

National Curriculum and Credit Framework (NCCF)

Syllabus

for

ELECTRONICS

w.e.f. Academic Session 2023-24



Kazi Nazrul University
Asansol, Paschim Bardhaman
West Bengal 713340

SEMESTER- I

MAJOR COURSE - 1

Course Name :Basic Electronics

Course Code : BSCELCMJ101

Course Type: Major (Theoretical & Practical)	Course Details: MJC-1		L-T-P: 3 – 0 – 4		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

- After the completion of course, the students will have ability to:
- Basics of electrical energy sources.
- Demonstrate and explain electrical components, electrical circuits and D.C. Network theorems.
- Distinguish between conductors, nonconductors and semiconductors based on energy band theory and classify different types of semiconductors.
- Demonstrate the operating principle and output characteristics of p-n junction diodes, Zener diode & BJT.

BASIC ELECTRONICS (Theory)

Unit-I

Voltage and current sources, 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, Capacitors, Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor.

Unit-II

Kirchhoff's current and voltage laws, examples of loop and nodal analysis, Network theorems: Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

Unit-III

Semiconductor diodes - Band structure (Qualitative discussions only), Majority and minority carriers, Doping, p-n Junction formation, p-n junction diode, breakdown in junction diodes, Zener diode.

Unit- IV

Bipolar Junction Transistor (BJT): Current flow mechanism, Current components, Transistor as two port network, CE, CB and CC configurations, comparisons, Transistor Biasing fundamentals.

Reference Books:

- B.L. Theraja & R. K. Theraja, A Text book on electrical Technology Vol-1, S. Chand.
- Van Valkenburg, Network analysis, Pearson.
- Millman and Halkias, Integrated Electronics, TMH.
- Chattopadhyay and Rakshit, Foundations of Electronics, New Age.
- Jyoti Prasad Bandyopadhyay, Basic Electronics Engineering, Vikas Publishing House Pvt. Ltd.
- Jyoti Prasad Bandyopadhyay, Basic Electrical and Electronics Engineering, Vols.1 & 2, Vikas Publishing House Pvt. Ltd.
- R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Pearson.

BASIC ELECTRONICS (Practical), Lab– I

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Verify network theorems using resistive networks and D.C. sources.
- Familiarize with basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope.
- Determine the current through a resistance by potentiometer.
- Study I-V characteristics of a suitable resistor and that of a junction diode within specified limit on a graph, and hence to estimate d.c. and a.c. resistances of both the elements at the point of intersection

List of Experiments:

1. Familiarization with basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope.

2. Determination of the current through a resistance by potentiometer.
3. Verification of (a) Thevenin's theorem and (b) Norton's theorem.
4. Verification of Maximum Power Transfer Theorem.
5. Study of I-V characteristics of a suitable resistor and that of a junction diode within specified limit on a graph, and hence to estimate d.c. and a.c. resistances of both the elements at the point of intersection.

MINOR COURSE - 1

Course Name : BASIC ELECTRONICS

Course Code : BSCELCMN101

Course Type: Minor (Theoretical & Practical)	Course Details: MNC-1		L-T-P: 3- 0- 4		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

- After the completion of course, the students will have ability to:
- Basics of electrical energy sources.
- Demonstrate and explain electrical components, electrical circuits and DC network theorems.
- Distinguish between conductors, nonconductors and semiconductors based on energy band theory and classify different types of semiconductors.
- Demonstrate the operating principle and output characteristics of p-n junction diodes, Zener diode & BJT.

Basic Electronics (Theory)

Unit-I

Voltage and current sources, 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, Capacitors, Principles of capacitance, Parallel plate

capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor.

Unit-II

Kirchhoff's current and voltage laws, examples of loop and nodal analysis, Network theorems: Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

Unit-III

Semiconductor diodes - Band structure (Qualitative discussions only), Majority and minority carriers, Doping, p-n Junction formation, p-n junction diode, breakdown in junction diodes, Zener diode.

Unit- IV

Bipolar Junction Transistor (BJT): Current flow mechanism, Current components, Transistor as two port network, CE, CB and CC configurations, comparisons, Transistor Biasing fundamentals.

Reference Books:

- B.L. Theraja & R. K. Theraja, A Text book on electrical Technology Vol-1, S. Chand.
- Van Valkenburg, Network analysis, Pearson.
- Millman and Halkias, Integrated Electronics, TMH.
- Chattopadhyay and Rakshit, Foundations of Electronics, New Age.
- Jyoti Prasad Bandyopadhyay, Basic Electronics Engineering, Vikas Publishing House Pvt. Ltd.
- Jyoti Prasad Bandyopadhyay, Basic Electrical and Electronics Engineering, Vols.1 & 2, Vikas Publishing House Pvt. Ltd.
- R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Pearson.

BASIC ELECTRONICS (Practical), Lab– I

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Verify network theorems using resistive networks and D.C. sources.
- Familiarize with basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope.
- Determine the current through a resistance by potentiometer.

- Study I-V characteristics of a suitable resistor and that of a junction diode within specified limit on a graph, and hence to estimate d.c. and a.c. resistances of both the elements at the point of intersection

List of Experiments:

1. Familiarization with basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope.
2. Determination of the current through a resistance by potentiometer.
3. Verification of (a) Thevenin's theorem and (b) Norton's theorem.
4. Verification of Maximum Power Transfer Theorem.
5. Study of I-V characteristics of a suitable resistor and that of a junction diode within specified limit on a graph, and hence to estimate d.c. and a.c. resistances of both the elements at the point of intersection.

