Spring, Dashpot and Mass equivalence. On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers, Introduction to control using state variable system models, Bode Plots and stability criteria.

**Unit-IV: CNC Machining and Vision** **(14 h)**

Introduction to CNC Technology, Geometrical Basics for CNC Machines, Technological Basics for CNC Machines, axis Co-ordinate system, G-codes & M-codes, Program Strategy for CNC Program, CNC Program Writing, Tool Setting & Job Setting.

**Machine Vision:** Introduction, Low level & High level vision, Sensing &Digitising, Template Matching, Image processing & analysis, Segmentation, Edge detection, Object description& recognition, Interpretation, Noises in Image, Applications.

**References:**


- Rajput R. K, (2007), A Textbook of Mechatronics, S. Chand and Co.
- Bolton W., (1999), Mechatronics; Electronic Control System in Mechanical Engineering, Pearson Education Asia
- HMT ltd., (1988), Mechatronics, Tata Mcgraw-Hill, New Delhi.
- David Gibbs, (1991), An Introduction to CNC Machining and Programming, Industrial Press
- Tzafestas S. G. (2020), Intelligent Robotic Systems, CRC Press.


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

**T.Y. B.Sc. (Electronics): Semester VI**
**Skill Enchantment Course (SEC)**
**ELE-360: Introduction to Arduino**

**Total Hours: 30** **Credits: 2**

**Course objectives:**

- To provide basic functional knowledge of the Arduino microcontroller
- To provide knowledge of hardware and software to control external devices using Arduino

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand handle the Arduino board.
- Do Arduino Programming
- Do Arduino communication and interfacing

**Unit-I: Introduction to Arduino** **(08 h)**

Introduction to Arduino, Pin configuration and architecture, Device and platform feature, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, Arduino data types

**Unit-II: Arduino i/o and Time Functions** **(08 h)**

Pins Configured as INPUT, Pull-up Resistors, Pins Configured as OUTPUT, **Looping Techniques, Decision Making Techniques,** pinMode() Function, digitalWrite() Function, analogRead() function, Arduino Interrupts, delay() function, delayMicroseconds() function, millis() function , micros() function .

**Unit-III: Arduino Inter facingand Programming** **(08 h)**

Interfacing a 8 bit LCD to Arduino, static display, Relay, Matrix Keypad, RF module, Buzzer, Humidity Sensor, Temperature Sensor, Ultrasonic Sensor, Connecting Switch (Magnetic relay switches)

**Unit-IV: Arduino Communications** **(06 h)**

Parallel Communication , Serial Communication Modules , Types of Serial Communications, Arduino UART , GSM/GPRS Arduino Interfacing

**References:**


- Singh R., Gehlot A., Singh B., & Choudhaury S. ,(2017) Arduino-Based Embedded Systems: Interfacing, Simulation, and LabVIEW,1st edition,. CRC press.
- Pajankar A., (2018). Arduino Made Simple. BPB.
- Banzil M., (2011). Getting Started with Arduino, 2nd edition, O'reilly


**Methods of Teaching:**

- Classroom teaching, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Electronics): Semester VI
Discipline Specific Core (DSC) Course
ELE-367: Laboratory–I

**Total Hours: 60** **Credits: 2**

**Course objectives:**

- To provide the knowledge and practical exposure of building digital circuits using VHDL.
- To provide the practical knowledge and methodology necessary for Optoelectronics Circuits
- To develop mathematical simulation skill.

