# CBCS SYLLABUS

**FOR**

**THREE YEARS UNDER-GRADUATE COURSE**

**IN**

**ELECTRONIC SCIENCE (PROGRAMME)**

**(*w.e.f. 2017*)**

**BANKURA UNIVERSITY**

**BANKURA**

**WEST BENGAL**

**PIN 722155**

**Details of Courses Under Undergraduate Program (B.Sc.)**

| **Course** | ***Credits** | |
|---|---|---|
| | Theory+ Practical | Theory+Tutorials |
| **I. Core Course**<br>**(12 Papers)**<br>04 Courses from each of the<br>03 disciplines of choice | 12X4= 48 | 12X5=60 |
| **Core Course Practical / Tutorial***<br>**(12 Practical/ Tutorials*)**<br>04 Courses from each of the<br>03 Disciplines of choice | 12X2=24 | 12X1=12 |
| **II. Elective Course**<br>**(6 Papers)**<br>Two papers from each discipline of choice including paper of interdisciplinary nature. | 6x4=24 | 6X5=30 |
| **Elective Course Practical / Tutorials***<br>**(6 Practical / Tutorials*)**<br>Two Papers from each discipline of choice including paper of interdisciplinary nature | 6 X 2=12 | 6X1=6 |
| **III. Ability Enhancement Courses** | | |
| 1**. Ability Enhancement Compulsory**<br>**(2 Papers of 2 credits each)**<br>**Environmental Science**<br>**English/MIL Communication** | 2 X 2=4 | 2X2=4 |
| 2**. Skill Enhancement Course**<br>**(Skill Based)**<br>**(4 Papers of 2 credits each)** | 4 X 2=8 | 4 X 2=8 |
| | **Total credit= 120** | **Total credit= 120** |

## SchemeforchoicebasedcreditsysteminB.Sc.withElectronics

| | **CORE COURSE (12)** | **Ability Enhancement Compulsory Course (AECC)** | **Skill Enhancement Course (SEC)** (4) | **Discipline Specific Elective DSE(6)** |
|---|---|---|---|---|
| I | Electronic circuits and PCB designing | (English/MIL Communication)/ EnvironmentalScience | | |
| | DSC- 2 A | | | |
| | DSC- 3 A | | | |
| II | Digital System Design | Environmental Science /(English/MIL Communication) | | |
| | DSC- 2 B | | | |
| | DSC- 3 B | | | |
| III | Communication Systems | | SEC-1 | |
| | DSC- 2 C | | | |
| | DSC- 3 C | | | |
| IV | Instrumentation | | SEC -2 | |
| | DSC- 2 D<br>DSC- 3 D | | | |
| V | | | SEC -3 | DSE-1 A |
| | | | | DSE-2 A |
| | | | | DSE-3 A |

