# BANKURA UNIVERSITY

(West Bengal Act XIX of 2013- Bankura University Act, 2013)

Main Campus, Bankura Block-II, P.O.: Purandarpur, Dist.: Bankura, Pin- 722155, West Bengal

**Office of the Secretary**

**Faculty Council for Undergraduate Studies**


Ref: BKU/FCUG/199/2025 Date: 30/07/2025

## NOTIFICATION

As directed, the undersigned is pleased to inform all concerned that Bankura University has initiated the process to implement New Curriculum and Credit Framework for Undergraduate Programme, UGC 2022 (as per NEP 2020) for 4-years Undergraduate programme with Electronics as Major, Minor etc. from the academic session 2023-2024. The syllabus as framed / drafted and partially implemented deserves to be analysed after receiving feedback from different stakeholders. As an important corollary to the process, a workshop will be organized on the date mentioned herewith to get the feedback from the stakeholders. Present Students, Alumni, Guardians, Academicians and other stakeholders related to the specific programme/course are requested for their kind participation in the workshop and to present their views/ observations, etc. The stakeholders may go through the draft syllabus attached herewith and convey their observations to the office of the undersigned on ugsecretaryoffice@bankurauniv.ac.in within seven days from the date of publication of this notice.

Date: 1st August, 2025

Time: 11:30 AM

Sd/-
Dr. Arindam Chakraborty
Secretary
Faculty Council for Undergraduate Studies

## SEMESTER–V

| Course Code | Course Title | Credit | Marks | | | No of Hours/Week | | |
|---|---|---|---|---|---|---|---|---|
| | | | IA | ESE | Total | Lec | Tu | Pr |
| S/ELE/ 501/MJC-9 | MJCT-9: Microprocessor and Microcontroller<br>MJCP-9: Microprocessor and Microcontroller Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| S/ELE/ 502/MJC-10 | MJCT-10: Electromagnetics<br>MJCP-10: Electromagnetics Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| S/ELE/ 503/MJE-11 | MJCT-11: Power Electronics<br>MJCP-11: Power Electronics Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| S/ELE/ 504/MJE-12 | MJET-12: Electronic Instrumentation<br>MJEP-12: Electronic Instrumentation Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| S/ELE/ 505/MN-5 | MNT-5: Microprocessor and Microcontroller<br>MNP-5: Microprocessor and Microcontroller Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| ACS/ELE/ 506/INT-3 | INT-3: Internship** | 2 | | | 50 | | | |
| | Total in Semester – V | 22 | 50 | 250 | 300 | 15 | | 10 |

## SEMESTER–VI

| Course Code | Course Title | Credit | Marks | | | No of Hours/Week | | |
|---|---|---|---|---|---|---|---|---|
| | | | IA | ESE | Total | Lec | Tu | Pr |
| S/ELE/ 601/MJC-13 | MJCT-13: Communication Electronics<br>MJCP-13: Communication Electronics Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| S/ELE/ 602/MJC-14 | MJCT-14: Photonics<br>MJCP-14: Photonics Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| S/ELE/ 603/MJE-15 | MJCT-15: Control Systems<br>MJCP-15: Control Systems lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| S/ELE/ 604/MJE-16 | MJCT-16: Numerical Techniques<br>MJCP-16: Numerical Techniques Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| S/ELE/ 605/MN-6 | MNT-6: Photonic Devices and Power Electronics<br>MNP-6: Photonic Devices and Power Electronics Lab | 3<br>1 | 10 | 25<br>15 | 50 | 3 | NA | 2 |
| | Total in Semester – VI | 20 | 50 | 250 | 250 | 15 | | 10 |
| Third Year (UG Degree Course) Total Credit | | 82+42 | 100 | 500 | 550 | | | |

N.B.: MJC – Major Core, MN – Minor; MD – Multidisciplinary; INT- Internship **(Mandatory)
Theory: - 1 Credit= 1 hour/Week, Practical: - 1 Credit= 2 hours/Week, Tutorial: - 1 Credit= 1 hour/Week

**Degree in Electronics will be awarded to a student if he or she completes Internship of 2 credits in addition to total 124 credits in Semester I, II, III, IV, V & VI.

# SEMESTER-V

**MJC-9: Microprocessor and Microcontrollers (Credits: Theory-03)**

**Course Code: S/ELE/501/MJC-9** **Course ID:** **F.M. = 25**

**Theory Lectures 60**

***Course Learning Objectives***

- ✓ To understand basic architecture of 8085 microprocessor
- ✓ To understand the instruction set and write programs in assembly language
- ✓ To interface 8085 microprocessors with common peripheral devices
- ✓ To understand the differences in architecture and applications between Microprocessors and Microcontrollers
- ✓ To understand basic architecture, instruction set and simple interfacing of PIC16F887 microcontroller

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

- ✓ CO1: Understand the basic blocks of microcomputers i.e. CPU, Memory, I/O and architecture of microprocessors and Microcontrollers
- ✓ CO2: Apply knowledge and demonstrate proficiency of designing hardware interfaces for memory and I/O as well as write assembly language programs for target microprocessor and microcontroller.
- ✓ CO3: Derive specifications of a system based on the requirements of the application and select the appropriate Microprocessor or Microcontroller