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand and design digital systems.
- Understand and handle optoelectronics circuits.

| Sr. No. | Topic Particular | Hours |
|---|---|---|
| **Section A: Advanced digital system (Any 4)** | | |
| 1 | To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's. | 04 |
| 2 | Simulation of logic gates using VHDL. | 04 |
| 3 | Simulation of Half adder/Full adder using VHDL | 04 |
| 4 | Simulation of Half subtractor/Full subtractor using VHDL. | 04 |
| 5 | Simulation of 4 bit binary adder using VHDL. | 04 |
| 6 | Simulation of RS Filp Flop using VHDL. | 04 |
| 7 | Simulation of counter using VHDL | 04 |
| **Section B: Transmission and Antenna (Any 2)** | | |
| 1 | Program to find the power dissipated in the lossless transmission line | 04 |
| 2 | Program to find the total loss in lossy lines | 04 |
| 3 | Program to find the load impedance of a slotted line | 04 |
| 4 | Program to find the input impedance for a line terminated with pure capacitive | 04 |
| 5 | Impedance | 04 |
| 6 | Program to determine the operating range of frequency for TE10 mode of air filled | 04 |
| 7 | rectangular waveguide | 04 |
| 8 | Program to determine Directivity, Bandwidth, Beamwidth of an antenna | 04 |
| 9 | Program to determine diameter of parabolic reflector | 04 |
| **Section C: Optoelectronics (any 4)** | | |
| 1 | Characteristics of optocoupler using IC. | 04 |
| 2 | Study of Photo Detectors using Infrared LED and photo Diode | 04 |
| 3 | Study the characteristics of Blue/Red/ Green LED, the relationship between LED voltage and current and the Wavelength of LED | 04 |
| 4 | Measurement of beam divergence of a LASER beam. | 04 |
| 5 | To determine the wavelength of light from LASER source. | 04 |
| 6 | Study the Characteristics of IR LED and Blue LED, the relation between voltage and current and the wavelength and compare it. | 04 |
| 7 | To determine the transmission loss due to bending of fiber cable. | 04 |

| | | |
|---|---|---|
| 8 | To measure the numerical aperture of an optical fiber. | 04 |
| 9 | Diffraction experiments using a laser. | 04 |
| 10 | Study of solar Cell. | 04 |

Perform total **ten experiments** altogether from all Sections: any **four** experiments from **Section (A)**, any two experiments from **Section (B)** and any **four** experiments from **Section (C)**

**References:**


- Bhaskar J., (2015), VHDL Primer, 3rd edition, Pearson education, India.
- Perry D. L, VHDL (2002), Programming by Example, 4thedition, McGraw Hill Education.
- Mano M. M., Ciletti M. D., (2008), Digital Design, 4thedition, Pearson India.
- Wilson J., Hawkes J.F.B., (1996), Optoelectronics: An Introduction, 3rdedition, Prentice Hall India.
- Senior J., (2001), Optical Fiber Communication Principle and Practice, 2nd edition, PHI


**Methods of Teaching:**

- Laboratory Method, Lecture cum demonstration methods

## T.Y. B.Sc. (Electronics): Semester VI
## Discipline Specific Core (DSC) Course
## ELE-368: Laboratory–II

**Total Hours: 60** **Credits: 2**

**Course objectives:**

- To provide the knowledge and practical exposure of handling biomedical instruments
- To develop expertise in python programming.
- To provide knowledge and develop programming skill of numerical method in electronics.

**Course outcomes:**

After successful completion of this course, students are able to:

- Understand and handle biomedical instruments.
- Develop program using python programming language.
- Apply and solve numerical methods in electronics system.