| | | | | |
|---|---|---|---|---|
| VI | | | SEC -4 | DSE-1 B |
| | | | | DSE-2 B |
| | | | | DSE-3 B |

| SEMESTER | COURSE OPTED | COURSE NAME | Credits |
|---|---|---|---|
| I | Ability Enhancement Compulsory Course-I | English communications/ Environmental Science | 2 |
| | Core course-I | Electronic Circuits and PCB Designing | 4 |
| | Core Course-I Practical/Tutorial | Electronic Circuits and PCB Designing Lab | 2 |
| | Core course-II | DSC 2A | 6 |
| | Core Course-III | DSC 3A | 6 |
| II | Ability Enhancement Compulsory Course-II | English communications/ Environmental Science | 2 |
| | Core course-IV | Digital System Design | 4 |
| | Core Course-IV Practical/Tutorial | Digital System Design Lab | 2 |
| | Core course-V | DSC 2B | 6 |
| | Core Course-VI | DSC 3B | 6 |
| III | Core course-VII | Communication Systems | 4 |
| | Core Course-VII Practical/Tutorial | Communication Systems Lab | 2 |
| | Core course-VIII | DSC 2C | 6 |
| | Core Course-IX | DSC 3C | 6 |
| | Skill Enhancement Course -1 | SEC-1 | 2 |
| IV | Core course-X | Instrumentation | 4 |
| | Course-X Practical/Tutorial | Instrumentation Lab | 2 |
| | Core course-XI | DSC 2D | 6 |
| | Core course-XII | DSC 3D | 6 |
| | Skill Enhancement Course -2 | SEC -2 | 2 |
| V | Skill Enhancement Course -3 | SEC -3 | 2 |
| | Discipline Specific Elective -1 | DSE-1A | 6 |
| | Discipline Specific Elective -2 | DSE-2A | 6 |
| | Discipline Specific Elective -3 | DSE-3A | 6 |
| VI | Skill Enhancement Course -4 | SEC -4 | 2 |
| | Discipline Specific Elective -4 | DSE-1B | 6 |
| | Discipline Specific Elective -5 | DSE-2B | 6 |
| | Discipline Specific Elective-6 | DSE-3B | 6 |
| Total Credits | | | 120 |

# B.Sc.withElectronics

## 1 credit = 1 hour/week for theory; 2 hours/week for practical

**Core papers Electronics (Credit: 06 each) (CP 1-4)**:

1. Electronic Circuits and PCB Designing Semester-I
2. Digital System Design Semester-II
3. Communication Systems Semester-III
4. Instrumentation Semester-IV

**Discipline Specific Elective papers (Credit: 06 each) (DSE 1, DSE 2)**:

1. Electronic Instrumentation Semester-V
2. Photonic Devices and Power Electronics Semester-VI

**Skill Enhancement Course (any four) (Credit: 02 each)- SEC 1 to SEC 4**

1. Renewable Energy and Energy harvesting Semester-III
2. Weather Forecasting Semester-IV
3. Computational Physics Skills Semester-V
4. Electrical circuits and network Skills Semester-VI

**Full Marks: 25 Time 2 hours**

Total 8 questions each of 2 marks are to be set; any 5 to be answered.
Total 4 questions each of 5 marks are to be set; any 1 to be answered.
Total 4 questions each of 10 marks are to be set; any 1 to be answered.

# Semester-I

## CP-1: Electronic Circuits and PCB Designing (Credits: Theory-04, Practicals-02)

**F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)**

**[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]**

**Theory Lectures** **60**

### Unit-1 (12 Lectures)

**Network theorems (DC analysis only):** Review of Ohms law, Kirchhoff's laws, voltagedivider and current divider theorems, open and short circuits.
Thevenin's theorem, Norton's theorem and interconversion, superposition theorem, maximum power transfer theorem.

### Unit 2 (13 Lectures)

**Semiconductor Diode and its applications:** PN junction diode and characteristics,idealdiode and diode approximations. Block diagram of a Regulated Power Supply, Rectifiers: HWR, FWR - center tapped and bridge FWRs. Circuit diagrams, working and waveforms, ripple factor & efficiency (no derivations).Filters: 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-3 (17 Lectures)

**BJT and Small Signal amplifier:** Bipolar Junction Transistor: Construction, principle &working of NPN transistor, terminology. Configuration: CE, CB, CC. Definition of α, β and γ and their interrelations, leakage currents. Study of CE Characteristics, Hybrid parameters.
Transistor biasing: need for biasing, DC load line, operating point, thermal runaway, stability and stability factor.
Voltage divider bias: circuit diagrams and their working, Q point expressions for voltage divider biasing.
Small signal CE amplifier: circuit, working, frequency response, re model for CE configuration, derivation for Av, Zin and Zout.

### Unit-4 (18 Lectures)

**Types of PCB:** Single sided board, double sided, Multilayer boards, Plated through holestechnology, Benefits of Surface Mount Technology (SMT), Limitation of SMT, Surface mount components: Resistors, Capacitor, Inductor, Diode and IC's.