**Unit-1** (18 Lectures)

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

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

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

**Unit-2** (10 Lectures)

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

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

**Unit-3** (18 Lectures)

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

**Unit–4** (18 Lectures)

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

***Suggested Books:***


1. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram.
2. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai.
3. Mazidi, McKinlay, Mazidi and Das, Microprocessors and Microcontrollers, Pearson.
4. Mathur and Panda, Microprocessors and Microcontrollers, PHI.
5. Krishna Kant, Microprocessors and Microcontrollers: Architecture, Programming and System Design, PHI.
6. Kumar, Saravanan, and Jeevananthan, Microprocessors and Microcontrollers, Oxford.
7. Verle, PIC Microcontrollers, MikroElektronika.
8. Mazidi, Naimi and Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson.
9. Ayala and Gadre, The 8051 Microcontroller and Embedded Systems using Assembly and C, Cengage.
10. Causey, McKinlay and Mazidi, PIC Microcontroller and Embedded Systems: Using assembly and C for PIC 18, Pearson.
11. Microchip PIC16F87X datasheet.


***MJC-9:*** **Microprocessor and Microcontrollers** ***Lab (Credits: Practical-01)***

***Course Code: S/ELE/501/MJC-9*** ***Course ID:*** ***F.M: 15***

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

- ✓ CO1: Be proficient in use of IDEs for designing, testing and debugging microprocessor and microcontroller-based system
- ✓ CO2: Interface various I/O devices and design and evaluate systems that will provide solutions to real world problem
- ✓ CO3: Prepare the technical report on the experiments carried.

List of Experiments to be carried out:

I. Program to transfer a block of data.
II. Program for multibyte addition
III. Program for multibyte subtraction
IV. Program to multiply two 8-bit numbers.
V. Program to divide a 16 bit number by 8 bit number.
VI. Program to search a given number in a given list.
VII. Program to generate terms of Fibonacci series.
VIII. Program to find minimum and maximum among N numbers
IX. Program to find the square root of an integer.
X. Program to sort numbers in ascending/descending order.

## PIC Microcontroller Programming

Note: Programs to be written using C programming language

I. LED blinking with a delay of 1 second.
II. Interfacing of LCD (2X16).
III. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with speed control.
IV. To test all the gates of a given IC74XX is good or bad.
V. Generate sine, square, saw tooth, triangular and staircase waveform using DAC interface.
VI. Display of 4- digit decimal number using the multiplexed 7-segment display interface.
VII. Analog to digital conversion using internal ADC and display the result on LCD.
VIII. Implementation of DC-Voltmeter (0-5V) using internal ADC and LCD
IX. Speed control of DC motor using PWM (pulse delay to be implemented using timers).
X. Interfacing of matrix keyboard (4X4).

**MJC-10: Electromagnetics (Credits: Theory-03)**

**Course Code: S/ELE/502/MJC-10** **Course ID:** **F.M. = 25**

**Theory Lectures 60**

***Course Learning Objectives***

- ✓ To introduce the basic mathematical concepts related to electromagnetic vector fields.
- ✓ To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
- ✓ To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
- ✓ To impart knowledge on the concepts of Faraday's law, induced emf and Maxwell' s equations.
- ✓ To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines.

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

- ✓ CO1: Getting familiar with vector algebra, coordinate system and coordinate conversion
- ✓ CO2: Plotting of fields (Electrostatic and Magnetostatics) and solution of Laplace's equation.
- ✓ CO3: Physical interpretation of Maxwell's equation and problem solving in different media.
- ✓ CO4: Understanding of propagation of an electromagnetic wave.

**Unit-1** (16 Lectures)

Electrostatic Fields: Coulomb's Law and Electric Field, Field due to Discrete and Continuous Charge Distributions, Electric Flux Density, Gauss's Law and Applications, Divergence Theorem and Maxwell's First Equation. Electric Potential, Potential due to a Charge and Charge distribution, Electric dipole. Electric Fields in Conductors, Current and Current Density, Continuity of Current, Metallic Conductor Properties and Boundary Conditions, Method of Images. Dielectric materials, Polarization, Dielectric Constant, Isotropic and Anisotropic dielectrics, Boundary conditions, Capacitance and Capacitors. Electrostatic Energy and Forces.

**Unit-2** (14 Lectures)

**Poisson's Equation and Laplace's Equation:** Derivation of Poisson's and Laplace's equation, Uniqueness Theorem, Examples of Solution of Laplace's Equation: Cartesian, Cylindrical and Spherical Coordinates.

**Magneto statics:** Biot Savert's law and Applications, Magnetic dipole, Ampere's Circuital Law, Curl of a magnetic field, Stoke's Theorem, Maxwell's Equation, Magnetic Flux and Magnetic Flux Density, Scalar and Vector Magnetic Potentials. Magnetization in Materials and Permeability, Anisotropic materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic Circuits. Inductances and Inductors, Magnetic Energy, Forces and Torques.

**Unit-3** (13 Lectures)

**Time-Varying Fields and Maxwell's Equations:** Faraday's Law of Electromagnetic Induction, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Maxwell's Equations in differential and integral form and Constitutive Relations. Potential Functions, Lorentz gauge and the Wave Equation for Potentials, Concept of Retarded Potentials. Electromagnetic Boundary Conditions. Time-Harmonic Electromagnetic Fields and use of Phasors.

