THE UNIVERSITY OF BURDWAN

SYLLABUS FOR 3-YEAR DEGREE/4-YEAR HONOURS

in

ELECTRONICS

Under Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) as per NEP, 2020
with effect from 2023-24

SEMESTER WISE & COURSE WISE CREDIT DISTRIBUTION STRUCTURE UNDER CCFUP AS PER NEP, 2020

Semester	Course Type with Code	Level	Course Title	Credit	Lect.	Tuto.	Practical	Full Marks	Distribution of Marks		
									Theory	Prac. -tical	Internal Assessment
I	Major/DS Course (Core) Code: ELEC1011	100-199	Circuit Theory and Network Analysis	4	3	0	1	75	40	20	15
	Minor Course Code: ELEC1021	100-199	Circuit Theory and Network Analysis	4	3	0	1	75	40	20	15
	Multi/Inter disciplinary Code: ELEC1031		Circuit Theory and Semiconductor devices: Elementary Idea	3	2	1	0	50	40	00	10
	Ability Enhancement Course (AEC) [L_1-1 MIL] Code: AEC1041		Arabic/ Bengali/ Hindi/ Sanskrit/ Santali/ Urdu or Equvlnt. Course from SWAYAM /Any other UGC recognized platform	2	2	0	0	50	40	00	10
	Skill Enhancement Course (SEC) Code: ELEC1051		Design and Fabrication of Printed Circuit Boards	3	2	1	0	50	40	00	10
	Common Value Added (CVA) Course Code: CVA1061		Environmental Science/ Education	4	3	0	1	100	60	20	20
	Total			**20**				**400**			

Semester	Course Type with Code	Level	Name of the Course	Credit	Lect.	Tuto.	Practical	Full Marks	Distribution of Marks		
									Theory	Prac -tical	Internal Assessment
II	Major/DS Course (Core) Code: ELEC2011	100-199	Mathematical Foundation for Electronics	4	3	0	1	75	40	20	15
	Minor Course Code: ELEC2021	100-199	Mathematical Foundation for Electronics	4	3	0	1	75	40	20	15
	Multi/Interdisciplinary Code: ELEC2031		Basic Digital Electronics	3	2	1	0	50	40	00	10
	Ability Enhancement Course (AEC)[L_2-1] Code: AEC2041		English or Equvlnt. Course from SWAYAM/ /Any other UGC-recognized platform	2	2	0	0	50	40	00	10
	Skill Enhancement Course (SEC) Code: ELEC2051		Renewable energy and Energy harvesting	3	2	1	0	50	40	00	10
	Common Value Added (CVA) Course Code: CVA2061		Understanding India/Digital & Technological Solutions/Health & Wellness,Yoga Education, Sports & Fitness	4	3/3	1/0	0/1	100	80/60	0/20	20
Skill based vocational course (addl. 4 Cr) during summer term for 8 weeks, who will exit the programme after securing 40 cr.											
For UG Certificate 40 cr + Additional 4 cr (work based vocational course) = 44 cr. Students are allowed to re-enter within 3 years and complete the program within the stipulated max. period of 7 years											
	Total			**20**				**400**			

MAJOR COURSE

Semester I

MAJOR I: ELEC1011

Circuit Theory and Network Analysis (Credits: 04, Theory-03, Practical-01)

F.M. = 75 (Theory – 40, Practical-20, Internal Assessment – 15)

COURSE OBJECTIVE: The aim of this course is to enable the students to understand the basics of circuit theory and network analysis.

Number of lectures: 45
Unit- 1

Basic Circuit Concepts: Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel, Inductors: Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Mutual Inductance, Transformer Capacitors: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, Testing of resistance, inductance and capacitance using multimeter. (10 lectures)

Unit-2
Circuit Analysis and Network Theorems: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star and Delta network, Star-Delta Conversion.
Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem, AC circuit analysis using Network theorems.
Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) parameters. (10-lectures)

Unit-3
DC Transient Analysis: RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits. (10 lectures)

Unit-4
AC Circuit Analysis: Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal circuit analysis for RL, RC and RLC Circuits, Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters (elementary ideas only): Low Pass, High Pass, Band Pass and Band Stop. (15 lectures)

COURSE OUTCOME: After the completion of the course the student will acquire necessary knowledge/ hands on experience on electric circuit elements, dc power sources. With the knowledge of basic electronics a student can be able to analyze electrical and electronic circuits.