| Sr. No. | Topic Particular | Hours |
|---|---|---|
| **Section A: Biomedical Instrumentation (Any 2)** | | |
| 1 | Study of ECG/EEG/EMG electrodes. | 04 |
| 2 | Study of temperature sensor for contact measurement (LM35//Thermistor). | 04 |
| 3 | Study of non-contact temperature measurement system (Infrared thermometers). | 04 |
| 4 | Study of ultrasonic sensors (Sensitivity/Directivity)/ Study of social distance maintenance equipment. Study of heart rate sensor. | 04 |
| 5 | To design a band pass filter to obtain the alpha frequency band of an amplified EEG signal. | 04 |
| 6 | Study of electronics stethoscope. | 04 |
| **Section B: Python programming (Any 4)** | | |
| 1 | Write a program of sum of 100 numbers. | 04 |
| 2 | Write a program of to find prime number. | 04 |
| 3 | Write a program of generate Fibonacci series. | 04 |
| 4 | Write a program to find factorial of a number. | 04 |
| 5 | Write a program to generate random numbers. | 04 |
| 6 | Write a program to demonstrate the use of slicing in string. | 04 |
| 7 | Write a Programs related to functions & modules | 04 |
| 8 | Write a program that demonstrate concept of functional programming. | 04 |
| 9 | Write a program to demonstrate the use of tuple | 04 |
| **Section C: Numerical methods using python/C language (Any 4)** | | |
| 1 | Write a program to find root of equation using Bisection method. | 04 |
| 2 | Write a program to find root of equation using Newton Raphson method. | 04 |
| 3 | Write a program to find integration using Simpson's rule. | 04 |
| 4 | Write a program to find integration using Trapezoidal Rule. | 04 |
| 5 | Write a program to solve differential equation using Runge-Kutta method. | 04 |
| 6 | Write a program to solve system equation using Guass elimination method. | 04 |

| | | |
|---|---|---|
| 7 | Write a program to find differentiation using finite difference method | 04 |
| 8 | Write a program to find eigen value | 04 |

**Section D: Mechatronics and Digital Machining (Any 4)**

| | | |
|---|---|---|
| 1 | Identify the components and Draw its ISO symbols used in hydraulic and pneumatic system | 04 |
| 2 | Hydraulic Circuit: Control of a Double Acting Cylinder | 04 |
| 3 | Hydraulic Circuit: Control of a Single Acting Cylinder | 04 |
| 4 | Pneumatic Circuit: Control of Single Acting Cylinder | 04 |
| 5 | Pneumatic Circuit: Control of double acting cylinder – manual | 04 |
| 6 | Pneumatic Circuit: Control of double acting cylinder with limit switches using Pilot operated valve | 04 |
| 7 | Study on the application of data acquisition system for industrial purposes | 04 |
| 8 | Position and velocity measurement using encoders | 04 |
| 9 | Measurement of displacement using POT, LVDT & Capacitive transducer | 04 |

Perform total **ten experiments** altogether from all Sections: any two experiments from **Section (A)** and at least **four experiments** from **Section (B) and Section (C or D)** each.

**References:**


- Khandpur R. S., (2004), Handbook of Biomedical Instrumentation, 2nd edition, McGraw Hill Profession.
- Guttag J. V., (2013), Introduction to Computation and Programming Using Python, Prentice Hall of India.
- Rajaraman V., (1993), Computer Oriented Numerical Methods (3rd ed). Prentice Hall India.


**Methods of Teaching:**

- Laboratory Method, Lecture cum demonstration methods

**T.Y. B.Sc. (Electronics): Semester VI**
**Discipline Specific Core (DSC) Course**
**ELE-369: Project – II**

**Total Hours: 60** **Credits: 2**

**Course objectives:**

- To develop technical skills to perform experiments in details.
- To encourage research and development activities.
- To develops students understanding and thinking for developing techniques for understanding physics and its applications.

**Course outcomes:**

After successful completion of this course, students are able to:

- Aware of various techniques to perform electronics experiments in detail.
- Successfully carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines

Student should perform the following activities in continuation with the work done in first term.

1. Completion of experimental work such as circuit designing, PCB making, components mounting, testing and so on.
2. Obtain the results.
3. Drawing of conclusions.
4. Writing of project report.
5. Preparation of power point presentation for the internal and external assessment/examination

**Project Report:**

1. Students have to write a 'project report'.
2. A report should be a concise account of project work containing full descriptions of the aims, method and outcomes.

**Assessment Criteria of the project:**

The following criteria are to be used in assessing the project work:

**(i) The conduct of project work:**

The following questions are considered in assessing how well students have carried out the project work.