**Layout and Artwork:** Layout Planning: General rules of Layout, Resistance, Capacitanceand Inductance, Conductor Spacing, Supply and Ground Conductors, Component Placing and mounting, Cooling requirement and package density, Layout check.
Basic artwork approaches, Artwork taping guidelines, General artwork rules: Artwork check and Inspection.
**Laminates and Photoprinting:** Properties of laminates, Types of Laminates, Manualcleaning process, Basic printing process for double sided PCB's, Photo resists, wet film resists, Coating process for wet film resists, Exposure and further process for wet film resists, Dry film resists
**Etching and Soldering**: Introduction, Etching machine, Etchant system. Principles of Solderconnection, Solder joints, Solder alloys, Soldering fluxes. Soldering, Desoldering tools and Techniques.

**Suggested Books:**


1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
2. Electronics text lab manual, Paul B. Zbar.
3. Electric circuits, Joeseph Edminister, Schaum series.
4. Basic Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshresta and D.C Gupta -TMH.
5. Electronic devices, David A Bell, Reston Publishing Company/DB Tarapurwala Publ.
6. Walter C.Bosshart "PCB DESIGN AND TECHNOLOGY" Tata McGraw Hill Publications, Delhi. 1983
7. Clyde F.Coombs "Printed circuits Handbook" III Edition, McGraw Hill.


## GE-1: Electronic Circuits and PCB Designing Lab 60 Lectures

## (Hardware and Circuit Simulation Software)

1. Verification of Thevenin's theorem
2. Verification of Super position theorem
3. Verification of Maximum power transfer theorem.
4. Half wave Rectifier – without and with shunt capacitance filter.
5. Centre tapped full wave rectifier – without and with shunt capacitance filter.
6. Zener diode as voltage regulator – load regulation.
7. Transistor characteristics in CE mode – determination of ri, ro and β.
8. Design and study of voltage divider biasing.
9. Designing of an CE based amplifier of given gain
10. Designing of PCB using artwork, its fabrication and testing.
11. Design, fabrication and testing of a 9 V power supply with zener regulator

# Semester-II

**CP-2: Digital System Design (Credits: Theory-04, Practicals-02)**

**F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)**

**[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]**

**Theory Lectures** **60**

**Unit-1** (15 lectures)

**Number System and Codes:** Decimal, Binary, Hexadecimal, Octal, BCD, Conversions,Complements (1's and 2's), Signed and unsigned numbers, addition and subtraction, multiplication and subtraction, Gray Codes

**Boolean algebra and Logic gates:** Boolean algebra- Positive and negative logic. Booleanlaws. De Morgan's theorems, simplification of Boolean expressions-SOP and POS. Logic gates- basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and 4 variable expressions. Characteristics of logic families: Fan In and Fan out, power dissipation and noise Immunity, propagation delay, comparison of TTL and CMOS families.

**Unit-2** (11 lectures)

**Combinational logic analysis and design**: Multiplexers and De-multiplexers, Adder (halfand full) and their use as subtractor, Encoder and Decoder, Code Converter (Binary to BCD and vice versa)

**Unit-3** (16 lectures)

**Sequential logic design**: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs,registers, Counters (ripple, synchronous and asynchronous, ring, modulus)

**Unit-4** (18 Lectures)

**VHDL:** A Brief History of HDL, Structure of HDL Module, Comparison of VHDL andVerilog, Introduction to Simulation and Synthesis Tools, Test Benches.
VHDL: Module, Delays, brief description - data flow style, behavioral style, structural style, mixed design style, simulating design.
Language Elements, Introduction, Keywords, Identifiers, White Space Characters, Comments, format, Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters. Operands, Operators, types of Expressions
Gate level modeling, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

**Suggested books:**


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


## GE-2: Digital System Design Lab 60 Lectures

### (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 seven segment display driver.
6. Design a 4 X 1 Multiplexer using gates.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.
9. Design a shift register and study Serial and parallel shifting of data.

