CBCS SYLLABUS

FOR

THREE YEARS UNDER-GRADUATECOURSE

IN

ELECTRONICS (PROGRAM)

(*w.e.f.2022*)

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN722155

STRUCTURE IN

ELECTRONICS(PROGRAM)SEMESTER –I

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/ELC/101/C-1A	Network Analysis and Analog Electronics (T)	4	10	25	50			
	Network Analysis and Analog Electronics (P)	2		15				
SP/ELC/102/C-2A	Discipline-2 (T)	4	10	25	50			
	Discipline-2 (P)	2		15				
SP/ELC/103/C-3A	Discipline-3(T)	4	10	25	50			
	Discipline-3(P)	2		15				
ACSHP/ 104/AECC-1	Environmental Studies	4	10	40	50			
Total in Semester – I		22	40	160	200			

SEMESTER –II

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/ELC/201/C-1B	DigitalSystemDesign (T)	4	10	25	50			
	DigitalSystemDesign (P)	2		15				
SP/ELC/202/C-2B	Discipline-2 (T)	4	10	25	50			
	Discipline-2 (P)	2		15				
SP/ELC/202/C-3B	Discipline-3(T)	4	10	25	50			
	Discipline-3(P)	2		15				
ACSHP/204/ AECC-2	English/Hind/MIL	2	10	40	50			
Total in Semester – II		20	40	160	200			

SEMESTER –III

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/ELC/ 301/C-1C	CommunicationSystems (T)	4	10	25	50			
	CommunicationSystems (P)	2		15				
SP/ELC/302/C-2C	Discipline-2 (T)	4	10	25	50			
	Discipline-2 (P)	2		15				
SP/ELC/303/C-3C	Discipline-3(T)	4	10	25	50			
	Discipline-3(P)	2		15				
SP/ELC/304/SEC-1	Design and Fabrication of Printed Circuit Boards (T)	2	10	40	50			
Total in Semester – III		20	40	160	200			

SEMESTER –IV

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/ELC/401/C-1D	Transmission Lines, Antenna and Radio Wave Propagation (T)	4	10	25	50			
	Transmission Lines, Antenna and Radio Wave Propagation (P)	2		15				
SP/ELC/402/C-2D	Discipline-2 (T)	4	10	25	50			
	Discipline-2 (P)	2		15				
SP/ELC/403/C-3D	Discipline-3(T)	4	10	25	50			
	Discipline-3(P)	2		15				
SP/ELC/404/SEC-2	Programmingwith MATLAB (T)	2	10	40	50			
Total in Semester – IV		20	40	160	200			

SEMESTER – V

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/ELC/501/DSE-1A	Instrumentation(T)	4	10	25	50			
	Instrumentation (P)	2		15				
SP/ELC/502/DSE-2A	Discipline-2 (T)	4		25				
	Discipline-2 (P)	2		15				
SP/ELC/503/DSE-3A	Discipline-3(T)	4		25				
	Discipline-3(P)	2		15				
SP/ELC/504/SEC-3	Programming in C (T)	2	10	40	50			
Total in Semester – V		20	40	160	200			

SEMESTER – VI

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/ELC/601/DSE-1B	Photonic Devices and Power Electronics (T)	4	10	25	50			
	Photonic Devices and Power Electronics (P)	2		15				
SP/ELC/602/DSE-2B	Discipline-2 (T)	4		25				
	Discipline-2 (p)	2		15				
SH/ELC/603/DSE-3	Discipline-3(T)	4		25				
	Discipline-3(P)	2		15				
SP/ELC/604/SEC-4	Computational Mathematics (T)	2	10	40	50			
Total in Semester – VI		20	40	160	200			

UGP= Under Graduate Programme/Pass, S.C.= Subject Code C= Core Course, E/H/MIL= English/ Hindi/ Modern Indian Language, H/MIL/E= Hindi/ Modern Indian Language/ English, AECC-E= Ability Enhancement Compulsory Course-English, AECC-ENV= Ability Enhancement Compulsory Course-Environmental Science, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.= Lecture, Tu.= Tutorial, and Pr.=Practical

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Details of Courses under Undergraduate Program (B.Sc.)

