SYLLABUS

FOR

FOUR YEARS UNDERGRADUATE PROGRAMME

IN

ELECTRONICS

Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) Based on NEP 2020

With effect from the Academic Session 2023-2024

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722 155

Scheme for Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)

Programme and Course Structure with Credit Distribution: UG Degree Programmes with Single Major										
Category of Course (Credit)	Major (4)		Minor Stream (4)	Multidisciplinary (3)	Skill Enhancement Course (SEC) (3)	Ability Enhancement Course (AEC) (2)	Value Added Courses Common for all (4)	Summer Internship (2)	Research Project / Dissertation (12)	Total Credit / Number of Courses
Semester	DSC	DSE								
I	1× 4 =4		1× 4=4	1×3=3	1×3=3	1× 2=2	1× 4=4			20/6
II	1× 4 =4		1× 4=4	1×3=3	1×3=3	1× 2=2	1× 4=4			20/6
Certificate (Total Credit)	8		8	6	6	4	8	1×4=4* (ADDITIONAL)		40/12
III	2×4 =8		1× 4=4	1×3=3	1×3=3	1 × 2=2				20/6
IV	4×4 = 16		1×4=4			1 × 2=2				22/6
Diploma (Total Credit)	32		16	9	9	8	8	1×4=4* (ADDITIONAL)		82/24
V	4×4 =16		1×4=4					1×2 =2 Mandatory		22/6
VI	4×4 = 16		1×4=4							20/5
UG Degree (Total Credit)	64		24	9	9	8	8	2		124/35
VII	4×4 =16		1×4=4							20/5
VIII	4× 4 =16		1×4=4							20/5
UG HONS. (Total Credit)	24×4 =96		32	9	9	8	8	2		164/45
UG HONS. With Research (Total Credit)	21×4= 84		32	9	9	8	8	2	12**	

Certificate course in ELECTRONICS 1 year duration (I-II Semester); Diploma course in ELECTRONICS 2 years duration (I-IV Semester); UG Degree in ELECTRONICS 3 years of duration (I-VI); UG Degree in ELECTRONICS Honours 4 years of duration (I-VIII; without Research) and

UG Degree in ELECTRONICS Honours 4 years of duration (I-VIII; with Research).

Credit Distribution Across Courses

Course Type	Total Papers	Credits
Major Core (MJC)	24	24×4 =96
Minor (MN)	8	8×4=32
Multidisciplinary (MD)	3	3×3=9
Skill Enhancement Courses (SEC)	3	3×3=9
Ability Enhancement Language Courses (AEC)	4	1×2=2 (ENG) 3×2=6 (MIL)
Value Added Course (VAC)	2	2×4=8
Internship (INT)	1	1×2=2
Research Project/Dissertation	1	1×12=12**
Totals	**46**	**164**

Curriculum and Credit Framework for Course in Electronics

SEMESTER–III

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ELE/ 301/MJC-3	MJCT-3: Semiconductor Devices MJCP-3 Semiconductor Devices Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 302/MJC-4	MJCT-4: Electronics Circuits MJCP-4: Electronics Circuits Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 303/MN-3	MNT-3: Semiconductor Devices and Analog Electronics MNP-3: Semiconductor Devices and Analog Electronics Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 304/MD-3	MDT-3: Communication Systems	3	10	40	50	3	NA	NA
S/ELE/305/ SEC-3	SECP-2 Programming in Python Lab	3	10	40	50	NA	NA	6
ACS/306/ AEC-3	MIL-2 Bengali, Sanskrit, Santali	2	10	40	50	2	NA	NA
Total in Semester - III		**20**	**60**	**240**	**300**	**14**		**12**

N.B. MJC – Major Core; MN – Minor; MD – Multidisciplinary; AEC- Ability Enhancement Course; SEC- Skill Enhancement Course.

Theory: - 1 Credit= 1 hour/Week, Practical: - 1 Credit= 2 hours/Week, Tutorial: - 1 Credit= 1 hour/Week

SEMESTER–IV

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ELE/ 401/MJC-5	MJCT-5: Signals & Systems MJCP-5: Signals & Systems Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 402/MJC-6	MJCT-6: Digital Electronics MJCP-6: Digital Electronics Lab	3 1	10	25 15	50	3		2
S/ELE/ 403/MJC-7	MJCT-7: C Programming and Data Structures MJCP-7: C Programming and Data Structures Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 404/MJC-8	MJCT-8: Operational Amplifiers and Applications MJCP-8: Operational Amplifiers and Applications Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 405/MN-4	MNT-4: Instrumentation MNP-4: Instrumentation Lab	3 1	10	25 15	50	3	NA	2
ACS/406/ AEC-4	Compulsary English: Literature Language and Communication	2	10	40	50	2	NA	NA
ACS/407/ INT-2	Internship	4*		50	50	NA	NA	NA
Total in Semester - IV		**22+4***	**60**	**240**	**300**	**17**		**10**
Second Year (Diploma Course) Total Credit		**(40+42) +4***	**120**	**480**	**600**			