**VHDL**

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates.
4. Clocked D FF, T FF and JK FF (with Reset inputs).

5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.
6. Decoder (2x4, 3x8), Encoders and Priority Encoders.
7. Design and simulation of a 4 bit Adder.
8. Code converters (Binary to Gray and vice versa).
9. 2 bit Magnitude comparator.
10. 3 bit Ripple counter.

# Semester-III

## CP-3: Communication Systems (Credits: Theory-04, Practicals-02)

**F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)**

**[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]**

**Theory Lectures** **60**

### Unit-1 (16 Lectures)

**Noise and Transmission lines:** Noise-Introduction, internal and external noises, signal tonoise ratio and noise figure

**Amplitude Modulation/demodulation techniques**: Block diagram of electroniccommunication system. Modulation-need and types of modulation-AM, FM & PM. Amplitude modulation – representation, modulation index, expression for instantaneous voltage, power relations, frequency spectrum, DSBFC, DSBSC and SSBSC (mention only). Limitations of AM.
Demodulation- AM detection: principles of detection, linear diode, principle of working and waveforms.
Block diagram of AM transmitter and Receiver.

### Unit-2 (12 Lectures)

**Frequency Modulation/demodulation techniques:** Frequency Modulation: definition,modulation index, FM frequency spectrum diagram, bandwidth requirements, frequency deviation and carrier swing, FM generator-varactor diode modulator.
FM detector – principle, slope detector-circuit, principle of working and waveforms. Block

diagram of FM transmitter and Receiver. Comparison of AM and FM.

**Unit- 3** (16 Lectures)

**Digital communication:** Introduction to pulse and digital communications, digital radio,sampling theorem, types- PAM, PWM, PPM, PCM – quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital transmission, characteristics of data transmission circuits – Shannon limit for information capacity, bandwidth requirements, data transmission speed, noise, cross talk, echo suppressors, distortion and equalizer, MODEM– modes, classification, interfacing (RS232). TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA

**Unit- 4** (16 Lectures)

**Cellular Communication:** Concept of cellular mobile communication – cell and cellsplitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts.
**Satellite communication:** Introduction, to Orbit, types of orbits, Block diagram of satellitetransponder.

**Suggested Books:**

1. Electronic Communication, George Kennedy, 3rd edition, TMH.
2. Electronic Communication, Roddy and Coolen, 4th edition, PHI.
3. Electronic Communication systems, Kennedy & Davis, IV edition-TATA McGraw Hill.
4. Advanced Electronic Communication systems, Wayne Tomasi- 6th edition, Low priced edition- Pearson education

## GE-3: Communication Systems Lab 60 Lectures

1. Amplitude modulator and Amplitude demodulator
2. Study of FM modulator using IC8038
3. Study of VCO using IC 566
4. Study of Time Division Multiplexing and de multiplexing
5. Study of AM Transmitter/Receiver
6. Study of FM Transmitter/Receiver
7. ASK modulator and demodulator
8. Study of FSK modulation
9. Study of PWM and PPM
10. Study of PAM modulator and demodulator

## Skill Enhancement Course

**SEC-1: RENEWABLE ENERGY AND ENERGY HARVESTING(Credits: 02)**
**F.M. = 50 (Theory - 40, Internal Assessment – 10)**

Internal Assessment [Class Attendance (Theory) – 05, Theory (Class Test/Assignment/ Tutorial) – 05]

**Theory: 30 Lectures**

*Theaimofthiscourseisnotjusttoimparttheoreticalknowledgetothestudentsbuttoprovide them with exposure and hands-on learning wherever possible*

**Fossil fuels and Alternate Sources of energy:** Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. **(3 Lectures)**

**Solar energy**: Solar energy, its importance, storage ofsolar energy, solar pond, non convectivesolarpond,applicationsofsolarpondandsolarenergy,solarwaterheater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. **(6 Lectures)**