**Unit-4** (17 Lectures)

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

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

***Suggested Books:***


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


**MJC-10: Electromagnetics Lab** ***(Credits: Practical-01)***

**(**using SCILAB/MATLAB/ any other similar freeware)

***Course Code: S/ELE/502/MJC-10*** ***Course ID:*** ***F.M: 15***

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

- ✓ CO1: Understand the basic mathematical concepts related to electromagnetic vector fields.
- ✓ CO2: Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.
- ✓ CO3: Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
- ✓ CO4: Understand the concepts related to Faraday's law, induced emf and Maxwell' s equations.
- ✓ CO-5: Apply Maxwell' s equations to solutions of problems relating to transmission lines and uniform plane wave propagation.

List of Experiments to be carried out:

I. Understanding and Plotting Vectors.
II. Transformation of vectors into various coordinate systems.
III. 2D and 3D Graphical plotting with change of view and rotation.
IV. Representation of the Gradient of a scalar field, Divergence and Curl of Vector Fields.
V. Plots of Electric field and Electric Potential due to charge distributions.
VI. Plots of Magnetic Flux Density due to current carrying wire.
VII. Solutions of Poisson and Laplace Equations – contour plots of charge and potential distributions
VIII. Introduction to Computational Electromagnetics: Simple Boundary Value Problems by Finite Difference/Finite Element Methods.

## MJE-11: Power Electronics (Credits: Theory-03)

*Course Code: S/ELE/503/MJE-11* *Course ID:* *F.M: 25*

**Theory Lectures 60**

*Course Learning Objectives*

- ✓ To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics.
- ✓ To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
- ✓ To provide strong foundation for further study of power electronic circuits and systems.

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

- ✓ CO1: Relate basic semiconductor physics and properties of power devices and combine circuit mathematics and characteristics of linear and non-linear devices.
- ✓ CO2: Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits
- ✓ CO3: Design and analyse power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.

**Unit- 1** (15 Lectures)

**Power Devices and SCR**

**Power Devices**: Need for semiconductor power devices, Power diodes, Enhancement of reverse blocking capacity,

**Introduction to family of thyristors:** Silicon Controlled Rectifier (SCR)-structure, two transistor analogy, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Factors affecting the characteristics/ratings of SCR, Gate triggering circuits, dv/dt triggering circuits, Control circuits design and Protection circuits, Snubber circuit.

**Unit- 2** (15 Lectures)

**DIAC, TRIAC, IGBT, Application of SCR and Power MOSFETs**

**DIAC and TRIAC**: Basic structure, working and V-I characteristic, application of a DIAC as a triggering device for a TRIAC,

**Insulated Gate Bipolar Transistors (IGBT)**: Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA) etc.

**Application of SCR**: SCR as a static switch, phase controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non-inductive loads; AC voltage control using SCR and TRIAC as a switch.

**Power MOSFETs**: Operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi-saturation state.

**Unit- 3** (15 Lectures)

**Power Inverters**

**Power Inverters**: Need for commutating circuits and their various types, d.c. link invertors, Parallel capacitor commutated invertors with and without reactive feedback and its analysis, Series Invertor, limitations and its improved versions, Bridge invertors.

**Unit- 4** (15 Lectures)

**Choppers**

Basic chopper circuit, types of choppers (Type A-D), step-down chopper, step-up chopper, operation of d.c. chopper circuits using self-commutation (A & B-type commutating circuit), cathode pulse turn-off chopper (using class D commutation), load sensitive cathode pulse turn-off chopper (Jones Chopper), Morgan's chopper.

***Suggested Books***


1. Sen, Power Electronics, Tata McGraw Hill.
2. Datta, Power Electronics and Controls, Reston/Prentice Hall.
3. Singh and Khanchandani, Power Electronics, Tata McGraw Hill.
4. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson.
5. Mohan, Undeland and Robbins, Power Electronics: Converters, Applications and Design, Wiley.
6. Hari Babu, Power Electronics, Scitech.
7. Asghar, Power Electronics, PHI.
8. Moorthi, Power Electronics, Oxford.


**MJE-11*:* Power Electronics Lab *(Credits: Practical-01)***

***Course Code: S/ELE/503/MJE-11*** ***Course ID:*** ***F.M: 15***

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

- ✓ CO1: Reproduce the characteristics of power semicondcutor devices like SCR, DIAC, TRIAC etc.
- ✓ CO2: Calculate the various device parameters from their characteristics.
- ✓ CO3: Design power control circuits using semicondcutor power devices.
- ✓ CO4: Prepare the technical report on the experiments carried.

List of Experiments to be carried out:

1. Study of I-V characteristics of DIAC
2. Study of I-V characteristics of a TRIAC
3. Study of I-V characteristics of a SCR
4. SCR as a half wave and full wave rectifiers with R and RL loads
5. AC voltage controller using TRIAC with UJT triggering.
6. Study of parallel and bridge inverter.
7. Design of Snubber circuit
8. VI Characteristic of MOSFET and IGBT
9. Study of chopper circuits

**MJE-12: Electronic Instrumentation (Credits: Theory-03)**

***Course Code: S/ELE/504/MJE-12*** ***Course ID:*** ***F.M: 25***

**Theory Lectures 60**

***Course Learning Objectives***

The objective of this subject is to provide insight into electronic instruments being used in the industries and labs. It details the basic working and use of different instruments used for measuring various physical quantities. Also, it details the identification, classification, construction, working principle and applications of various transducers used for displacement, temperature, pressure and intensity measurement.