N.B. MJC – Major Core; MN – Minor; MD – Multidisciplinary; AEC- Ability Enhancement Course; INT- Internship; 4*- Additional

Theory: 1 Credit= 1 hour/Week, Practical: - 1 Credit= 2 hours/Week, Tutorial: - 1 Credit= 1 hour/Week. * Diploma in Physiology will be awarded to a student if he or she completes Internship of 4 credits at least 1 in 2 years in addition to total 82 credits in Semester I, II, III & IV.

SEMESTER-III

MJC-3: Semiconductor Devices (Credits: Theory-03)

Course Code: S/ELE/301/MJC-3 Course ID: F.M. = 25

Course Learning Objectives

- To understand the basic crystal structure and different types of semiconductor materials and physics of semiconductor devices
- To be able to plot the current voltage characteristics of Diode, Transistors and MOSFETs
- The student should be able to explain and calculate small signal parameters of semiconductor devices.
- The student should be able to understand the behavior, characteristics and applications of power devices such as SCR, UJT, DIAC, TRIAC.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Describe the behavior of semiconductor materials
- CO2: Reproduce the I-V characteristics of diode/BJT/JFET/MOSFET devices
- CO3: Apply standard device models to explain/calculate critical internal parameters of semiconductor devices
- CO4: Explain the behavior and characteristics of power devices such as SCR/UJT etc.

Unit- 1 (14 Lectures)

Semiconductor Basics: Introduction to Semiconductor Materials, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Derivation of Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations.

Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes, Continuity Equation.

Unit 2 (14 Lectures)

P-N Junction Diode: Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism.

Tunnel diode, varactor diode, solar cell: circuit symbol, characteristics, applications.

Unit 3 (14 Lectures)

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

Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.

Unit 4 (18 Lectures)

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

MOSFET - Types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel), Complimentary MOS (CMOS).

Power Devices: UJT - Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression.
SCR - Construction, Working and Characteristics, TRIAC, DIAC, IGBT, MESFET- Circuit symbols, Basic constructional features, Operation and Applications.

Suggested Books:

1. S.M. Sze, Semiconductor Devices: Physics and Technology, Wiley India edition (2002).
2. B. G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
3. M. Shur Physics of semiconductor devices, Prentice Hall (1990)
4. J. Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
5. K. Kano, Semiconductor Devices, Pearson Education (2004)
6. R.F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)
7. M.S. Tyagi, Introduction to Semiconductor Materials and Devices, Wiley India Pvt. Limited (2008)
8. J.M. Fiore, Semiconductor Devices: Theory and ApplicationIndependently Published, (2017)
9. D.A. Neamen, Semiconductor Physics and Devices, McGraw-Hill Education (2012)

MJC-3: Semiconductor Devices Lab (Credits: Practical-01)

Course Code: S/ELE/301/MJC-3 Course ID: F.M. = 15

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Examine the characteristics of basic semiconductor devices.
- CO2: Perform experiments for studying the behavior of semiconductor devices for circuit design applications.
- CO3: Calculate various device parameter's values from their IV characteristics.
- CO4: Interpret the experimental data for better understanding the device behavior.

List of Experiments: Using Hardware and Circuit Simulation Software

1. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
2. Study of the I-V Characteristics of the CE configuration of BJT and obtain R_i, R_0, β.
3. Study of the I-V Characteristics of the CB Configuration of BJT and obtain R_i, R_0, α.
4. Study of the I-V Characteristics of the UJT.
5. Study of the I-V Characteristics of the SCR.
6. Study of the I-V Characteristics of JFET.
7. Study of the I-V Characteristics of MOSFET.
8. Study of Characteristics of Solar Cell
9. Study of Hall Effect.