**Wind Energy harvesting**: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.**(3 Lectures)**

**Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.**(3 Lectures)**

**Tide characteristics and Statistics:** Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. **(2 Lectures)**

**Geothermal Energy**: Geothermal Resources, Geothermal Technologies.**(2 Lectures)**

**HydroEnergy**:Hydropowerresources,hydropowertechnologies,environmentalimpactof hydro power sources. **(2 Lectures)**

**Piezoelectric Energy harvesting**: Introduction, Physics and characteristics of piezoelectric effect, materialsand mathematical description ofpiezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power **(4 Lectures)**

**Electromagnetic Energy Harvesting**: Linear generators, physics mathematical models, recent applications **(2 Lectures)**

Carbon captured technologies, cell, batteries, power consumption **(2 Lectures)**

Environmental issues and Renewable sources of energy, sustainability. (1 Lecture)

**Demonstrations and Experiments**

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

**Reference Books:**


- Non-conventional energy sources, B.H. Khan, McGraw Hill
- Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.
- RenewableEnergy,Powerforasustainablefuture,GodfreyBoyle,3rd Edn., 2012, Oxford University Press.
- Renewable Energy Sources and Emerging Technologies, Kothari et.al., 2nd Edition, PHI Learning.• Solar Energy: Resource Assesment Handbook, P Jayakumar, 2009
- J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
- http://en.wikipedia.org/wiki/Renewable_energy

# Semester-IV

## CP-4: Instrumentation (Credits: Theory-04, Practicals-02)

**F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)**

**[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]**

**Theory Lectures** **60**

### 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 synchronisation, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: 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 nonelectrical quantities: Types and their principle of working , measurement of Linear displacement, Acceleration, Flow rate, Liquid level, strain, Force, Pressure, Temperature.

### Unit - 4 (20 Lectures)

**Data acquisition systems:** Block diagram, brief description of preamplifier, signalconditioner, instrumentation amplifier, waveform generator, A/D and D/A converter blocks,computer controlled test and measurement system.
**Bio-medical instrumentation:** Bio-Amplifiers: Bio potentials - Bio-electricity – Necessityfor special types of amplifiers for biological signal amplifications - Different types of Bio-OP - Amps. Electrodes for ECG, EEG, and EMG, block diagram of ECG and EEG systems, brief analysis of graphs.

**Suggested Books:**

1. Electrical Measurement in Measuring Instruments. Goldwing E.W. and Widdies
2. Electrical and Electronics Measurement and Instrumentation Sahwany A.K.
3. Instrumentation devices and systems: Rangan, Sarma, Mani, TMH
4. Instrumentation measurement and analysis: Nakra B C, Chaudry K K, TMH
5. Handbook of biomedical instrumentation: Khandpur R S, TMH
6. Measurement systems applications and design: Doeblin E O, McGraw Hill, 1990.
7. Electron measurements and instrumentation techniques: Cooper W D and Helfric A D, PHI, 1989.
8. Biomedical instrumentation and measurements: Leslie-Cromwell, Fred J Weibell,

Erich A Pfieffer, PHI, 1994.
9. Mechatronics – principles and applications, Godfrey C Onwubolu, Elsevier, 2006

**Instrumentation Lab: 60 Lectures**

1. Design of multi range ammeter and voltmeter using galvanometer.
2. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
3. To determine the Characteristics of LVDT.
4. To determine the Characteristics of Thermistors and RTD.
5. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
6. Characterization of bio potential amplifier for ECG signals.
7. Study on ECG simulator
8. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator
9. Study of pulse rate monitor with alarm system.
10. Measurement of respiration rate using thermister /other electrodes.