Suggested books:

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGrawHill. (2005)
3. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits, Revised Edition, Damodar Group (Publishers), Burdwan, ISBN:978-93-85775-15-4 (2019)
4. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
5. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005)
6. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)

Practical: Number of lectures: 30

Basic Circuit Theory and Network Analysis Lab (Hardware and Circuit Simulation Software)

1. Familiarization with
    a) Resistance in series, parallel and series – Parallel.
    b) Capacitors & Inductors in series & Parallel.
    c) Multimeter – Checking of components.
    d) Voltage sources in series, parallel and series – Parallel
    e) Voltage and Current dividers

2. Verification of Kirchoff's Law.
3. Verification of Norton's theorem.
4. Verification of Thevenin's Theorem.
5. Verification of Superposition Theorem.
6. Verification of the Maximum Power Transfer Theorem.
7. RC Circuits: Time Constant, Differentiator, Integrator.
8. Designing of a Low Pass RC Filter and study of its Frequency Response.
9. Designing of a High Pass RC Filter and study of its Frequency Response.
10. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

MAJOR COURSE

Semester II

MAJOR COURSE-2: ELEC2011 (Credit: 04, Theory-03, Practical-01)
Mathematical Foundation for Electronics
F.M. = 75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The aim of this course is to equip students with mathematical methods that are important prerequisites for electronics courses.

Number of lectures: 45

Unit-1

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. (5 lectures)

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. (6 lectures)

Vector Integration: Ordinary integrals of vectors, Multiple integrals, Jacobian. Notion of an infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field, Gauss' divergence theorem. Green's and Stokes Theorems and their applications (no rigorous proofs).

(10 lectures)

Unit-2

Orthogonal Curvilinear Coordinates: Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. (4 lectures)

Unit-3

Ordinary Differential Equations: First Order Ordinary Differential Equations, Basic Concepts, Separable Ordinary Differential Equations, Exact Ordinary Differential Equations, Linear Ordinary Differential Equations. Second Order homogeneous and non-homogeneous Differential Equations
Series solution of differential equations and special functions: Power series method, Legendre Polynomials, Frobenius Method, Bessel's equations and Bessel's functions of first and second kind. Error functions and gamma function. (10 lectures)

Unit-4

Matrices: Introduction to Matrices, System of Linear Algebraic Equations, Gaussian Elimination Method, Gauss -Seidel Method, LU decomposition, Solution of Linear System by LU decomposition. Eigen Values and Eigen Vectors, Linear Transformation, Properties of Eigen Values and Eigen Vectors, Cayley Hamilton Theorem, Diagonalization, Powers of a Matrix. Real and Complex Matrices, Symmetric, Skew Symmetric, Orthogonal Quadratic Form, Hermitian, Skew Hermitian, Unitary Matrices. (10 lectures)

Suggested Books

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Vector Analysis, M R Spiegel, Schaums Outline Series.
4. E. Kreyszig, advanced engineering mathematics, Wiley India (2008)
   Murray Spiegel, Seymour Lipschutz, John Schiller, Outline of Complex Variables, Schaum Outline Series, Tata McGraw Hill (2007)
5. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
6. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)
7. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited(2007)

Practical: Number of lectures: 30
Mathematics Foundation for Electronics Lab (Using C language/Scilab/MATLAB/ any other Mathematical Simulation software)

1. Solution of First Order Differential Equations
2. Solution of Second Order homogeneous Differential Equations
3. Solution of Second Order non-homogeneous Differential Equations
6. Solution of linear system of equations using Gauss Elimination method.
7. Solution of linear system of equations using Gauss – Seidel method.
8. Solution of linear system of equations using L-U decomposition method.
9. Numerical integration of a given function in a specified interval.

COURSE OUTCOME: On completion of this course, the student must be able to perform different mathematical operations like calculus and vector operations which are extremely essential to study electronics.

MINOR-ELECTRONICS

Semester I

MINOR COURSE: ELEC1021

Circuit Theory and Network Analysis (Credits: 04, Theory-03, Practical-01)

F.M. = 75 (Theory – 40, Practical-20, Internal Assessment – 15)

COURSE OBJECTIVE: The aim of this course is to enable the students to understand the basics of circuit theory and network analysis.