MJC-4: Electronics Circuits (Credit: Theory-03)

Course Code: S/ELE/302/MJC-4 Course ID: F.M. = 25

Course Learning Objectives

- Understand diode and it's applications in clipping and clamping circuits, Rectifiers and design regulated powersupply using Zener diodes.
- Understand frequency response of BJT and MOSFET amplifiers.
- Understand the concept of feedback and design feedback amplifiers and oscillators.
- Understand different power amplifiers and single tuned amplifiers.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Illustrate about rectifiers, transistor and FET amplifiers and its biasing. Also compare the performances ofits low frequency models.
- CO2: Describe the frequency response of MOSFET and BJT amplifiers.
- CO3: Explain the concepts of feedback and construct feedback amplifiers and oscillators.
- CO4: Summarizes the performance parameters of amplifiers with and without feedback

Unit- 1 (14 Lectures)

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

Unit- 2 (16 Lectures)

Bipolar Junction Transistor: Review of CE, CB Characteristics and regions of operation, Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias without and with R_E, collector to base bias, voltage divider bias and emitter bias ($+V_{CC}$ and $-V_{EE}$ bias), circuit diagrams and their working.
Transistor as a switch, circuit and working**,** Darlington pair and its applications.
BJT amplifier (CE): dc and ac load line analysis, Hybrid parameters, Hybrid model of CE configuration, Quantitative study of the frequency response of a CE amplifier, Effect on gain and bandwidth for Cascaded CE amplifiers (RC coupled).

Unit- 3 (12 Lectures)

Feedback Amplifiers and Oscillators: Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage and current feedback amplifiers, gain, input and output impedances, Bark hausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.

Unit- 4 (18 Lectures)

MOSFET Circuits: Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits.
Power Amplifiers: Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C, Class AB and their comparisons. Operation of a Class A single ended power amplifier, Operation of Transformer coupled Class A power amplifier, overall efficiency, Circuit operation of complementary symmetry Class B push pull power amplifier, crossover distortion.
Single tuned amplifiers: Circuit diagram, Working and Frequency Response, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits.

Suggested Books:

1. R. Boylstead and L. Nashelsky Electronic Devices and circuit theory, PHI (2013)
2. D. A Bell, Electronic devices and Circuits, Prentice-Hall (1986)
3. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, TMH (2002)
4. D. A. Neamen, Electronic Circuit Analysis and Design, TMH (2002)
5. J. Millman and C. C. Halkias, Integrated Electronics, TMH (2001)
6. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, TMH (2010)
7. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, TMH (1991)
8. A. Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation, (1973)
9. K.A. Navas, Electronics Lab Manual (Vol-1 & 2), PHI Learning (2018)
10. M. H. Tooley Electronic Circuits: Fundamentals and Applications, Elsevier (2006)

MJC-4: Electronics Circuits Lab (Credit: Practical-01)

Course Code: S/ELE/302/MJC-4 Course ID: F.M. = 15

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Study various stages of a zener diode based regulated power supply.
- CO2: Understand various biasing concepts, BJT and FET based amplifiers.
- CO3: Understand the concept of various BJT based power amplifiers and Oscillators.
- CO4: Prepare the technical report on the experiments carried.

List of Experiments: Hardware and Circuit Simulation Software

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

MNT-3: Semiconductor Devices and Analog Electronics (Credits: Theory-03)

Course Code: S/ELE/ 303/MNT-3 Course ID: F.M:25

Course Learning Objectives

- To understand the basic crystal structure and different types of semiconductor materials and physics of semiconductor devices
- To be able to plot the current voltage characteristics of Diode, Transistors and MOSFETs
- The student should be able to explain and calculate small signal parameters of semiconductor devices.
- The student should be able to understand the behaviour, characteristics and applications of power devices such as SCR, UJT, DIAC, TRIAC.

Course Learning Outcomes: At the end of this course, Students will be able to

- CO1: Describe the behaviour of semiconductor materials
- CO2: Reproduce the I-V characteristics of diode/BJT/MOSFET devices
- CO3: Apply standard device models to explain/calculate critical internal parameters of semiconductor devices

Unit- 1 (10 Lectures)

Semiconductor Basics: Introduction to Semiconductor Materials, Energy Band in Solids, Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation.

Unit 2 (20 Lectures)

Semiconductor Diodes: Depletion Layer, Space Charge, Depletion Width and Depletion Capacitance, Diode Equation and I-V Characteristics, Zener and Avalanche Junction Breakdown Mechanism, Clipping and Clamping circuits, Rectifiers: HWR, FWR (Center tapped and Bridge)- Circuit diagrams, working and waveforms, ripple factor & efficiency.
Filters: Types, circuit diagram and explanation of shunt capacitor filter with waveforms. Zener diode regulator circuit diagram and explanation.
Bipolar Junction Transistors (BJT): Basic Transistor Action (PNP and NPN), Current Gain, Base-Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations, Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias without and with R_E, Collector to base bias, Voltage divider bias- Circuit diagrams and their working.

Unit 3 (20 Lectures)

Field Effect Transistors: JFET- Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics.
MOSFET - Types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel).

Unit- 4 (10 Lectures)

Feedback Amplifiers and Oscillators: Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage and current feedback amplifiers, gain, input and output impedances. Bark hausen criteria for oscillations, Study of RC phase shift oscillator.