# Skill Enhancement Course

## SEC-2: WEATHER FORECASTING (Credits: 02)
## .M. = 50 (Theory - 40, Internal Assessment – 10)

Internal Assessment [Class Attendance (Theory) – 05, Theory (Class Test/Assignment/ Tutorial) – 05]

**Theory: 30 Lectures**

*The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness and understanding regarding the causes and effects of different weather phenomenon and basic forecasting techniques*

**Introduction to atmosphere:** Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics. **(9 Periods)**

**Measuring the weather:** Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws. **(4 Periods)**

**Weather systems:** Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes. **(3 Periods)**

**Climate and Climate Change:** Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate. **(6 Periods)**

**Basics of weather forecasting:** Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts. **(8 Periods)**

**Demonstrations and Experiments:**

1. Study of synoptic charts & weather reports, working principle of weather station.
2. Processing and analysis of weather data:
(a) To calculate the sunniest time of the year.
(b) To study the variation of rainfall amount and intensity by wind direction.
(c) To observe the sunniest/driest day of the week.
(d) To examine the maximum and minimum temperature throughout the year.
(e) To evaluate the relative humidity of the day.
(f) To examine the rainfall amount month wise.
3. Exercises in chart reading: Plotting of constant pressure charts, surfaces charts, upper wind charts and its analysis.
4. Formats and elements in different types of weather forecasts/ warning (both aviation and non aviation).

**Reference books**:

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
4. Text Book of Agro meteorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur
5. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.

# Semester-V

**DSE-1: Electronic Instrumentation (Credits: Theory-04, Practicals-02)**
**F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)**

**[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]**

**Theory Lectures** **60**

**Measurements:** Accuracy and precision. Significant figures. Error and uncertaintyanalysis. Shielding and grounding. Electromagnetic Interference. **(4 Lectures)**

**Basic Measurement Instruments**: DC measurement-ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating). Digital Multimeter; Block diagram principle of measurement of I, V, C. Accuracy and resolutionofmeasurement.**MeasurementofImpedance-**A.C.bridges,Measurement of Self Inductance (Anderson's bridge), Measurement of Capacitance (De Sauty'sbridge), Measurement of frequency (Wien's bridge). **(14 Lectures)**

**Powersupply:**BlockDiagramofaPowerSupply,QualitativeideaofCandLFilters. IC Regulators (78XX and 79XX), Line and load regulation, Short circuit protection. Idea of switched mode power supply (SMPS) and uninterrupted power supply (UPS).**(5 Lectures)**

**Oscilloscope**: Block Diagram, CRT, Vertical Deflection, Horizontal Deflection. Screens for CRT, Oscilloscope probes, measurement of voltage, frequency and phase by Oscilloscope. Digital Storage Oscilloscopes. LCD display for instruments.(**10 Lectures)**

**Lock-in-amplifier**:BasicPrinciplesofphaselockedloop(PLL),Phasedetector(XOR& edge triggered), Voltage Controlled Oscillator (Basics, varactor), lock and capture. Basic idea of PLL IC (565 or 4046). Lock-in-amplifier,Ideaoftechniquesforsumand averaging of signals. **(8 Lectures)**

**Signal Generators**: Function generator, Pulse Generator, (Qualitative only).**(3 Lectures)**

**Virtual Instrumentation**: Introduction, Interfacing techniques (RS 232, GPIB, USB), Idea about Audrino microcontroller and interfacing software like lab View).(**5 Lectures)**

**Transducers**: Classification of transducers, Basic requirement/characteristics of transducers, Active and Passive transducers, Resistive (Potentiometer- Theory, temperature compensation & applications), Capacitive (variable air gap type), Inductive (LVDT) & piezoelectric transducers. Measurement of temperature (RTD, semiconductor IC sensors), Light transducers (photo resistors & photovoltaic cells). **(11 Lectures)**

**Reference Books:**

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

• E.O. Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003).
• David A. Bell, Electronic Devices and Circuits, Oxford University Press (2015).
• Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Butterworth Heinmann-2008).
• S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).
• Introduction to measurements and instrumentation, 4th Edn., Ghosh, PHI Learning

**DSE-1:ELECTRONICINSTRUMENTATIONLAB60Lectures**

AT LEAST 05 EXPERIMENTS FROM THE FOLLOWING

1. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
2. Measurement of Capacitance by De Sauty's bridge
3. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
4. To determine the Characteristics of LVDT.
5. To determine the Characteristics of Thermistors and RTD.
6. Measurement of temperature by Thermocouples.
7. Design a regulated power supply of given rating (5 V or 9V).
8. To design and study the Sample and Hold Circuit.
9. To plot the frequency response of a microphone.