	Theory+Practical	Theory+Tutorials
I. Core Course (12 Papers) 04 Courses from each of the 03 disciplines of choice	12×4=48	12×5=60
Core Course Practical/Tutorial*(12 Practical/ Tutorials*) 04 Courses from each of the 03 Disciplines of choice	12×2=24	12×1=12
II. Elective Course (6 Papers) Two papers from each discipline of choice including paper of interdisciplinary nature.	6×4=24	6×5=30
Elective Course Practical / Tutorials*(6Practical / Tutorials*) Two Papers from each discipline of choice including paper of interdisciplinary nature	6×2=12	6×1=6
III. Ability Enhancement Courses		
1. **Ability Enhancement Compulsory (2 Papers of 2 credits each) Environmental Science English/MIL Communication**	2×2=4	2×2=4
2. **Skill Enhancement Course (Skill Based) (4 Papers of 2 credits each)**	4×2=8	4×2=8
	Total credit = 120	**Total credit = 120**

Scheme for choice based credit system in B.Sc. with Electronics

SEM	CORE COURSE (12)	Ability Enhancement Compulsory Course (AECC)	Skill EnhancementCourse (SEC)(4)	Discipline Specific Elective DSE(6)
I	Network Analysis and Analog Electronics	(Communicative English)/Environmental Science		
	DSC-2 A			
	DSC-3 A			
II	Digital System Design	(Communicative English)/Environmental Science		
	DSC-2 B			
	DSC-3 B			
III	Communication systems		SEC-1	
	DSC-2 C			
	DSC-3 C			
IV	Instrumentation		SEC-2	
	DSC-2 D			
	DSC-3 D			
V	Transmission Lines, Antenna and Radio Wave Propagation		SEC-3	DSE-1A
	DSC-2 E			DSE-2A
	DSC-3 E			DSE-3A
VI	Photonic Devices and Power Electronics		SEC-4	DSE-1B
	DSC-2 F			DSE-2B
	DSC-3 F			DSE-3B

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I	**Ability Enhancement Compulsory Course-I**	English communications/Environmental Science	**2**
	Core course-I (Theory)	Network Analysis and Analog Electronics (Theory)	**4**
	Core Course-I Practical	Network Analysis and Analog Electronics (Practical)	**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 (Theory)	Digital System Design (Theory)	**4**
	Core Course-IV Practical	Digital System Design (Practical)	**2**
	Core course-V	DSC 2B	**6**
	Core Course-VI	DSC 3B	**6**
III	**Core course-VII (Theory)**	Communication Systems (Theory)	**4**
	Core Course-VII Practical	Communication Systems (Practical)	**2**
	Core course-VIII	DSC 2C	**6**
	Core Course-IX	DSC 3C	**6**
	Skill Enhancement Course-1 (Theory)	SEC-1 (Theory)	**2**
IV	**Core course-X (Theory)**	Instrumentation (Theory)	**4**
	Course-X Practical	Instrumentation (Practical)	**2**
	Core course-XI	DSC 2D	**6**
	Core course-XII	DSC 3D	**6**
	Skill Enhancement Course-2(Theory)	SEC-2 (Theory)	**2**
V	**Skill Enhancement Course-3 (Theory)**	SEC-3 (Theory)	**2**
	Discipline Specific Elective-1 (Theory)	DSE-1A (Theory)	**4**
	Discipline Specific Elective-1 (Practical	DSE-1A (Practical)	**2**
	Discipline Specific Elective-2	DSE-2A	**6**
	Discipline Specific Elective-3	DSE-3A	**6**
VI	**Skill Enhancement Course-4 (Theory)**	SEC-4 (Theory)	**2**
	DisciplineSpecificElective-4 (Theory)	DSE-1B (Theory)	**4**
	DisciplineSpecificElective-4 (Practical)	DSE-1B (Practical)	**2**
	Discipline Specific Elective-5	DSE-2B	**6**
	Discipline Specific Elective-6	DSE-3B	**6**
Total Credits			**120**

B.Sc. with Electronics

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

Core papers Electronics (Credit: 06 each) (CP1-4)

1.	Network Analysis and Analog Electronics	Semester-I
2.	Digital System Design	Semester-II
3.	Communication Systems	Semester-III
4.	Instrumentation	Semester-IV

Discipline Specific Elective papers (Credit: 06 each) (DSE1, DSE2)

1.	Transmission Lines, Antenna and Radio Wave Propagation	Semester-V
2.	Photonic Devices and Power Electronics	Semester-VI

Skill Enhancement Course (any four) (Credit: 02 each) - SEC1 to SEC4

1.	Design and Fabrication of Printed Circuit Boards	Semester-III
2.	Programming with MATLAB	Semester-IV
3.	Programming in C	Semester-V
4.	Computational Mathematics	Semester-VI