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

- ✓ CO1: Describe the working principle of different measuring instruments.
- ✓ CO2: Choose appropriate measuring instruments for measuring various parameters in their laboratory.
- ✓ CO3: Correlate the significance of different measuring instruments, recorders and oscilloscopes.

**Unit-1** (12 Lectures)

**Qualities of Measurement:** 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.

**Basic Measurement Instruments:** PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, **o**hm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system (different modes and universal counter).

**Unit–2** (16 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.

**Unit-3** (16 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-4** (16 Lectures)

**Transducers and sensors:** Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge–Theory, types, temperature compensation and applications), Capacitive (Variable Area Type–Variable Air Gap type–Variable Permittivity type), Inductive (LVDT) and piezoelectric transducers. Measurement of displacement, velocity and acceleration (translational and rotational).

Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photo resistors, photovoltaic cells, photodiodes).

***Suggested Books:***


1. H. S. Kalsi, Electronic Instrumentation, TMH (2006)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice-Hall (2005).
3. Nakra B C, Chaudry K, Instrumentation, Measurement and analysis, TMH
4. E.O. Doebelin, Measurement Systems: Application and Design, McGraw Hill Book-fifth Edition (2003).
5. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education, (2005)
6. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
7. Oliver and Cage, "Electronic Measurements and Instrumentation", TMH (2009).
8. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann-2008).
9. A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons (2007).
10. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).


**MJE-12: Electronic Instrumentation Lab (Credits: Practical-01)**

***Course Code: S/ELE/504/MJE-12*** ***Course ID:*** ***F.M: 25***

***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.

I. Design of multi range ammeter and voltmeter using galvanometer.
II. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
III. Measurement of Capacitance by de Sauty bridge.
IV. Measure of low resistance by Kelvin's double bridge.
V. To determine the Characteristics of resistance transducer-Strain Gauge (Measurement of Strain using half and full bridge)
VI. To determine the Characteristics of LVDT.
VII. To determine the Characteristics of Thermistors and RTD.
VIII. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.

## MNT-5: Microprocessor and Microcontroller (Credits: Theory-03)

**Course Code: S/ELE/505/MNT-4** **Course ID:** **F.M. = 25**

**Theory Lectures 60**

***Course Learning Objectives***

- ✓ To understand basic architecture of 8085 microprocessor
- ✓ To understand the instruction set and write programs in assembly language
- ✓ To interface 8085 microprocessor with common peripheral devices
- ✓ To understand the differences in architecture and applications between Microprocessors and Microcontrollers
- ✓ To understand basic architecture, instruction set and simple interfacing of PIC16F887 microcontroller

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

- ✓ CO1: Understand the basic blocks of microcomputers i.e. CPU, Memory, I/O and architecture of microprocessors and Microcontrollers
- ✓ CO2: Apply knowledge and demonstrate proficiency of designing hardware interfaces for memory and I/O as well as write assembly language programs for target microprocessor and microcontroller.
- ✓ CO3: Derive specifications of a system based on the requirements of the application and select the appropriate Microprocessor or Microcontroller

**Unit-1** (10 Lectures)

Introduction to Microprocessor: Introduction, Applications, Basic Block Diagram, Speed, Word Size, Memory Capacity, Classification of Microprocessors (Mention Different Microprocessors being used).

8085 Microprocessor: Main Features, Architecture, Block Diagram, CPU, ALU, Registers, Flags, Stack Pointer, Program Counter, Data and Address Buses, Control Signals, Pin-Out Diagram and Pin Description.

**Unit-2** (16 Lectures)

**8085 Instruction and Programming**: Operation Code, Operand and Mnemonics, Instruction Classification, Addressing Modes, Instruction Format, Instructions Set, Data Transfer, Arithmetic, Increment, Decrement, Logical, Branch and Machine Control Instructions, Assembly Language Programming Examples, Stack Operations, Subroutines and Delay Loops Call and Return Operations, Use of Counters, Timing and Control Circuitry, Timing Diagram, Instruction Cycle, Machine Cycle, T (Timing)-States, Time Delay.

**Interrupts**: Structure, Hardware and Software Interrupts, Vectored and Non-Vectored Interrupts, Latency Time and Response Time.

**Interfacing**: Basic Interfacing Concepts, Memory Mapped I/O and I/O Mapped I/O and Isolated I/O Structure, Partial/Full Memory Decoding, Interfacing of Programmable Peripheral Interface (PPI) Chip (8255), Address Allocation Technique and Decoding, Interfacing of I/O Devices (LEDs and Toggle-Switches as Examples).

**Unit-3** (14 Lectures)

**Introduction to Microcontroller**: Introduction, Types, Basic Block Diagram, Comparison of Microcontroller with Microprocessors, Comparison of 8 Bit, 16 Bit and 32Bit Microcontrollers.

**8051 Microcontroller**: Architecture, Internal Block Diagram, Key Features, Pin Diagram, Memory Organization, Internal RAM, Internal ROM, General Purpose Data Memory, Special Purpose/Function Registers, External Memory, Program Counter and ROM Memory Map, Data Types and Directives, Flag Bits and Program Status Word (PSW) Register, Jump, Loop and Call Instructions.

**Unit–4** (20 Lectures)

**8051 I/O Port Programming**: Introduction of I/O Port Programming, Pin-Out Diagram of 8051 Microcontroller, I/O Port Pins Description and their Functions, I/O Port Programming in 8051 (using Assembly Language), I/O Programming: Bit Manipulation.