Reference Books:

• W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice Hall (2005).
• David A. Bell, Electronic Instrumentation & Measurements, Prentice Hall (2013)
•S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).
•BasicElectronics:Atextlabmanual,P.B.Zbar,A.P.Malvino,M.A.Miller,1990, Mc-Graw Hill

# Skill Enhancement Course

## SEC-3: COMPUTATIONAL PHYSICS(Credits: 02)

**F.M. = 50 (Theory - 40, Internal Assessment – 10)**

**Internal Assessment [Class Attendance (Theory) – 05, Theory (Class Test/ Assignment/ Tutorial) – 05]**

## Theory: 30 Lectures

*The aim of this course is not just to teach computer programming and numerical analysis but to emphasize itsrole in solving problems in PhysicsandScience.*

- *Highlights the use of computational methods to solve physical problems*
- *Use of computer language as a tool in solving physics/science problems*
- *Course will consist of hands on training on the Problem solving on Computers.*

**Introduction:** Importance of computers in Physics, paradigm for solving physics problems for solution**.** Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols,guidelines,types.Examples:CartesiantoSphericalPolarCoordinates,Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculationofsin(x)asaseries,algorithmforplotting(1)lissajousfiguresand(2) trajectory of a projectile thrown at an angle with the horizontal. **(4 Lectures)**

**Scientific Programming**: Some fundamental Linux Commands (Internal and External commands). Development ofFORTRAN, Basic elements ofFORTRAN: Character Set, Constantsandtheirtypes,Variablesandtheirtypes,Keywords,VariableDeclaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems. **(5 Lectures)**

**Control Statements:** Types of Logic(Sequential, Selection, Repetition), BranchingStatements(Logical**IF**,ArithmeticIF,BlockIF,NestedBlockIF,SELECTCASEand ELSEIFLadderstatements),LoopingStatements(DO-CONTINUE,DO-ENDDO,DO-WHILE,ImpliedandNestedDOLoops),JumpingStatements(UnconditionalGOTO, ComputedGOTO,AssignedGOTO)SubscriptedVariables(Arrays:TypesofArrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL,COMMONandEQUIVALENCEStatements),Structure,DiskI/OStatements, open a file, writing in a file, reading from a file. Examples from physics problems.

**Programming:**

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.

5. Calculating Euler number using exp(x) series evaluated at x=1 **(6 Lectures)**

**Scientific word processing: Introduction to LaTeX:** TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. **Equation representation:** Formulae and equations, Figures and other floatingbodies,Liningincolumns-Tabbingandtabularenvironment,Generatingtable of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors. **(6 Lectures)**

**Visualization:** Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

**Hands on exercises:(9 Lectures)**

1.To compile a frequency distribution and evaluate mean, standard deviation etc.
2.To evaluate sum of finite series and the area under a curve.
3.To find the product of two matrices
4.To find a set of prime numbers and Fibonacci series.
5.To write program to open a file and generate data for plotting using Gnuplot.
6.Plotting trajectory of a projectile projected horizontally.
7.Plotting trajectory of a projectile projected making an angle with the horizontally.
8.CreatinganinputGnuplotfileforplottingadataandsavingtheoutputforseeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numericalsolutionofequationofmotionofsimpleharmonicoscillatorandplot the outputs for visualization.
12.Motion of particle in a central force field and plot the output for visualization.