For Papers having practical, distribution of 50 marks be as follows:

i) *Internal Assessment*: 20% of 50 marks = 10 marks which is distributed as follows:

Class Attendance (Theory) – 05 and Class Test/ Assignment/ Tutorial – 05

ii) 15 marks be allotted for ***Semester-end- Practical Examination*** of each paper, distribution of which may be as under:

a) Lab. Note Book: 03 Marks b) Viva-voce: 02 Marks c) Experiment: 10 marks

iii) 25 marks be allotted for ***Semester-end-Theoretical Examination*** of each paper (Duration of Exam: 1 hour 15 min), distribution of which may be as under:

a) Answer 3 questions out of 8 carrying 1 marks each = 3×1 = 3
b) Answer 3 questions out of 8 carrying 2 marks each = 3×2 = 6
c) Answer 2 questions out of 5 carrying 5 marks each = 2×5 = 10
d) Answer 1 questions out of 4 carrying 6 marks each = 1×6 = 6

For each SEC paper, distribution of 50 marks be as follows:

i) *Internal Assessment:* 20% of 50 marks = 10 marks be reserved for **Class Attendance (Theory) – 05 marks and Class Test/ Assignment/ Tutorial – 05 marks**

ii) 40 marks be allotted for ***Semester-end-Theoretical Examination*** of each paper (Duration of Exam: 2 hours), distribution of which may be as under:

a) Answer 5 questions out of 10 carrying 2 marks each = 5×2 = 10
b) Answer 4 questions out of 8 carrying 5 marks each = 4×5 = 20
c) Answer 1 question out of 3 carrying 10 marks each = 1×10 = 10

SEMESTER-I

CP-1 (Theory): Network Analysis and Analog Electronics (Credits: Theory-04, Practicals-02)

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

Theory Lectures **60**

Course Learning Objectives

- To impart knowledge of basic concepts in Electronics
- To provide the knowledge and methodology necessary for building electronics circuits.
- The practical exposure enables students to learn circuit implementations and troubleshooting.

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

- CO1: Analyze the electric circuit using network theorems.
- CO2: Illustrate about rectifiers, transistor based amplifiers and its biasing.

Unit-1 **(15 Lectures)**

Circuit Analysis: Concept of Voltage and Current Sources, Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Mesh Analysis, Node Analysis, Star and Delta Networks, Star-Delta Conversion, Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem, Two Port Network Parameters- h, Z and Y Parameters and their Conversions.

Unit2 **(13 Lectures)**

Semiconductor Diode and its applications: PN junction diode and characteristics, ideal diode 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 **(20 Lectures)**

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.
Transistor biasing: Need for biasing, Fixed Bias, Collector to Base Bias, Voltage Divider Bias and Emitter Bias, Circuits and Working, DC Load Line and Operating (Q) Point, Thermal Runaway, Stability and Stability factor.
BJT Amplifiers: Small Signal Analysis of Single Stage CE Amplifier, r_e-Model and h-Parameter equivalent circuit, Frequency Response, Input and Output Impedance, Current and Voltage Gains, Class A, B and C amplifiers, Two Stage RC Coupled Amplifier and its Frequency Response.
Sinusoidal Oscillators: Barkhausen Criterion for Sustained Oscillations, Phase Shift, Colpitt's and Hartley Oscillators, Determination of Frequency and Condition of Oscillation.

Unit-4 **(12 Lectures)**

Unipolar Devices: JFET, Construction, Working and I-V Characteristics (Output and Transfer), Pinch-off Voltage, MOSFET, MOS Capacitor, Channel Formation, Threshold Voltage (Ideal and Real), Current-Voltage Relation, Depletion and Enhancement Type MOSFET, Complementary MOS (CMOS), UJT, Basic Construction, Working, Equivalent Circuit and I-V Characteristics.

Suggested Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013,PHI
2. Hyat, Kemmerly and Durbin, Engineering Circuit Analysis, Tata McGraw Hill.
3. Electric circuits, JoesephEdminister, Schaumseries.
4. Basic Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshrestaand D.C Gupta -TMH.
5. Electronic devices, David A Bell, Reston Publishing Company/DB Tarapurwala Publ.
6. Kuo, Network Analysis and Synthesis, Wiley.
7. Neamen, Electronic Circuits: Analysis and Design, Tata McGraw Hill.