Suggested Books:

1. R. Boylstead and L. Nashelsky Electronic Devices and circuit theory, 9th Edition, 2013, PHI
2. D. A Bell Electronic devices, Reston Publishing Company
3. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
4. D. A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
5. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
6. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
7. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill
(1991)
8. A. Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation, (1973)
9. K.A. Navas, Electronics Lab Manual (VOLUME 2), PHI Learning (2018)
10. M. H. Tooley Electronic Circuits: Fundamentals and Applications, Elsevier (2006)

MNP-3: Semiconductor Devices and Analog Electronics Lab (Credit: Practical-01)

Course Code: S/ELE/ 303/MNT-3 Course ID: F.M:15

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Study various stages of a zener diode based regulated power supply.
- CO2: Understand various biasing concepts, BJT and FET based amplifiers.
- CO3: Understand the concept of various BJT based power amplifiers and Oscillators.
- CO4: Prepare the technical report on the experiments carried.

List of Experiments:

1. Study of the I-V Characteristics of Diode: Ordinary and Zener Diode.
2. Study of the I-V Characteristics of the CE configuration of BJT and obtain R_i, R_0, β.
3. Study of the I-V Characteristics of JFET.
4. Study of the I-V Characteristics of MOSFET.
5. Study of the Half wave rectifier and Full wave rectifier.
6. Study of power supply using C filter and Zener diode.
7. Study of the frequency response of Common Source FET amplifier.
8. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation

MDT-3: Communication Systems (Credits: Theory-03)

Course Code: S/ELE/304/MD-3 Course ID: F.M: 40

Course Learning Objectives:

- Basic concept & block diagram of communication system, types of noise & noise parameters.
- Need of modulation, AM , types of AM & their comparison , block diagram of AM transmitter & receiver
- Frequency modulation basics, bandwidth requirements of FM, block diagram of FM transmitter & receiver, comparison of AM & FM.
- Need for sampling & types of pulse communication, types of digital communication techniques, concepts of TDMA, FDMA and their comparison.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Familiarization with the basic concept of a communication system and need for modulation
- CO2: Familiarization with various continuous modulation techniques
- CO3: Familiarization with various digital modulation techniques

Unit-1 (16 Lectures)

Electronic Communication: Introduction to Communication, 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, Noise, Internal and External Noises, Signal-to-Noise (S/N) Ratio and Noise Figure.

Amplitude Modulation: Definition, Representation, Modulation Index, Expression for Instantaneous Voltage, Power Relations, Frequency Spectrum, Concept of DSBFC, DSBSC, SSBSC Generation and Detection, Limitations of AM, Demodulation, AM Detection, Diode Detector Circuit, Principle of Working and Waveforms, Concept of VSB, Block Diagram of AM Transmitter and Receiver.

Unit-2 (12 Lectures)

Frequency Modulation and Phase Modulation: Definition, Representation, Modulation Index, Frequency Spectrum, Bandwidth Requirements, Frequency Deviation and Carrier swing, Equivalence between FM and PM, Generation of FM using VCO, Demodulation, FM Detector, Slope Detector Circuit, Principle of Working and Waveforms, Block Diagram of FM Transmitter and Receiver, Comparison of AM and FM, Qualitative Idea of Super Heterodyne Receiver.

Unit- 3 (16 Lectures)

Digital communication: Introduction to pulse and digital communications, Sampling theorem, types-PAM, PWM, PPM, PCM–quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital transmission, TDMA, FDMA, CDMA- concepts only, Comparison of TDMA and FDMA.

Unit- 4 (16 Lectures)

Optical Communication: Introduction of Optical Fiber, Block Diagram of optical communication system, Types of Fiber, Guidance in Optical Fiber, Concept of Optical modes in Step index and graded index Optical Fiber, Attenuation and Dispersion in Fiber, Optical Sources and Detectors-Concept only.

Suggested Books:

1. G. Kennedy Electronic Communication, TMH.
2. Roddy and Coolen, Electronic Communication, PHI.
3. Kennedy and Davis, Electronic Communication systems, TMH.
4. S. Haykin, Communication Systems, Wiley India Pvt. Limited.
5. W.Tomasi, Advanced Electronic Communication systems, Pearson.
6. , J.G. Proakis, M. Salehi,Fundamentals of Communication Systems, Pearson Education.
7. J. S. Chitode, Communication Systems – I, Amazon Digital Services LLC.
8. A.K. Ghatak, K. Thyagarajan, An Introduction to Fiber Optics, Cambridge University Press

SECP-3: Programming in Python Lab (Credits: Practical-03)

Course Code: S/ELE/305/SEC-3 Course ID: F.M: 40

Course Learning Outcomes:

- At the end of this course, students will be able to
- CO1: Write, Test and Debug Python Programs
- CO2: Learn how to write loops and decision statements in Python.
  CO3: Learn how to write functions and pass arguments in Python.
- CO4: How to use lists, tuples, and dictionaries in Python programs.
  CO5: Learn how to use indexing and slicing to access data in Python programs.