**8051 Programming**: 8051 Addressing Modes and Accessing Memory Locations using Various Addressing Modes, Assembly Language Instructions using Addressing Mode, Arithmetic and Logic Instructions, 8051 Programming in C for Time Delay and I/O Operations and Manipulation, for Arithmetic and Logic operations, for ASCII and BCD Conversions, 8051 Assembly Language Programming Examples.

***Suggested Books:***


1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar - Wiley Eastern Limited- IV Edition.
2. Fundamentals of Microprocessor & Microcomputer: B. Ram, Danpat Rai Publications.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education 2008.
4. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006.
5. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar - Wiley Eastern Limited- IV Edition.
6. Fundamentals of Microprocessor & Microcomputer: B. Ram. Dhanpat Rai Publications.


***MNP-4:* Microprocessor and Microcontrollers *Lab (Credits: Practical-01)***

***Course Code: S/ELE/505/MNP-4*** ***Course ID:*** ***F.M: 15***

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

- ✓ CO1: Be proficient in use of IDEs for designing, testing and debugging microprocessor and microcontroller-based system
- ✓ CO2: Interface various I/O devices and design and evaluate systems that will provide solutions to real world problem
- ✓ CO3: Prepare the technical report on the experiments carried.

List of Experiments to be carried out:

I. Transfer of Block of Data.
II. Addition and Subtraction of Numbers using Direct Addressing Mode.
III. Addition and Subtraction of Numbers using Indirect Addressing Mode.
IV. Multiplication by Repeated Addition.
V. Division by Repeated Subtraction.
VI. Search a given Number in a given List.
VII. Generate Fibonacci Series.
VIII. Sorting of numbers in Ascending/Descending Order.
IX. To Find Square Root of an Integer.
X. Use of CALL and RETURN Instruction.
XI. To Find that the given Numbers are Prime or not.

XII. To Find the Factorial of a Number.
XIII. To Find (a) Largest of N Numbers and (b) Smallest of N numbers.

# SEMESTER-VI

**MJC-13: Communication Electronics (Credits: Theory-03)**

*Course Code: S/ELE/601/MJC-13* *Course ID:* *F.M: 25*

**Theory Lectures 60**

***Course Learning Objectives***

- ✓ Basic working of communication system
- ✓ Analog Modulation Techniques and their comparative analysis and applications suitability.
- ✓ Process of Modulation and Demodulation.
- ✓ Types, characterization and performance parameters of transmission channels.
- ✓ Analog to digital conversion and Digital data transmission and Multiplexing Techniques.
- ✓ Basic working principles of existing and advanced communication technologies.

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

- ✓ CO1: Understand the basic concept of a communication system and need for modulation
- ✓ CO2: Evaluate modulated signals in time and frequency domain for various continuous modulation techniques
- ✓ CO3: Describe working of transmitters and receivers and effect of noise on a communication system
- ✓ CO4: Understand baseband Pulse Modulation

**Unit-1** (10 Lectures)

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

**Unit-2** (20 Lectures)

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

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

**Unit-3** (14 Lectures)

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

**Pulse Code Modulation:** Need for digital transmission, Quantizing, Uniform and Non-Uniform Quantization, Quantization Noise, Commanding, Coding, Decoding, Regeneration.

**Unit-4** (16 Lectures)

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

***Suggested Books:***


1. Kennedy, Electronic Communication Systems, Tata McGraw Hill.
2. Roddy and Coolen, Electronic Communications, Pearson.
3. Haykin, Communication Systems, Wiley.
4. Lathi and Ding, Modern Digital and Analog Communication Systems, Oxford.
5. Blake, Electronic Communication Systems, Cengage.
6. Frenzel, Principles of Electronic Communication Systems, Tata McGraw Hill.
7. Tomasi, Advanced Electronic Communications Systems, Pearson.
8. Kundu, Analog and Digital Communications, Pearson.
9. Couch, Digital and Analog Communication Systems, Pearson.


**MJC-13: Communication Electronics Lab (Credits: Practical-01)**

***Course Code: S/ELE/601/MJC-13*** ***Course ID:*** ***F.M: 15***

**Hardware and Circuit Simulation Software)**

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

- ✓ CO1: Understand basic elements of a communication system.
- ✓ CO2: Analyze the baseband signals in time domain and in frequency domain.
- ✓ CO3: Build understanding of various analog and digital modulation and demodulation techniques.
- ✓ CO4: Prepare the technical report on the experiments carried.

List of Experiments to be carried out:

I. Study of Amplitude Modulation and Demodulation
II. Study of Frequency Demodulation and Demodulation
III. Study of Pulse Amplitude Modulation
IV. Study of TDM, FDM
V. Study of Pulse Code Modulation
VI. Study of Amplitude Shift Keying
VII. Study of Phase Shift Keying,
VIII. Study of Frequency Shift Keying.