CP-1(Practical): ***60 Lectures***

(Hardware and Circuit Simulation Software)

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

- CO1: Verify the network theorems and operation of typical electrical circuits.
- CO2: Study various stages of a zener diode based regulated power supply.
- CO3: Understand various biasing concepts, BJT and FET based amplifiers

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 r_i, r_o andβ.
8. Design and study of voltage divider biasing.
9. Designing of an CE based amplifier of given gain
10. Design, fabrication and testing of a 9 V power supply with Zener regulator

SEMESTER-II

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

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

Theory Lectures **60**

Course Learning Objectives

As there are lot of industrial and research based job opening in the area, the course offers a hands-on in designing digital systems on hardware (fabrication) and testing with a holistic approach to the subject, making students ready for the industry or research.

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

- CO1: Understand and represent numbers in powers of base and converting one from the other
- CO2: Understand basic logic gates, concepts of Boolean algebra and techniques
- CO3: Analyze and design combinatorial as well as sequential circuits

Unit-1 **(15 Lectures)**

Number System and Codes: Decimal, Binary, Octal and Hexadecimal Number Systems, Base Conversions, 1's and 2's Complements, Representation of Signed and Unsigned Numbers, BCD Code, Grey Codes, Binary, Octal and Hexadecimal Arithmetic, Addition, Subtraction by 2's Complement Method, Multiplication.
Boolean algebra and Logic gates: Boolean algebra- Positive and negative logic. Boolean laws. 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 **(10 Lectures)**

Combinational logic analysis and design: Half and Full Adder, Half and Full Subtractor, 4-Bit Binary Adder and Subtractor, Multiplexers, Demultiplexers, Encoder, Decoder, Code Converter (Binary to BCD and Vice Versa).

Unit-3 **(15 lectures)**

Sequential logic design: Latches, Flip flop, SR, JK, D and T Flip Flops, Truth Table, Excitation Table and Excitation Equation, Clocked (Level and Edge Triggered) Flip Flops, Preset and Clear Operations, Race around conditions in JK flip flop, Master-Slave JK Flip Flop.

Shift Registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers.

Counters: Ripple, Ring, Synchronous, Asynchronous, Decade and Modulo-N Counters, State Table and State Diagram, Excitation Table and Excitation Equation.

Unit 4 (20 Lectures)

D-A and A-D Conversion: 4-Bit Binary Weighted and R-2R D-A Converter, Circuit and Working, Accuracy and Resolution, A-D Conversion Characteristics, Successive Approximation ADC. (Mention of relevant ICs for all).

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

Suggested Books:

1. M. 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, PHI(2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

CP-2 (Practical) ***60 Lectures***

(Hardware and Circuit Simulation Software)

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

- CO1: Familiarize with combinational circuit design.
- CO2: Familiarize with sequential circuit design.
- CO3:Prepare the technical report on the experiments carried.

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. ToconvertaBooleanexpressionintologicgatecircuitandassembleitusinglogic 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.

SEMESTER – III

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

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

Theory Lectures **60**

Course Learning Objectives

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

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

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

Unit-1 (16 Lectures)

Electronic Communication: Introduction to Communication, Means and Modes, Need for Modulation, Block Diagram of an Electronic Communication System, Brief Idea of Frequency Allocation for Radio Communication System in India (TRAI), Electromagnetic Communication Spectrum, Band Designations and Usage, Channels and Base-Band Signals, Noise, Internal and External Noises, Signal-to-Noise (S/N) Ratio and Noise Figure.
Amplitude Modulation: Definition, Representation, Modulation Index, Expression for Instantaneous Voltage, Power Relations, Frequency Spectrum, Concept of DSBFC, DSBSC, SSBSC Generation and Detection, Limitations of AM, Demodulation, AM Detection, Diode Detector Circuit, Principle of Working and Waveforms, Concept of VSB, Block Diagram of AM Transmitter and Receiver.

Unit-2 (12 Lectures)

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

Unit- 3 (16 Lectures)

Digital communication: Introduction to pulse and digital communications, 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)

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

Suggested Books:

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

CP-3 (Practical): 60 Lectures

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

- CO1: Basic understanding of analog modulation and demodulation techniques.
- CO2: Basic understanding of digital modulation and demodulation techniques.
- CO3: Basic understanding of various types of pulse modulation.
- CO4: Prepare the technical report on the experiments carried

1. Amplitude modulator and Amplitude demodulator
2. Study of FM modulator using IC 8038
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: Design and Fabrication of Printed Circuit Boards (Credits: 02)
F.M. = 50 (Theory-40, Internal Assessment–10)

Theory Lectures 30

Course Learning Objectives

The main objective of the course is to introduce the students to the industrial tools, Protocols and Design Specifics used in PCB Designing, so that students are able to design an electronic printed circuit board for a specific application using industry standard software after going through the complete procedural steps of developing circuit schematic, board files, image transferring, assembly, soldering and testing.