1. How difficult was the project?
2. How well did the student understand the scientific principles behind the project?
3. How well did the student plan the project work?
4. How much effort was put into the project?
5. Was an interim report presented on time?
6. Was the student's project logbooks adequate?
7. How much initiative and/or originality did the student contribute to the project.
8. How well did the student cope with problems that arose during the course of project?
9. Did a project reach a stage of completion where meaningful results were obtained and definite conclusions could be drawn?

**(ii) The Project Report:**

1. How well did the report set out the background?
2. How well did the report describe the underlying them?
3. Was the report a reasonable length?
4. How well was the report structured?
5. How understandable was the written content?
6. How well did the report describe the execution of the project?
7. Did the report have an adequate summary or conclusions?

**(iii) Oral Examination:**

1. Did the student adequately describe what he/she had done in their project?
2. Did the student have a clear interpretation of his/her results?
3. What was the clarity and overall standard of the presentation?
4. How well was the talk/presentation structured?
5. Did the student cover all the relevant material in a reasonable time?

**Scheme of Marking at end-semester examination:**

| Sr. No. | Performance Criteria | Max. Marks |
|---|---|---|
| 1 | Working model of project | 10 |
| 2 | Regularity of Work | 05 |
| 3 | Report and Report Writing Skills | 10 |
| 4 | Self Expression, Communication Skill and Presentation | 05 |
| 5 | Viva -Voce | 10 |
| | **Total** | **40** |

**Skills acquired and Job prospects for the Electronics students:**

Electronics combines the concept of physics, engineering, technology and application. The specified Degree program in electronics develops the student for the upcoming technologies. The students are acquired skills like Designing and Simulation, Building and testing of Digital and Analog electronic circuits or system. A significant attraction of the course is the development of appropriate practical skills suitable as per industrial need and indirectly it provides the interesting and challenging job opportunities.

After successful completion of three years degree course in Electronics, student will be expert in laboratory skills as well as transferable skills.

**Laboratory Skills:**

- Designing and Simulation, of Analog/ Digital electronic circuit/system
- Building and testing of Analog/ Digital electronic circuits
- Laboratory safety practices
- Good understanding of microcontrollers and its interfacing
- Programming in 'C', python, Assembly language
- Skillful handling of basic and advanced instruments

**Transferable Skills:**

During the course student will develop skills other than laboratory skills that are transferable across the number of career areas which include;

- Analytical skill, Observational skill
- Planning and Time management
- Mathematical and IT skills
- Creative thinking, Problem solving
- Report writing skill, Presentation skill

**Job Opportunities:**

After successful completion of B.Sc. in Electronics, student may continue further studies like M.Sc. in Electronics and then Ph.D. in Electronics and make career in research field. Students have opportunities in private as well as public (Government) sectors.

**Private Sector:**

- Communication equipment Manufacturing industries
- PCB Design and Fabrication Industries
- Consumer Electronics Industries
- Electronic Components and Devices Manufacturing
- Semiconductor Manufacturing Industries
- Instrumentation and Control Industries
- Mobile Phone assembly Industries
- Medical Electronics Industries
- Automation and Control Industries

**Public Sectors:**

- Public Sector Undertakings (like BHEL, BEL, HAL, IOCL, HPCL, ISRO, DRDO NTPC, SAIL etc)
- Civil Services
- Defense and Railway
- Any government department where eligibility of any graduation
- Banking
- Educator

**Job profiles:**

Project manager, Electronics design engineer, R & D Engineer, Electronics and Communication Consultant, Laboratory Technician, Research Associates, Research Officers, Research Scientist, Industrial Administrator, Technical executive, software testing, software developer etc. and many other job profiles depending on the job profile and interest to work in the field.

**Opportunities in higher studies**

After successful completion of B.Sc. in Electronics, student may continue further studies like M.Sc. in Electronics and pursue other higher studies like MBA and MCA. Even students can pursue other courses where graduation is essential.

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