## MJC-14: Photonics (Credits: Theory-03)

*Course Code: S/ELE/602/MJC-14* *Course ID:* *F.M: 25*

**Theory Lectures 60**

*Course Learning Objectives*

- ✓ To understand light as an electromagnetic wave and various phenomenon like interference, diffraction and polarization.
- ✓ Interaction between a photon and electron and its relevance to laser and various other optoelectronic devices.
- ✓ Understand the propagation of wave in optical fibre

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

- ✓ CO1: Describe optics and simple optical systems.
- ✓ CO2: Understand the concept of light as a wave and the relevance of this to optical effects such as interference and diffraction and hence to lasers and optical fibers.
- ✓ CO3: Use mathematical methods to predict optical effects e.g. light-matter interaction, interference, fiber optics, geometrical optics

**Unit-1** (22 Lectures)

**Light as an Electromagnetic Wave:** Plane waves in homogeneous media, concept of spherical waves. Reflection and transmission at an interface, total internal reflection, Brewster's Law. Interaction of electromagnetic waves with dielectrics: origin of refractive index, dispersion.

**Interference:** Superposition of waves of same frequency, Concept of coherence, Interference by division of wavefront, Young's double slit, Division of Amplitude, thin film interference, anti-reflecting films, Newton's rings; Michelson interferometer. Holography.

**Diffraction:** Huygen Fresnel Principle, Diffraction Integral, Fresnel and Fraunhoffer approximations. Fraunhoffer Diffraction by a single slit, rectangular aperture, double slit, Resolving power of microscopes and telescopes; Diffraction grating: Resolving power and Dispersive power

**Unit-2** (13 Lectures)

**Polarization:** Linear, circular and elliptical polarization, polarizer-analyzer and Malus's law; Double refraction by crystals, Interference of polarized light, Wave propagation in uniaxial media. Half wave and quarter wave plates. Faraday rotation and electro-optic effect.

**Unit-3** (13 Lectures)

**Light Emitting Diodes**: Construction, materials and operation.

**Lasers:** Interaction of radiation and matter, Einstein coefficients, Condition for amplification, laser cavity, threshold for laser oscillation, line shape function. Examples of common lasers. The semiconductor injection laser diode.

**Photodetectors:** Bolometer, Photomultiplier tube, Charge Coupled Device. Photo transistors and Photodiodes (pi- n, avalanche), quantum efficiency and responsivity.

**LCD Displays:** Types of liquid crystals, Principle of Liquid Crystal Displays, applications, advantages over LED displays.

**Unit-4** (12 Lectures)

**Guided Waves and the Optical Fiber:** TE and TM modes in symmetric slab waveguides, effective index, field distributions, Dispersion relation and Group Velocity. Step index optical fiber, total internal reflection, concept of linearly polarized waves in the step index circular dielectric waveguides, single mode and multimode fibers, attenuation and dispersion in optical fiber.

***Suggested Books:***


1. Ghatak, Optics, Tata McGraw Hill.
2. Hecht, Optics, Pearson.
3. Wilson and Hawkes, Optoelectronics: An Introduction, Pearson.
4. Kasap, Optoelectronics and Photonics: Principles and Practices, Pearson.
5. Ghatak and Thyagarajan, An Introduction to Fiber Optics, Cambridge.
6. Khare, Fiber Optics and Optoelectronics, Oxford.
7. Roy, Advanced Optical Fiber Communications, Scitech.


**MJC-14: Photonics Lab (Credits: Practical-01)**

*Course Code: S/ELE/602/MJC-14* *Course ID:* *F.M: 15*

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

- ✓ CO1: Perform experiments based on the phenomenon of light/photons.
- ✓ CO2: Measure the parameters such as wavelength, resolving power, numerical aperture etc. using the appropriate photonic/optical technique.
- ✓ CO3: Prepare the technical report on the experiments carried

List of Experiments to be carried out:

I. To verify the law of Malus for plane polarized light.
II. To determine wavelength of sodium light using Michelson's Interferometer.
III. To determine wavelength of sodium light using Newton's Rings.
IV. To determine the resolving power and Dispersive power of Diffraction Grating.
V. Diffraction experiments using a laser.
VI. Study of Faraday rotation.
VII. To measure the numerical aperture of an optical fiber.
VIII. To determine the specific rotation of scan sugar using polarimeter.
IX. To determine characteristics of LEDs and Photo- detector.

## MJE-15: Control Systems (Credits: Theory-03)

*Course Code: S/ELE/603/MJE-15* *Course ID:* *F.M: 25*

**Theory Lectures 60**

*Course Learning Objectives*

- ✓ Mathematical modelling and analysis of open-loop and closed-loop control systems.
- ✓ Time-domain and Frequency-domain analysis of control systems.
- ✓ Methods for accessing absolute and relative stability of control systems.
- ✓ State-space analysis

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

- ✓ CO1: Understand the concepts of closed loop control systems.
- ✓ CO2: Analyse the stability of closed loop systems.
- ✓ CO3: Apply the control techniques to any electrical systems.
- ✓ CO4: Compute and assess system stability.

**Unit 1** (16 Lectures)

**Introduction to Control Systems:** Open loop and Closed loop control systems, Mathematical modelling of physical systems (Electrical, Mechanical and Thermal), Derivation of transfer function, Armature controlled and field-controlled DC servomotors, AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason's Gain Formula, Effect of feedback on control systems, Parameter Variation and sensitivity.

**Unit 2** (14 Lectures)

**Time Domain Analysis:** Time domain performance criteria, transient response of first, second & higher order systems, steady state errors and static error constants, Performance indices.

**Concept of Stability:** Asymptotic stability and conditional stability, Routh–Hurwitz criterion, relative stability analysis, Root Locus plots and their applications.