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

- CO1: Familiarize with the type of devices/components that may be mounted on PCB
- CO2: Understand the PCB layout techniques for optimized component density and powersaving.
- CO3: Perform design and printing of PCB with the help of various image transfer andsoldering techniques
- CO4: Understand the trends in the current PCB industry

Unit 1 (6 Lectures)

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

Unit II (8 Lectures)

Layout and Artwork: Layout Planning: General rules of Layout, Resistance, Capacitance and 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.

Unit III (8 Lectures)

Laminates and Photoprinting: Properties of laminates, Types of Laminates, Manual cleaningprocess, Basic printing process for double sided PCB's, Photo resists, wet film resists, Coatingprocess for wet film resists, Exposure and further process for wet film resists, Dry film resists.

Unit IV (8 Lectures)

Etching and Soldering: Introduction, Etching machine, Etchant system. Principles of Solder connection, Solder joints, Solder alloys, Soldering fluxes, Soldering, Desoldering tools and Techniques.

Suggested Books:

1. PrintedcircuitBoard– Design&TechnologybyWalterC.Bosshart,TataMcGrawHill.
2. PrintedCircuitBoard –Design,Fabrication,Assembly&Testing,R.S.Khandpur,TAataMcGraw Hill Publisher.
3. Printed circuits Handbook, Clyde F. Coombs, 3rd Edition, Tata McGraw Hill.

SEMESTER-IV

CP-4 (Theory): Transmission Lines, Antenna and Radio Wave Propagation

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

Theory Lectures 60

TheoryLectures 60

Course Learning Objectives

The course discusses the fundamentals of propagation of electromagnetic waves. The basics of transmission lines along with its parameters is included. Wave propagation along with modes in waveguides is discussed along with their applications. Antenna parameters along with their types is also discussed.

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

- CO1: Describe the principals of electromagnetic wave propagation and various effects involved in it
- CO2:Explain the phenomenon of transmission line, its types and finding out performance parameters of transmission lines like losses, SWR.
- CO3: Calculate input impedance and reflection coefficient of an arbitrarily terminated transmission-line and can use Smith chart to convert these quantities.
- CO4: Concept of retarded potential to explain radiation, half wave dipole and characteristics of antenna, radar equation.

Electromagnetic Waves and Radiation: Wave Spectrum and its Applications, Electromagnetic Fields and Maxwell's Equations, Wave Polarization, Phase and Group Velocities, Plane Wave and Uniform Plane Wave, Propagation of EM Waves in Good Conductor, Good Dielectric, Lossy and Lossless Dielectric, Pointing Vector and Power Flow of Uniform Plane Wave, Concept of Retarded Vector Potential. [8]

Transmission Lines: Typical Transmission Lines, Co-axial and Two Wire Lines, Transmission Line Parameters, Transmission Line Equations and Solutions, Characteristic Impedance, Propagation Constant, Lowloss, Lossless and Distortionless Lines and Condition, Short Circuited, Open Circuited and Matched Lines, Reflection Coefficient, Standing Waves, VSWR, Transmission Line as Circuit Elements. [10]

Wave Guide: Basic Concept of Waveguide, Advantages over Transmission Line, Qualitative Study of Rectangular Waveguide, TE and TM Modes, Group and Phase Velocities, Guide Wavelength, Cutoff Wavelength, Free Space Wavelength, Dominant and Degenerate Modes, Field Pattern of TE_{10} Mode in Transverse and Longitudinal Cross-Sections of Rectangular Waveguide. [8]

Antenna Fundamentals and Parameters: Antenna Radiation Mechanism, Types of Antenna, Field Regions around Antenna, Input Impedance, Radiation Resistance, Radiation Pattern (Field, Power and Phase Patterns),Radiation Intensity, Gain, Directivity, Power Gain, Efficiency, Beamwidth, Bandwidth, Effective Aperture and Height, Antenna Noise Temperature and Noise Figure. [8]

Antenna as Transmitter/Receiver: Radiation from Elementary Dipole, Radiation, Induction and Electrostatic Fields, Radiation Field of Half Wave Dipole, and their Radiation Resistance. [6]