- **Parts of Python Programming Language:** Identifiers, Keywords, Statements and Expressions Variables, Assigning Values to Variables, Indentation, Comments, Single Line Comment, Multiline Comments, Reading Input and Print Output

- **Operators**: Arithmetic Operators, Assignment Operators, Comparison Operators, Logical Operators, Bitwise Operators, Ternary operator, Precedence and Associativity
- **Data Types**: Numbers, Boolean, Strings, None, The *int()* Function, The *float()* Function., The *str()* Function , The *chr()* Function , The *complex()* Function , The *ord()* Function ., The *hex()* Function., The *oct()* Function

- **Control Flow Statements:** *if ,if...else , if...elif...else,* Nested *if, while* Loop, *for* Loop, *continue* and *break* Statement

- **Functions**: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, return Statement, Default Parameters, Keyword Arguments

- **Strings:** Creating and Storing String, s*tr()* Function, Basic String Operations, Built-In Functions, String Slicing and Joining

- **Lists:** Creating Lists, Basic List Operations, *list()* Function, Indexing and Slicing in Lists, Modifying Items in Lists, Built-In Functions Used on Lists
- **Dictionaries:** Creating Dictionary, Accessing and Modifying *key:value*Pairs in Dictionaries, *dict()* Function, Built-In Functions Used on Dictionaries, Dictionary Methods

- **Tuples and Sets**.: Creating Tuples, Basic Tuple Operations, *tuple()* Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists&Tuples and Dictionaries, Tuple Methods, Sets, Set Methods, Traversing of Sets

Suggested Books:

1. Introduction to Python Programming, S. Gowrishankar, A. Veena, CRC Press, 2019
2. Let us Python, A. Kanetkar Y. Kanetkar - 6th Edition, BPB Publications, 2023
3. Python: The Complete Reference, M.C. Brown, McGraw Hill Education, 4th Edition 2018

4. Programming in Python, R.S. Salaria, Khanna Publishing House,2019
5. Python Programming: Using Problem Solving, R. Thareja, Oxford University Press 2017

List of Programs to be executed using Python:

- Write a program to read two integers and perform arithmetic operations on them (addition, subtraction, multiplication and division).
- Write a program to convert temperature from centigrade (read it as float value) to Fahrenheit.
- Program to Find the GCD of Two Positive Numbers
- Program to Check if a 3 Digit Number is Armstrong Number or Not
- Write a program to find the largest of three numbers using functions.
- Write Python Program to Find the Sum of Digits in a Number
- Write a Program to Display the Fibonacci Sequences up to *n*th Term Where *n* is Provided by the User
- Write a Program to Find the Factorial of a Number
- Write a Program to Check Whether a Number is Prime or Not
- Write Python Code to Determine Whether the Given String is a Palindrome or Not Using Slicing
- Write Python Program to Count the Total Number of Vowels, Consonants and Blanks in a String
- Write Python Program That Accepts a Sentence and Calculate the Number of Words, Digits, Uppercase Letters and Lowercase Letters
- Write a program that reads the date in the format (dd/mm/yyyy) and replaces the '/' with a '-' and displays the date in (dd-mm-yyyy) format.
- Write a program to read the Richter magnitude value from the user and display the
- Write a program to display the following pattern using nested loops.

a)
```
1
22
333
4444
55555
```

b)
```
    1
   21
  321
 4321
54321
```

- Write Python Program to find sum of the following series for n terms: 1 – 2/2! + 3/3! - - - - - n/n!
- Write Python Program to calculate the sum and product of two compatible matrices.

AEC-3: _____(Credits: Theory-04)

Course Code: ACS/406/AEC-3 Course ID: F.M: 40

As per University norms.

SEMESTER-IV

MJC-5: Signals & Systems (Credits: Theory-03)

Course Code: S/ELE/401/MJC-5 Course ID: F.M: 25

Course Learning Objectives

- Understand mathematical description and representation of continuous and discrete time signals and systems.
- Develop input-output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system.
- Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
- Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s-domain.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Represent various types of continuous-time and discrete-time signals
- CO2: Understand concept of convolution, LTI systems and classify them based on their properties and determine the response of LTI system
- CO3: Determine the impulse response, step response and frequency response of LTI systems
- CO4: Analyze system properties based on impulse response and Fourier analysis
- CO5: Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis
- CO6: Understand Laplace transform and its properties and apply the Laplace transform to obtain
impulse andstep response of simple circuits.