Number of lectures: 45
Unit- 1

Basic Circuit Concepts: Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel, Inductors: Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Mutual Inductance, Transformer Capacitors: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, Testing of resistance, inductance and capacitance using multimeter. (10 lectures)

Unit-2
Circuit Analysis and Network Theorems: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star and Delta network, Star-Delta Conversion.
Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem, AC circuit analysis using Network theorems.
Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) parameters. (10-lectures)

Unit-3
DC Transient Analysis: RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits. (10 lectures)

Unit-4
AC Circuit Analysis: Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal circuit analysis for RL, RC and RLC Circuits, Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters (elementary ideas only): Low Pass, High Pass, Band Pass and Band Stop. (15 lectures)

COURSE OUTCOME: After the completion of the course the student will acquire necessary knowledge/ hands on experience on electric circuit elements, dc power sources. With the knowledge of basic electronics a student can be able to analyze electrical and electronic circuits.

Suggested books:

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGrawHill. (2005)
3. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits, Revised Edition, Damodar Group (Publishers), Burdwan, ISBN:978-93-85775-15-4 (2019)
4. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
5. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005)
6. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)

Practical: Number of lectures: 30

Basic Circuit Theory and Network Analysis Lab (Hardware and Circuit Simulation Software)

1. Familiarization with
    a) Resistance in series, parallel and series – Parallel.
    b) Capacitors & Inductors in series & Parallel.
    c) Multimeter – Checking of components.
    d) Voltage sources in series, parallel and series – Parallel
    e) Voltage and Current dividers
2. Verification of Kirchoff's Law.
3. Verification of Norton's theorem.
4. Verification of Thevenin's Theorem.
5. Verification of Superposition Theorem.
6. Verification of the Maximum Power Transfer Theorem.
7. RC Circuits: Time Constant, Differentiator, Integrator.
8. Designing of a Low Pass RC Filter and study of its Frequency Response.
9. Designing of a High Pass RC Filter and study of its Frequency Response.
10. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

MINOR-ELECTRONICS

Semester II

MINOR COURSE-2: ELEC2021 (Credit: 04, Theory-03, Practical-01)
Mathematical Foundation for Electronics
F.M. = 75 (Theory-40, Practical–20, Internal Assessment–15)

COURSE OBJECTIVE: The aim of this course is to equip students with mathematical methods that are important prerequisites for electronics courses.

Number of lectures: 45

Unit-1

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. (5 lectures)

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. (6 lectures)

Vector Integration: Ordinary integrals of vectors, Multiple integrals, Jacobian. Notion of an infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field, Gauss' divergence theorem. Green's and Stokes Theorems and their applications (no rigorous proofs).

(10 lectures)

Unit-2

Orthogonal Curvilinear Coordinates: Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. (4 lectures)

Unit-3

Ordinary Differential Equations: First Order Ordinary Differential Equations, Basic Concepts, Separable Ordinary Differential Equations, Exact Ordinary Differential Equations, Linear Ordinary Differential Equations. Second Order homogeneous and non-homogeneous Differential Equations
Series solution of differential equations and special functions: Power series method, Legendre Polynomials, Frobenius Method, Bessel's equations and Bessel's functions of first and second kind. Error functions and gamma function. (10 lectures)

Unit-4

Matrices: Introduction to Matrices, System of Linear Algebraic Equations, Gaussian Elimination Method, Gauss -Seidel Method, LU decomposition, Solution of Linear System by LU decomposition. Eigen Values and Eigen Vectors, Linear Transformation, Properties of Eigen Values and Eigen Vectors, Cayley Hamilton Theorem, Diagonalization, Powers of a Matrix. Real and Complex Matrices, Symmetric, Skew Symmetric, Orthogonal Quadratic Form, Hermitian, Skew Hermitian, Unitary Matrices. (10 lectures)

Suggested Books

8. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
9. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
10. Vector Analysis, M R Spiegel, Schaums Outline Series.
11. E. Kreyszig, advanced engineering mathematics, Wiley India (2008)
    Murray Spiegel, Seymour Lipschutz, John Schiller, Outline of Complex Variables, Schaum Outline Series, Tata McGraw Hill (2007)
12. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007)
13. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)
14. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited(2007)