Types of Antennas (Qualitative Study Only): Monopole, Dipole, Folded Dipole, Loop, Helical, Rhombic, Yagi-Uda, Log Periodic, Horn, Parabolic Reflector, Antenna Array. [8]

Propagation of Radio Waves: Different Modes of Propagation, Ground Wave and Field Strength, Space

Wave and Field Strength, Line of Sight Distance and Radio Horizons, Sky Wave, Structure of Ionosphere, Ionosphere Refractive Index, Critical Frequency, Maximum Usable Frequency (MUF), Skip Distance, Virtual Height, Lowest Usable Frequency (LUF), Critical Angle, Optimum Working Frequency (OWF), Duct Propagation, Ideas of Microwave communication and Satellite Communication. [12]

Suggested Books:

1. Jordan and Balmain, Electro Magnetic Waves and Radiating Systems, Pearson.
2. Rao, Elements of Engineering Electromagnetics, Pearson.
3. Ballanis, Antenna Theory: Analysis and Design, Wiley.
4. Raju, Antennas and Propagation, Pearson.
5. Hayt, Buck and Akhtar, Engineering Electromagnetics, Tata McGraw Hill.
6. Cheng, Field and Wave Electromagnetics, Pearson.
7. Edminster, Electromagnetics, Schaum's Outline Series, Tata McGraw Hill
8. Sadiku, Principles of Electromagnetics, Oxford.

DSE-1 (Practical): ***60 Lectures***

Implementation with Hardware and/or SCILAB/MATLAB/Any Other Mathematical Simulation Software

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

- CO1: Understanding the propagation of plan electromagnetic wave in different types of media
- CO2: Study of various types of transmission line, power flow and power loss along the length.
- CO3: Study of various types of waveguide power flow and power attenuation along the length.
- CO4: Study of Antenna types, characteristics and radar Transmission equation.

1. Program to Determine the Instantaneous Field of Plane Wave.
2. Program to Find the Phase Constant, Phase Velocity, Electric Field Intensity and Intrinsic Ratio.
3. Program to Determine the Total Voltage as Function of Time and Position in Lossless Transmission Line.
4. Program to Find the Characteristic Impedance, Phase Constant and Phase Velocity.
5. Program to Find the Power Dissipated in Lossless Transmission Line.
6. Program to Find the Input Impedance of Transmission Line Terminated with Pure Capacitive Impedance.
7. Program to Determine the Operating Range of Frequency for TE10 Mode of Air-filled Rectangular Waveguide.

Skill Enhancement Course

SEC-2: Programming with MATLAB (Credits: 02)
F.M. = 50 (Theory-40, Internal Assessment – 10)

Theory Lectures **30**

Course Learning Objectives

- To Impart the Knowledge to the students with MATLAB software.
- To provide a working introduction to the MATLAB technical computing environment.
- Introduce students the use of a high-level programming language

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

- CO1: Able to use MATLAB for interactive computations.
- CO2: Familiar with memory and file management in MATLAB.
- CO3: Able to generate plots and export this for use in reports and presentations.
- CO4: Able to program scripts and functions using the MATLAB development environment.
- CO5: Able to use basic flow controls (if-else, for, while).
- CO6: Familiar with strings and matrices and their use.

MATLAB Basics **(5 Lectures)**

The MATLAB environment-Command Window, Command History Window, Workspace, Current Directory, Editor Window, Help feature, Types of Files–M-files, MAT files, MEX files, Some useful MATLAB commands, MATLAB toolboxes.

Constants, Variables, Expressions and control structures **(5 Lectures)**

Character set, Data types, Constants and variables, Operators, Hierarchy of operators, Built-in-functions, Loops (for, nested for, while), Branches (if, switch), Break, Continue.

Matrices and vectors **(5 Lectures)**

Scalars and vectors, Assigning data to elements of a vector/scalar, vector products, vector transpose, Entering data in Matrices, Multidimensional Matrices, Matrix manipulations, Generation of special matrices, Matrix and array operations.

Input and Output statements **(5 Lectures)**

Assignment statement and variable declaration, Interactive inputs (input, keyboard, menu and pause), Reading/storing file data, Output commands (format, disp), Formatted input/output functions.

MATLAB Graphics **(5 Lectures)**

Two dimensional plots, Multiple plots, Style options, Legend, Subplots, Specialized 2-D plots (polar, area, bar, barh, hist, rose, pie, stairs, stem, compass etc.), Three dimensional plots (plot3, bar3, barh3, pie3, stem3, meshgrid, mesh, surf, contour etc.).