**Reference Books:**


- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Pvt. Ltd.
- Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
- LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- ComputationalPhysics:AnIntroduction,R.C.Verma,etal.NewAgeInternational Publishers, New Delhi(1999)

# Semester-VI

## DSE-2: PHOTONIC DEVICES AND POWER ELECTRONICS (Credits: Theory-04, Practicals-02)

**F.M. = 50 (Theory - 25, Practical – 15, Internal Assessment – 10)**

**[Internal Assessment [Class Attendance (Theory) – 03, Theory (Class Test/ Assignment/ Tutorial) – 03, Practical (Sessional Viva-voce) - 04]**

**Theory Lectures 60**

### UNIT-I: PHOTONIC DEVICES

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. (12 Lectures)

Photodetectors: Photoconductor. Photodiodes (p-i-n, avalanche) and Photo transistors, quantum efficiency and responsivity. Photomultiplier tube. (5 Lectures)

Solar Cell: Construction, working and characteristics (2 Lectures)

LCD Displays: Types of liquid crystals, Principle of Liquid Crystal Displays, applications, advantages over LED displays. (4 Lectures)

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. (13 Lectures)

### UNIT-II:POWER ELECTRONICS

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 asa triggering device for Triac. (10 Lectures)

Insulated Gate Bipolar Transistors (IGBT): Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA). (2 Lectures)

Applications of SCR: Phase controlled rectification, AC voltage control using SCR and Triac as a switch. Power Invertors- Need for commutating circuits and their various types, dc link invertors, Parallel capacitor commutated invertors, Series Invertor, limitations and its improved versions, bridge invertor (12 Lectures)

Reference Books:


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


### DSE-1: PHOTONIC DEVICES AND POWER ELECTRONICS LAB 60 Lectures

AT LEAST 06 EXPERIMENTS FROM THE FOLLOWING

1. To determine wavelength of sodium light using Michelson's Interferometer.
2. Diffraction experiments using a laser.
3. Study of Electro-optic Effect.
4. To determine characteristics of (a) LEDs, (b) Photo voltaic cell and (c) Photo diode.

5. To study the Characteristics of LDR and Photodiode with (i) Variable Illumination intensity, and (ii) Linear Displacement of source.
6. To measure the numerical aperture of an optical fiber.
7. Output and transfer characteristics of a power MOSFET.
8. Study of I-V characteristics of SCR
9. SCR as a half wave and full wave rectifiers with R and RL loads.
10. AC voltage controller using TRIAC with UJT triggering.
11. Study of I-V characteristics of DIAC
12. Study of I-V characteristics of TRIAC

Reference Books:

• AK Ghatak & K Thyagarajan, Introduction to fiber optics, Cambridge Univ. Press (1998)
• Power Electronics, M.D. Singh & K.B. Khanchandani, Tata McGraw Hill
• Power Electronics Circuits, Devices & Applications, 3rd Edn., M.H.Rashid, Pearson Education
• A Textbook of Electrical Technology-Vol-II, B.L. Thareja, A.K. Thareja, S.Chand.

# Skill Enhancement Course

## SEC-4: Electrical Circuits and Network Skills(Credits: 02)
## F.M. = 50 (Theory - 40, Internal Assessment – 10)

**Internal Assessment [Class Attendance (Theory) – 05, Theory (Class Test/ Assignment/ Tutorial) – 05]**

## Theory: 30 Lectures

*The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode*

**Basic Electricity Principles**: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.**(3 Lectures)**

**Electrical Circuits**: Basic electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money. **(4 Lectures)**

**Electrical Drawing and Symbols**: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.**(4 Lectures)**

**Generators and Transformers**: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. **(3 Lectures)**

**ElectricMotors**:Single-phase,three-phase&DCmotors.Basicdesign.InterfacingDCor AC sources to control heaters & motors. Speed & power of ac motor. **(4 Lectures)**

**Solid-State Devices**: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources. **(3 Lectures)**

**Electrical Protection**: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Relay protection device. **(4 Lectures)**

**Electrical Wiring**: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable.Conduit.Cable trays.Splices: wirenuts,crimps,terminal blocks,andsolder. Preparation of extension board. **(5 Lectures)**

## Reference Books:


- Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn.


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