**Unit 3** (14 Lectures)

**Frequency Domain Analysis:** Correlation between time and frequency response, Polar and inverse polar plots, frequency domain specifications, Logarithmic plots (Bode Plots), gain and phase margins, Nyquist stability criterion, relative stability using Nyquist criterion, constant M & N circles.

**Unit 4** (16 Lectures)

**State Space Analysis:** Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties.

**Controllers and Compensation Techniques:** Response with P, PI and PID Controllers, Concept of compensation, Lag, Lead and Lag-Lead networks.

*Suggested Books:*


1. Nagrath and Gopal, Control System Engineering, New Age.
2. Ogata, Modern Control Engineering, Pearson.
3. Golnaraghi and Kuo, Automatic Control System, Wiley.
4. Nise, Control System Engineering, Wiley.
5. Anand Kumar, Control Systems, PHI.

6. Distefano, Stubberud, Williams and Mandal, Control Systems, Schaum's Outline Series, Tata McGraw Hill.
7. Wolovich, Automatic Control Systems: Basic Analysis and Design, Oxford.
8. Venkatesh and Rao, Control Systems, Cengage.

**MJE-15: Control Systems (Credits: Practical-01)**

***Course Code: S/ELE/603/MJE-15*** ***Course ID:*** ***F.M: 15***

(Hardware and SCILAB/MATLAB/Other Mathematical Simulation software)

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

- ✓ CO1: Perform experiments involving concepts of control systems
- ✓ CO2: Design experiments for controlling devices like AC/DC motors etc.
- ✓ CO3: Study the behaviour of First and Second Order systems.
- ✓ CO4: Comparison of various types of control mechanisms.

List of Experiments to be carried out:

I. To study position control of DC motor
II. To study speed control of DC motor
III. To study time response of type 0, 1 and 2 systems
IV. To study frequency response of first and second order systems
V. To study time response characteristics of a second order system.
VI. To study effect of damping factor on performance of second order system
VII. To study frequency response of Lead and Lag networks.
VIII. Study of P, PI and PID controller.

## MJE-16: Numerical Techniques (Credits: Theory-03)

*Course Code: S/ELE/604/MJE-16* *Course ID:* *F.M: 25*

**Theory Lectures 60**

*Course Learning Objectives*

- ✓ Apply numerical methods to obtain approximate solutions to mathematical problems.
- ✓ Analyze and evaluate the accuracy of common numerical methods.
- ✓ Implement numerical methods in MATLAB.
- ✓ Write efficient, well-documented MATLAB code and present numerical results in an informative way.

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

- ✓ CO1: Understand the common numerical methods and how they are used to obtain approximate solutions to mathematical problems.
- ✓ CO2: Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- ✓ CO3: Analyze and evaluate the accuracy of common numerical methods.

**Unit-1** (16 Lectures)

**Numerical Methods**: Floating point, Round-off error, Error propagation, Stability, Programming errors.

**Solution of Transcendental and Polynomial Equations f(x)=0:** Bisection method, Secant and Regula-Falsi Methods, Newton Raphson method, Rate of convergence, General Iteration Methods, Newton's Method for Systems, Method for Complex Roots, Roots of Polynomial Equations.

**Unit-2** (14 Lectures)

**Interpolation and Polynomial Approximations**: Taylor Series and Calculation of Functions, Lagrange Interpolation, Newton Divided Difference Interpolation (forward and backward difference formulae), Truncation errors.

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

**Unit-3** (16 Lectures)

**Numerical Integration**: Trapezoidal Rule, Error bounds and estimate for the Trapezoidal rule, Simpson's Rule, Error of Simpson's rule.

**Numerical Differentiation**: Finite difference method and applications to electrostatic boundary value problems.

**Numerical methods for first order differential equations:** Euler-Cauchy Method, Heun's Method, Classical Runge-Kutta method of fourth order. Methods for system and higher order equations.

**Unit- 4** (14 Lectures)

**Numerical Methods in Linear Algebra:** Linear systems Ax=B, Gauss Elimination, Partial Pivoting, LU factorization, Doolittle's, Crout's and Cholesky's method. Matrix Inversion, Gauss-Jordon, Iterative Methods: Gauss-Seidel Iteration, Jacobian Iteration.

**Matrix Eigenvalue:** Power Method.

***Suggested Books:***


1. Kreyszig, Advanced Engineering Mathematics, Wiley.
2. Dey and Gupta, Numerical Methods, Tata McGraw Hill.
3. Balagurusamy, Numerical Methods, Tata McGraw Hill.
4. Rajaraman, Computer Oriented Numerical Methods, PHI.
5. Sastry, Introductory Methods of Numerical Analysis, PHI.
6. Jain, Iyengar and Jain, Numerical Methods (Problems and Solutions), New Age.
7. Grewal, Numerical Methods in Engineering and Science with Programs in C, C++ & MATLAB, Khanna.
8. Thangaraj, Computer-Oriented Numerical Methods, PHI.


**MJE-16: Numerical Techniques Lab (Credits: Practical-01)**

***Course Code: S/ELE/604/MJE-16*** ***Course ID:*** ***F.M: 15***

(C language/ SCILAB/MATLAB/Other Mathematical Simulation software)

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

- ✓ CO1: Implement numerical methods in C language/ SCILAB/MATLAB/Other Mathematical Simulation software.
- ✓ CO2: Write efficient, well-documented code in the above mathematical simulation software and present numerical results in an informative way.
- ✓ CO3: Prepare the technical report on the experiments carried.