MATLAB applications in computational mathematics **(5 Lectures)**

Solution of simultaneous linear algebraic equations, Finding eigen values and eigen vectors of a matrix, Factorization of Matrices, Solution of Non-Linear Linear Algebraic equations, Solution of Non-Linear Algebraic equations involving only one variable/several variables, Solution of ordinary differential equations.

Suggested Books:

1. Mastering MATLAB, Duane C. Hanselman, Bruce L. Littlefield, Pearson, 2012.
2. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, RudraPratap,
3. MATLAB and Its Applications in Engineering, Raj Kumar Bansal, Ashok K. Goel, Manoj Kumar Sharma, Raj Kumar Bansal, Ashok K. Goel, Manoj Kumar Sharma, Pearson Education, 2009
4. Lab Primer Through Matlab: Digital Signal Processing, Digital Image Processing, Digital Signal Processor and Digital Communication, A. K. Navas, R. Jawadevan, Prentice Hall India Learning Private Limited, 2014.

SEMESTER-V

DSE-1 (Theory): Instrumentation (Credits: Theory-04, Practicals-02)

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

Theory Lectures **60**

Course Learning Objectives

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

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

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

Unit-1 (10 Lectures)

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

Unit- 2 (18 Lectures)

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

Signal Generators: Audio oscillator, Pulse Generator, Function generators.

Unit - 3 (12 Lectures)

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

Unit - 4 (20 Lectures)

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

Suggested Books:

- Electrical Measurement in Measuring Instruments. Goldwing E.W. and Widdies
- Electrical and Electronics Measurement and Instrumentation, A.K. Sahwany.
- Instrumentation devices and systems: Rangan, Sarma, Mani, TMH
- Instrumentation measurement and analysis: Nakra B C, Chaudry K K,TMH
- Measurement systems applications and design: Doeblin E O, McGraw Hill,1990.
- Electron measurements and instrumentation techniques: Cooper W D and HelfricA D, PHI, 1989.

CP-4 (Practical): ***60 Lectures***

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

- CO1: To measure various electrical parameters.
- CO2: To measure characteristics of various sensors and transducers.
- CO3:Prepare the technical report on the experiments carried.

1. Design of multi range ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
3. Measurement of Capacitance by de Sautybridge.
4. Measurement of low resistance by Kelvin's double bridge.
5. To determine the Characteristics of resistance transducer-Strain Gauge (Measurement of Strain using half and full bridge.)
6. To determine the Characteristics of LVDT.
7. To determine the Characteristics of Thermistors and RTD.

Skill Enhancement Course

SEC-3 (Theory): Programming in C (Credits: 02)
F.M. = 50 (Theory-40, Internal Assessment–10)

Theory Lectures 30

Course Learning Objectives: To understand

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

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

- CO1: Develop algorithms for arithmetic and logical problems and write programs in C language
- CO2: Implement conditional branching, iteration and recursion.
- CO3: Use concept of modular programming by writing functions and using them to form a complete program.
- CO4: Understand the concept of arrays, pointers and structures.

UNIT-I (6 Lectures)

Fundamentals: Character set - Keywords - Identifiers - Data types - Constants - Variables - Operators and their hierarchy - Expression - Statements - Input/Output functions.

UNIT-II (6 Lectures)

Decision making statements: if-else, while, do-while, for, switch, break, continue, goto statements. Functions: Definitions - Arguments - Function prototype - Recursion - Library functions.

UNIT-III (6 Lectures)

Arrays: Array definition - Processing arrays - Passing array to a function - Multidimensional arrays - Strings - Storage classes.
Pointers: Pointer declaration - Pointer arithmetic - Pointers and arrays - Pointer operation - Passing pointers to a function - Passing function to a function.

UNIT-IV (6 Lectures)

Structures and Unions: Structure definition - Processing a structure - Structures and pointers - Passing structure to a function - Self-referential structures - Unions.

UNIT-V (6 Lectures)

Data Files: Opening, Closing, Creating, Processing data files - Register variables and bitwise operations - Command line parameters - C preprocessor.

Suggested Books:

1. Theory and Problems of Programming with 'C' (Schaum's Series) - B.S. Gottfried, McGraw Hill International Book Company.
2. Programming in ANSI C - E. Balagurusamy, Tata McGraw Hill Publishing Co. Ltd., 2/e.
3. The C Programming Language - B.W. Kernighan & D.M. Ritchie, Prentice Hall of India Private Ltd., New Delhi, 2/e.
4. Let Us C – YashawantKanetkar, BPB Publications, New Delhi, 3/e.