Practical: Number of lectures: 30
Mathematics Foundation for Electronics Lab (Using C language/Scilab/MATLAB/ any other Mathematical Simulation software)

1. Solution of First Order Differential Equations
2. Solution of Second Order homogeneous Differential Equations
3. Solution of Second Order non-homogeneous Differential Equations
6. Solution of linear system of equations using Gauss Elimination method.
7. Solution of linear system of equations using Gauss – Seidel method.
8. Solution of linear system of equations using L-U decomposition method.
9. Numerical integration of a given function in a specified interval.

COURSE OUTCOME: On completion of this course, the student must be able to perform different mathematical operations like calculus and vector operations which are extremely essential to study electronics.

MULTI-DISCIPLINARY COURSE (Electronics)

Semester I

MULTI-DISCIPLINARY-1: ELEC1031 (Credits: 03)

Circuit Theory and Semiconductor devices: Elementary Idea
F.M. = 50 (Theory - 40, Internal Assessment – 10)

COURSE OBJECTIVE: The aim of this course is to enable the students to understand the basics of circuits theory and semiconductor devices.

Number of lectures: 45

Basic Circuit Concepts and Circuit Analysis: Voltage and Current Sources, Resistors: Fixed and Variable resistors, Color coding of resistors, resistors in series and parallel, Inductors: Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Mutual Inductance, Transformer. Capacitors: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, Testing of resistance, inductance and capacitance using multimeter. (15 lectures)

Circuit Analysis and Network Theorems: Ohm's law, Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem. **(**10 lectures)

Semiconductor devices: Physics of Semiconductor, Energy Band in Solids: Classification of Metal, Insulator and Semiconductor, Classification of semiconductor, N-type and P-type semiconductor, Effects of temperature on Conductivity of semiconductor. PN junction diode, depletion layer, Forward & Reverse bias, V-I Characteristic, Effects of temperature, Zener diode, LED, Photo diode; Bipolar Junction Transistor, Operation of NPN and PNP transistors, Biasing of BJT. CB, CE and CC configuration; Introduction to FET, JFET, MOSFET. (20 lectures)

COURSE OUTCOME: After the completion of the course the student will acquire necessary knowledge on electric circuit elements and semiconductor elements. With the knowledge of basic electronics a student can able to understand basic electrical and electronic circuits that they encounter in their daily life.

Suggested Books:

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
2. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits, Revised Edition, Damodar Group (Publishers), Burdwan, ISBN:978-93-85775-15-4 (2019)
3. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGrawHill.(2005)
4. Robert L. Boylestad and L Nashelsky, Electronic Devices and Circuit Theory, Prentice Hall, India, 2009
5. J Millman and A Grabel, Microelectronics: digital and Analog Circuits and Systems, McGraw-Hill InternationalStudent Edition, 1979
6. A S Sedra and K C Smith, Microelectronic Circuits: theory and Applications, Oxford University Press, 2010.

MULTI-DISCIPLINARY COURSE (ELECTRONICS)

Semester II

MULTI-DISCIPLINARY-2: ELEC2031 (Credits: 03)

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

Basic Digital Electronics (Credits: 03)
F.M. = 50 (Theory - 40, Internal Assessment – 10)

COURSE OBJECTIVE: The aim of this course is to equip students with basic knowledge on digital electronics that are important prerequisites for electronics courses.
Number of lectures: 45

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code. (10 lectures)

Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators, Truth Tables of OR, AND, NOT, Basic postulates and fundamental theorems of Boolean algebra, Truth tables, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates. Standard representation of logic functions (SOP and POS), Karnaugh map minimization. (20 lectures)

Brief idea on Combinational Logic circuits: Half Adder, Half Subtractor, Full Adder, Full Subtractor, Multiplexers and Demultiplexers, Encoder and Decoder. (8 lectures)

Brief idea on Sequential logic circuits: Latches and Flip flops , S-R Flip flop, J-K Flip flop, T and D type Flip flop, Clocked and edge triggered Flip flops, master slave flip flop. (7 lectures)

COURSE OUTCOME: On completion of this course, the student will be able to understand the basic working principles of digital electronics.