List of Experiments to be carried out:

I. Program to implement Bisection Method
II. Program to implement Secant Method
III. Program to implement Regula-Falsi method
IV. Program to implement Newton Raphson Method
V. Program to implement Trapezoidal rule
VI. Program to implement Simpson's rule
VII. Program to implement Runge-Kutta Method
VIII. Program to implement Euler-Cauchy Method
IX. Program to implement Gauss-Jordon Method
X. Program to implement Gauss-Seidel Iteration

**MNT-6: Photonic Devices and Power Electronics (Credits: Theory-03)**

**Course Code: S/ELE/ 605/MNT-6** **Course ID:** **F.M:25**

**Theory Lectures 60**

**Course Learning Objectives:**

- ✓ This paper aims to provide students with in-depth understanding of the principles, concepts, and applications of photonic devices and power electronics.
- ✓ The course covers a range of topics, including, semiconductor lasers, fibre optics, power diodes, power MOSFETs, and power electronics applications.
- ✓ Students will develop the necessary knowledge and skills to design and analyze various photonic and power electronic devices and systems.

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

- ✓ CO1: Understand the basic principles and concepts of photonic devices and power electronics, including semiconductor lasers, fibre optics, power diodes, power MOSFETs, and power electronics applications.
- ✓ CO2: Develop the necessary knowledge and skills to design and analyse various photonic and power electronic devices and systems.
- ✓ CO3: Gain practical experience in device design, fabrication, and characterization.
- ✓ CO4: Apply the knowledge and skills learned in the course to real-world challenges and opportunities in the fields of photonics and power electronics.

**UNIT-I: PHOTONIC DEVICES (36 Lectures)**

**Classification of photonic devices**: Interaction of radiation and matter, Radiative transition and optical absorption. Light Emitting Diodes- Construction, materials and operation. Semiconductor Laser- Condition for amplification, laser cavity, heterostructure and quantum well devices. Charge carrier and photon confinement, line shape function. Threshold current. Laser diode.

**Photodetectors**: Photoconductor. Photodiodes (p-i-n, avalanche) and Photo transistors, quantum efficiency and responsivity. Photomultiplier tube

**Solar Cell**: Construction, working and characteristics

**LCD Displays**: Types of liquid crystals, Principle of Liquid Crystal Displays, applications, advantages over LED displays

**Introduction to Fiber Optics**: Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure

**UNIT-II: POWER ELECTRONICS (24 Lectures)**

**Power Devices**: Need for semiconductor power devices, Power MOSFET (Qualitative).

**Introduction to family of thyristors**: Silicon Controlled Rectifier (SCR)- structure, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Gate-triggering circuits. Diac and Triac- Basic structure, working and V-I characteristics. Application of Diac as a triggering device for Triac.

**Insulated Gate Bipolar Transistors (IGBT)**: Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA).

**Applications of SCR**: Phase controlled rectification, AC voltage control using SCR and Triac as a switch. Power Inverters- Need for commutating circuits and their various types, dc link inverters, Parallel capacitor commutated inverters, Series Inverter, limitations and its improved versions, bridge inverter.

**Reference Books:**


1. J. Wilson & J.F.B. Hawkes, Optoelectronics: An Introduction, Prentice Hall India (1996)
2. S.O. Kasap, Optoelectronics & Photonics, Pearson Education (2009)
3. AK Ghatak & K Thyagarajan, Introduction to fiber optics, Cambridge Univ. Press (1998)
4. Power Electronics, P.C. Sen, Tata McGraw Hill
5. Power Electronics, M.D. Singh & K.B. Khanchandani, Tata McGraw Hill
6. Power Electronics Circuits, Devices & Applications, 3rd Edn., M.H. Rashid, Pearson Education
7. Optoelectronic Devices and Systems, Gupta, 2nd Ed., PHI learning.
8. Electronic Devices and Circuits, David A. Bell, 2015, Oxford University Press.


**MNP-6: Photonic Devices and Power Electronics Lab (Credits: Practical-01)**

**Course Code: S/ELE/ 605/MNP-6** **Course ID:** **F.M:15**

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

- ✓ Equip with the practical skills to measure and analyze the performance of various photonic devices (like LEDs, photodetectors, lasers) alongside power electronic components (like transistors, diodes),
- ✓ Enabling them to understand their characteristics, limitations, and applications in real-world circuits,
- ✓ Developing proficiency in experimental setup, data collection, and analysis techniques.

**List of Experiments to be carried out:**

I. To determine wavelength of sodium light using Michelson's Interferometer.
II. Diffraction experiments using a laser.
III. Study of Electro-optic Effect.
IV. To determine characteristics of (a) LEDs, (b) Photo voltaic cell and (c) Photo diode.
V. To study the Characteristics of LDR and Photodiode with (i) Variable Illumination
VI. intensity, and (ii) Linear Displacement of source.
VII. To measure the numerical aperture of an optical fiber.
VIII. Output and transfer characteristics of a power MOSFET.
IX. Study of I-V characteristics of SCR
X. SCR as a half wave and full wave rectifiers with R and RL loads.
XI. AC voltage controller using TRIAC with UJT triggering.
XII. Study of I-V characteristics of DIAC
XIII. Study of I-V characteristics of TRIAC