Unit-I (17 Lectures)

Signals and Systems: Continuous and discrete time signals, Transformation of the independent variable, Exponential and sinusoidal signals, Impulse and unit step functions, Continuous-Time and Discrete-Time Systems, Basic System Properties.

Unit-II (13 Lectures)

Time-Invariant Systems (LTI): Discrete time LTI systems, the Convolution Sum, Continuous time LTI systems, the Convolution integral, Properties of LTI systems, Commutative, Distributive, Associative. LTI systems with and without memory, Invariability, Causality, Stability, Unit Step response. Differential and Difference equation formulation, Block diagram representation of first order systems.

Unit-3 (18 Lectures)

Fourier Series Representation of Periodic Signals: Continuous-Time periodic signals, Convergence of the Fourier series, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series. Frequency-Selective filters, Simple RC high pass and low pass filters.

Fourier Transform: Aperiodic signals, Periodic signals, Properties of Continuous-time Fourier transform, Convolution and Multiplication Properties, Properties of Fourier transform and basic Fourier transform Pairs.

Unit-IV (12 Lectures)

Laplace Transform: Laplace Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Laplace Transform for signals, Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits.

Suggested Books:

1. V. Oppenheim, A. S. Wilsky and S. H. Nawab, Signals and Systems, Pearson Education (2007)
2. S. Haykin and B. V. Veen, Signal and Systems, John Wiley & Sons (2004)
3. C. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)
4. H. P. Hsu, Signals and Systems, Tata McGraw Hill (2007)
6. W. Y. Young, Signals and Systems with MATLAB, Springer (2009)
7. A. Anand Kumar, Signals and Systems, PHI Learning (2012)
8. T. K. Rawat,Signals and Systems Oxford University Press (2010)
9. M. Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill (2007)
10. S. S. Haykin, B.V. Veen, Signals and Systems, Wiley (2003)

MJC-5: Signals & Systems Lab (Credits: Practical-01)

Course Code: S/ELE/401/MJC-5 Course ID: F.M: 15

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Learn the practical implementation issues stemming from the lecture material.
- CO2: Learn the use of simulation tools and design skills.
- CO3: Learn to work in groups and to develop SCILAB/MATLAB/other mathematical simulation software simulations of various signals and systems.
- CO4: Prepare the technical report on the experiments carried.

List of Experiments: Use SCILAB/MATLAB/ Other Mathematical Simulation software

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

MJC-6: Digital Electronics (Credits: Theory-03)

Course Code: S/ELE/402/MJC-6 Course ID: F.M: 25

Course Learning Objectives

- To represent information in various number systems
- To convert data from one number system to another and do various arithmetic operations
- To analyze logic systems and able to implement optimized combinational circuit using Karnaugh Map.
- To analyze and implement sequential circuits

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand and represent numbers in powers of base and converting one from the other, carry out arithmetic operations
- CO2: Understand basic logic gates, concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions
- CO3: Analyze and design combinational as well as sequential circuits

Unit-1 (15 Lectures)

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code.

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

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

Unit-2 (12 Lectures)

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

Unit-3 (15 Lectures)

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

Unit-4 (18 Lectures)

Memory Technology: Classification of different types of memory (Semiconductor memory, magnetic memory, Optical memory), ROM, PROM, EPROM, EEPROM, Flash memory, SRAM, DRAM, SDRAM, Concept of Primary, Secondary and Cache memory, Concept of CCD.

Suggested Books:

1. M. M. Morris Mano Digital Design, Pearson Education (2002)
2. T.L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. A.K. Maini, Digital Electronics Principles, Devices and Applications, Wiley India (2007)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
5. A. Anand Kumar, Fundamentals of Digital Circuits, PHI (2016)
6. R. P. Jain, Modern Digital Electronics, McGraw-Hill Education (1984)
7. G. K. Kharate, Digital Electronics, Oxford University Press, India (2012)
8. S.K. Sarkar, A.K. De, S. Sarkar, Foundation of Digital Electronics and Logic Design, Pan Stanford Publishing (2014)
9. J.E. Uffenbeck, Digital Electronics: A Modern Approach, Prentice Hall Career & Technology (1994)

MJC-6: Digital Electronics Lab (Credits: Practical-01)

Course Code: S/ELE/402/MJC-6 Course ID: F.M: 15

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: To understand and design simple digital systems.
- CO2: Familiarize with Simulation and Synthesis Tools, Test Benches used in Digital system design.
- CO3: Prepare the technical report on the experiments carried.