SEMESTER-VI

DSE-2 (Theory): Photonic Devices and Power Electronics (Credits: Theory-04, Practicals-02)

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

Theory Lectures 60

Course Learning Objectives

The course deals with use of electronics for control and conversion of electrical power and Photonic devices. The concept of high power devices, their construction and their applications is discussed. The concept of converters and inverters is important to evolve their applications for DC to AC and Ac to AC conversion. Its importance carries good relevance with regard to the high demand of battery operated vehicles.

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 Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.
- Understand the propagation of wave in optical fibre

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, hetero structure and quantum well devices, Charge carrier and photon confinement, line shape function, (12 Lectures)

Photodetectors: Photoconductor. Photodiodes (p-i-n, avalanche) and Photo transistors, quantum efficiency and responsivity, Photo multiplier tube. APD (Avalanche Photo Detector) (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 Waveguides-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 as a 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. (2 Lectures)

Power Inverters- Need for commutating circuits and their various types, dc link invertors, Parallel capacitor commutated invertors, Series Invertor, limitations and its improved versions, Bridge invertor (10 Lectures)

Suggested 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, M.H. Rashid, Pearson Education
7. Optoelectronic Devices and Systems, Gupta, PHI learning.
8. Electronic Devices and Circuits, David A. Bell, Oxford University Press.

DSE-2 (Practical): ***60 Lectures***

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, TRIACetc.
- 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.

1. To determine wavelength of sodium light using Michelson's Interferometer.
2. Diffraction experiments using a laser.
3. To determine characteristics of (a) LED (b) Photo voltaic cell and (c) Photodiode.
4. To study the Characteristics of LDR and Photodiode with (i) Variable Illumination intensity, and (ii)Linear Displacement of source.
5. To measure the numerical aperture of an optical fiber.
6. Output and transfer characteristics of a power MOSFET.
7. Study of I-V characteristics of SCR
8. SCR as a Half wave and Full wave rectifiers with R and RL loads.
9. Study of I-V characteristics of DIAC and TRIAC

Skill Enhancement Course

SEC-4 (Theory): Computational Mathematics (Credits: 02)
F.M. = 50 (Theory-40, Internal Assessment–10)

Theory Lectures: 30

Course Learning Objectives

Algebraic solutions of mathematical problems of real situation are rare. Computational mathematics are the foundational algorithms for computational predictions of solutions in modern systems science. Such methods include techniques for simple optimisation, interpolation, ordinary differential equations, differentiation, integration and solution of systems of linear and nonlinear equations to simulate systems.

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 (8Lectures)

NumericalMethods:Floatingpoint,Round-offerror,Errorpropagation,Stability,Programmingerrors.
SolutionofTranscendentalandPolynomialEquationsf(x)=0: Bisectionmethod,Secant and Regula Falsi Methods, Newton Raphson method, Rate of convergence, GeneralIteration Methods, Newton's Method for Systems.

Unit-2 (7Lectures)

InterpolationandPolynomialApproximations:TaylorSeriesandCalculationofFunctions, Langrange Interpolation, Newton Divided Difference Interpolation (forward andbackwarddifference formulae),

Unit-3 (8Lectures)

Numerical Integration: Trapezoidal Rule, Error bounds and estimate for the Trapezoidalrule,Simpson'sRule,Error ofSimpson'srule.
NumericalDifferentiation:Finitedifferencemethodandapplicationstoelectrostaticboundaryvalue problems.
Numericalmethodsforfirstorderdifferentialequations: Euler-CauchyMethod,Heun's Method, Classical RungeKutta method of fourth order.

Unit-4 (7Lectures)

NumericalMethodsinLinearAlgebra: LinearsystemsAx=B,GaussElimination, Partial Pivoting,LUfactorization,Doolittle's,Crout'sandCholesky'smethod.Matrix Inversion,Gauss-Jordon,IterativeMethods:Gauss-SeidelIteration.

SuggestedBooks:

1. E.Kreyszig,AdvancedEngineeringMathematics,JohnWiley&Sons(1999).
2. S.S.Sastry,IntroductoryMethodsofNumericalAnalysis,PrenticeHallIndia(2008).
3. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods: Problems and Solutions, New Age International (2007).
4. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C and C++, Khanna Publishers (2012).