Suggested books:

1. M. Morris Mano Digital System Design, Pearson Education Asia, (Fourth Edition)
2. B. C. Sarkar and S. Sarkar, Digital Electronics: Circuits and Systems, Sad-UI-Tan prakasani, Burdwan, ISBN:978-81-88391-57-8 (2018)
3. S Salivahanan and S Arivazhagan, Digital Circuits and Design, Oxford University Press, 2000.
4. W. H. Gothmann, Digital Electronics: An Introduction to Theory and Practice, Prentice Hall of India (2000)

SEC-ELECTRONICS

Semester-I

SEC-I: ELEC1051: Design and Fabrication of Printed Circuit Boards (Credit: 03)
F.M. = 50 (Theory - 40, Internal Assessment – 10)

COURSE OBJECTIVE: The aim of this course is to enable the students to understand and design printed circuit board.

Number of lectures: 45

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 **(4 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. **(4 lectures)**
Laminates and Photoprinting: Properties of laminates, Types of Laminates, Manual cleaning 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**. (4 lectures)**
Etching and Soldering: Introduction, Etching machine, Etchant system. Principles of Solder connection, Solder joints, Solder alloys, Soldering fluxes. Soldering, Desoldering tools and Techniques**. (4-lectures)**
PCB Fundamentals: PCB Advantages, components of PCB, Electronic components, Microprocessors and Microcontrollers, IC's, Surface Mount Devices (SMD). Classification of PCB - single, double, multilayer and flexible boards, Manufacturing of PCB, PCB standards. **(5 lectures)**
Schematic & Layout Design: Schematic diagram, General, Mechanical and Electrical design considerations, Placing and Mounting of components, Conductor spacing, routing guidelines, heat sinks and package density, Net list, creating components for library, Tracks, Pads, Vias, power plane, grounding.

(10 lectures)

Technology of PCB: Design automation, Design Rule Checking; Exporting Drill and Gerber Files; Drills; Footprints and Libraries Adding and Editing Pins, copper clad laminates materials of copper clad laminates, properties of laminates (electrical & physical), types of laminates, soldering techniques. Film master reparation, Image transfer, photo printing, Screen Printing, Plating techniques etching techniques, Mechanical Machining operations, Lead cutting and Soldering Techniques, Testing and quality controls.

(**10 lectures)**

PCB Technology: Trends, Environmental concerns in PCB industry. **(4 lectures)**

COURSE OUTCOME: After the completion of the course the student will acquire necessary skills/ hands on experience /working knowledge on printed circuit boards. With the knowledge a student can able to design PCB that will be useful for electronic instrumentation.

Suggested Books:

1. Printed circuit Board – Design & Technology by Walter C. Bosshart, Tata McGraw Hill.
2. Printed Circuit Board –Design, Fabrication, Assembly & Testing, R.S. Khandpur, TMH

SEC-ELECTRONICS

Semester-II

SEC-2: ELEC2051 (Credits: 03)
Renewable energy and Energy harvesting
F.M. = 50 (Theory - 40, Internal Assessment – 10)

COURSE OBJECTIVE: To impart knowledge and hands on learning about various alternate energy sources like wind, solar, mechanical, ocean, geothermal energy etc. To review the working of various energy harvesting systems which are installed worldwide.

Number of lectures: 45

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. (10 lectures)
Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, 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. (5 lectures)
Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. (5 lectures)
Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. (5 lectures)
Geothermal Energy: Geothermal Resources, Geothermal Technologies. (5 lectures)
Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. (5 lectures)
Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications. (5 lectures)
Electromagnetic Energy Harvesting: Linear generators, physics of mathematical models, recent applications of Carbon captured technologies, cell, batteries, power consumption Environmental issues and Renewable sources of energy, sustainability. (5 lectures)

COURSE OUTCOME: The students are expected to learn theories and importance of the renewable sources of energy.

Suggested books:

1. Non-conventional energy sources, B.H. Khan, McGraw Hill
2. Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.
3. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rd Edn., 2012, Oxford University Press.
4.Renewable Energy Sources and Emerging Technologies, Kothari et.al., 2ndEdition, PHI
5. Solar Energy: Resource Assesment Handbook, P Jayakumar, 2009
6. http://en.wikipedia.org/wiki/Renewable_energy