List of Experiments: (Hardware and Circuit Simulation Software)

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

MJC-7: C Programming and Data Structures (Credits: Theory-03)

Course Code: S/ELE/403/MJC-7 Course ID: F.M: 25

Course Learning Objectives: To understand

- The basic structure of the C-language, declaration and usage of variables
- Operators, conditional, branching, iterative statements and recursion
- Arrays, string and functions (modular programming)
- Pointers to access arrays, strings and functions
- Input/Output statement and library functions (math and string related functions)
- User defined data types-structures
- The basic data structures and their implementations
- Various searching and sorting techniques.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Develop algorithms for arithmetic and logical problems and write programs in Clanguage
- CO2: Implement conditional branching, iteration and recursion.
- CO3: Use concept of modular programming by writing functions and using them to form a complete program.
- CO4: Understand the concept of arrays, pointers and structures and use them to develop algorithms and programs for implementing stacks, queues, link list, searching and sorting.

Unit- 1 (12 Lectures)

C Programming Language: Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program.

Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators, Arrays-concepts, declaration, accessing elements, storing elements, two-dimensional and multi-dimensional arrays, Input output statement and library functions (math and string related functions).

Unit-2 (19 Lectures)

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

Structures: defining and declaring a structure variables, accessing structure members, initializing a structure, copying and comparing structure variables, array of structures, arrays within structures, structures within structures, structures and functions, Pointers.

Unit-3 (15 Lectures)

Data Structures: Definition of stack, array implementation of stack, conversion of infix expression to prefix, postfix expressions, evaluation of postfix expression, Definition of Queue, Circular queues, Array implementation of queues, Linked List and its implementation, Link list implementation of stack and queue, Circular and doubly linked list.

Unit-4 (14 Lectures)

Searching and sorting: Insertion sort, selection sort, bubble sort, merge sort, linear Search, binary search.
Trees: Introduction to trees, Binary search tree, Insertion and searching in a BST, preorder, post order and in order traversal (recursive).

Suggested Books:

1. Y. Kanetkar, Let Us C, BPB Publications
2. E. Balagurusamy, Programming in ANSI C, TMH.
3. B.S. Gottfried, Programming with C, Schaum Series
4. B.W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice Hall
5. Y. Kanetkar, Pointers in C, BPB Publications
6. S. Sahni and E. Horowitz, "Data Structures", Galgotia Publications
7. Tanenbaum: "Data Structures using C", Pearson/PHI.
8. Y. Kanetkar, Data Structures Through C, BPB Publications.
9. R.Thareja, Data Structures Using C, Oxford University Press.
10. A.N. Kamthane, Introduction to Data Structures in C, Pearson Education.

MJC-7:C Programming and Data Structures Lab (Credits: Practical-01)

Course Code: S/ELE/403/MJC-7 Course ID: F.M: 15

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Develop algorithms and write programs in C language for arithmetic and logical operations.
- CO2: Write programs in C language to implement the concept of conditional branching, iteration, recursion, arrays and pointers.
- CO3: Write Programs in C language to implement data structures.
- CO4: Prepare the technical report on the experiments carried.

List of Programs to be executed:

1. Generate Fibonacci series up to the given limit N and print the number of elements in the series.
2. Find minimum and maximum of N numbers.
3. Find the GCD of two integer numbers.
4. Calculate factorial of a given number.
5. Find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non – zero coefficients A, B and C.
6. Calculate the value of sin (x)/cos (x) using the series and print sin (x) and cos (x) value using library function.
7. Generate and print prime numbers up to an integer N.
8. Find the sum & difference of two matrices of order M×N and P×Q.
9. Find the product of two matrices of order M×N and P×Q.
10. Calculate the subject wise and student wise totals and store them as a part of the structure.
11. Create a stack and perform Pop, Push, Traverse operations on the stack using Linked list
12. Implement Insertion sort, Merge sort, Bubble sort, Selection sort.

MJC-8: Operational Amplifiers and Applications (Credits: Theory-03)

Course Code: S/ELE/404/MJC-8 Course ID: F.M: 25

Course Learning Objectives

- To develop understanding of Analog Devices starting with ideal Op Amp model and assessing the practical device limitations covering the direct and cascading approach and learning importance of the Data Sheets.
- Design not only linear applications but also design of non-linear application without feedback (voltage comparators), with positive feedback (Schmitt Trigger), and the negative feedback but using non-linear elements such as diodes and switches (sample and hold circuits)
- Study of Signal Generators including also Timers, Multivibrators using IC 555, and V-F conversion with IC566, and also a Study of various fixed and variable IC Regulators 78XX and 79XX and ICLM317.
- Understanding of non-linear circuits such as log/anti-log amplifiers and also study of Phase Locked Loop (PLL), a topic that covers many important concepts of this paper.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand basic building blocks of an op-amp and its parameters for various applications design.
- CO2: Elucidate and design the linear and non-linear applications of an op-amp.
- CO3: Understand the working of multivibrators using IC 555 timer and V-F inter-conversion using special application ICs 565 and 566.
- CO4: Study various fixed and variable IC regulators.

Unit-1 (18 Lectures)

Basic Operational Amplifier: Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741)

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

Unit-2 (14 Lectures)

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

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

Signal generators: Phase shift oscillator, Wein bridge oscillator, Square wave generator, triangle wave generator, saw tooth wave generator and Voltage controlled oscillator (IC 566).

Unit-3 (10 Lectures)

Multivibrators (IC 555): Block diagram, Astable and Monostable multivibrator circuit, Applications of Monostable and Astable multivibrators, Phase locked loops (PLL): Block diagram, phase detectors, IC565.

Fixed and variable IC regulators: IC 78xx and IC 79xx -concepts only, IC LM317- output voltage equation

Unit-4 (18 Lectures)

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

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

Suggested Books:

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)
3. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill (2001)
4. A.P.Malvino, Electronic Principals, Tata McGraw-Hill,(2003)
5. S.K. Sarkar, Operational Amplifiers and Their Applications, S. Chand & Company Limited (1999)
6. W.D. Stanley, Operational Amplifiers with Linear Integrated Circuits, Pearson Education (2002)

MJC-8: Operational Amplifiers and Applications Lab (Credits: Practical-01)

Course Code: S/ELE/404/MJC-8 Course ID: F.M: 15

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Understand the non-ideal behaviour by parameter measurement of Op-amp.
- CO2: Design application oriented circuits using Op-amp ICs.
- CO3: Generate square wave using different modes of 555 timer IC.
- CO4: Prepare the technical report on the experiments carried.

List of Experiments: Use Hardware and/or Circuit Simulation Software

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

MNT-4: Instrumentation (Credits: Theory-03)

Course Code: S/ELE/405/MN-4 Course ID: F.M: 25

Course Learning Objectives

- Explain the importance and working principle of different electronic measuring instruments.
- Use the complete knowledge of various instruments and transducers to make measurements in the laboratory.

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Familiarize with the working principle of different measuring instruments
- CO2: Understand measuring instruments used in the laboratory like oscilloscopes, signal generators
- CO3: Understand working principle of transducers
- CO4: Familiarize with the working principle of data acquisition devices and instruments.

Unit-1 (10 Lectures)

DC and AC indicating Instruments: Accuracy and precision, Types of errors, PMMC galvanometer, sensitivity, Loading effect, Conversion of Galvanometer into ammeter, Voltmeter and Shunt type ohmmeter, Multimeter.

Unit- 2 (18 Lectures)

Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Power scope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).
Signal Generators: Audio oscillator, Pulse Generator, Function generators.

Unit - 3 (12 Lectures)

Transducers: Basic requirements of transducers, Transducers for measurement of non-electrical quantities: Types and their principle of working, measurement of Linear displacement, Acceleration, Flow rate, Liquid level, strain, Force, Pressure, Temperature.

Unit - 4 (20 Lectures)

Measurement of Resistance and Impedance: 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, De Sauty's bridge, Measurement of frequency, Wien's bridge.

Suggested Books:

1. E.W. Goldwing and F.C. Widdies Electrical Measurement in Measuring Instruments, AH WHEELER & Company
2. A.K. Sahwany, Electrical and Electronics Measurement and Instrumentation, Dhanpatrai Pvt. Ltd.

3. Kalsi, Electronic Instrumentation, TMH
4. Instrumentation measurement and analysis: B C Nakra, K K Chaudry, TMH
5. E O Doeblin, Measurement systems applications and design:, McGraw Hill.
6. Electron measurements and instrumentation techniques: Cooper and Helfric, PHI.
7. Electrical Measurements and Instrumentation, Bakshi, Bakshi, Amazon Digital Services
8. D. Patranabis, Principles of Electronic Instrumentation, PHI Learning.
9. J.J. Carr, Elements of Electronic Instrumentation and Measurement, Prentice Hall.
10. R. K. Rajput, Electrical Measurements and Measuring Instruments, S. Chand Limited.

MNP-4: Instrumentation Lab (Credits: Practical-01)

Course Code: S/ELE/405/MN-4 Course ID: F.M: 15

Course Learning Outcomes: At the end of this course, students will be able to

- CO1: Perform experiments on the measuring instruments.
- CO2: Perform measurements of various electrical/electronic parameters using appropriate instruments available in the laboratory.
- CO3: Prepare the technical report on the experiments carried.

List of Experiments:

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

AEC-4: _____(Credits: Theory-04)

Course Code: ACS/406/AEC-4 Course ID: F.M: 40

As per University norms.