SKILL ENHANCEMENT COURSE - 1

Course Name : DESIGN AND FABRICATION OF ELECTRONIC CIRCUIT I

Course Code : BSCELCSE101

Course Type: SE (Practical)	Course Details: SEC-1		L-T-P: 0-0-6		
Credit: 3	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30		20	

DESIGN AND FABRICATION OF ELECTRONIC CIRCUIT I (Practical)

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Gain knowledge of different electronic/ electrical components.
- Design dc power supply with ICs, combination of 6V battery eliminator, design of CE AFamplifier on broadband, design of Zener regulator, FET audio amplifier, feedback amplifier, design of low frequency oscillator, various op-amp circuits, modulator and demodulator.

Design and fabrication of electronic circuits I

1. Knowledge of electronic/ electrical components, resistor, capacitor, inductor, transformer, signal sources (ac and dc), transistor, FETs, op-amps.
2. Design of dc power supply with ICs, combination of 6V battery eliminator, design of CE AF amplifier on broadband, design of Zener regulator, FET audio amplifier, feedback amplifier, design of low frequency oscillator, various op-amp circuits, modulator and demodulator.

MULTI-DISCIPLINARY COURSE - 1

Course Name : ELECTRONIC MEASUREMENTS

Course Code : MDC116

Course Type: Multi-disciplinary (Theoretical)	Course Details: MDC-1		L-T-P: 3 – 0 – 0		
Credit: 3	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			15		35

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Explain the basic working principle of various electronic measurement instruments used to measure electrical parameters like current, voltage, power etc.
- Understand and describe the specifications, features, characteristics, error and the performance of an instrument
- Gain knowledge about the functional blocks of a CRO and do analysis, measurements of waveform display.

ELECTRONIC MEASUREMENTS (Theoretical)

Unit-I:

Basics of Measurements: Accuracy, Precision, resolution, reliability, repeatability, validity, Errors and their analysis, Standards of measurement.

Bridge Measurement: DC bridges- Wheatstone bridge, AC bridges – Maxwell, Wien bridges.

Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter, Digital voltmeter.

Unit-II:

Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Probes.

Specification of an Oscilloscope. Oscilloscope measurement Techniques, Overview of special Oscilloscopes – Storage Oscilloscope.

Signal Generators: Sine wave generator, Overview of Function Generators.

Reference Books:

- Albert D. Helfrick and William D. Cooper, Modern Electronics Instrumentation & Measurement Techniques, Pearson Education.
- Joseph J. Carr, Elements of Electronics Instrumentation and Measurement-3rd Edition, Pearson Education.
- Anand, Electronics Instruments and Instrumentation Technology, PHI.

SEMESTER- II

MAJOR COURSE - 2

Course Name : SOLID STATE ELECTRONICS

Course Code : BSCELCMJ201

Course Type: Major (Theoretical & Practical)	Course Details: MJC-2		L-T-P: 3 – 0 – 4		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

(After the completion of course, the students will have ability to) :

- Learn about semiconductor physics.

- Describe the behavior of semiconductor devices such as diodes, transistor, FET etc.
- Reproduce the I-V characteristics of Diodes/BJT/FET devices.
- Learn about the applications of p-n junction diodes.

SOLID STATE ELECTRONICS (Theoretical)

Unit-I: Semiconductor Physics

The atomic structure, Energy band diagram and classifications of solids, Metals insulators and semiconductors (Qualitative discussions only), Generation of hole-electron pairs at room-temperature and intrinsic semiconductor, Energy band diagram, carrier density; doping and impurity semiconductor, majority and minority carriers, p-type and n-type semiconductors, advantage of silicon over germanium as semiconductor device material, Transport parameters, Current flow in semiconductors, Diffusion and Drift current.

Unit-II: Junction Diode and its applications

p-n junction and its properties (depletion region, barrier voltage, barrier width, junction capacitance and junction resistance), Junction diode, forward and reverse biased characteristics, diode equation (I-V expression only), a.c. and d.c. resistances of a diode, Zener and avalanche breakdown. Qualitative idea of Schottky diode. Use of diode as rectifier, calculation of ripple factor and efficiency of half and full wave rectifier, Filter-capacitor and inductance filters, their role in power supply, output waveform and working, Regulation- Line and load regulation, Zener diode as voltage regulator.

Unit-III: Bipolar Junction Transistor

Input and output characteristics of transistor in CE and CB configurations, Regions of operation (active, cut off and saturation), Current gains α and β , Relations between α and β , dc load line and Q point, Simple problems. Biasing of BJT (PNP and NPN), idea of bias stability, Factors affecting Stability, Stability factor, Study of Fixed, Self and Voltage divider biasing.

Reference Books:

- C. Kittel, Introduction to Solid State Physics, Wiley.
- Millman and Halkias, Integrated Electronics, TMH.
- Chattopadhyay and Rakshit, Foundations of Electronics, New Age.
- B. L. Theraja, Basic Electronics -Solid State, S. Chand, (Current Edition).
- V. K. Mehta, Principles of Electronics, S. Chand, (Current Edition).

- R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- Bhargava, Kulashretha, Gupta, Basic Electronics & Linear Circuits, TMH.
- Streetman & Banerjee, Solid State Electronic Devices, PHI.
- Salivahanan, Electronic Devices and Circuits, TMH.
- David A. Bell, Electronic Devices and Circuits, 5th Edition 2015, Oxford University Press.
- D.L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill.

SOLID STATE ELECTRONICS (Practical), LAB – II

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Study P-N Junction diode characteristics, to calculate dc and ac resistances.
- Study Zener diode Characteristics in reverse bias, to determine breakdown voltage and acresistance at breakdown.
- Study Transistor input & output characteristics (CE & CB Modes). To determine dc & acresistances and current gain.
- Study half & full wave rectifier with junction diode with (capacitor) and without filter.
- Study voltage regulation using Zener diode.

List of Experiments:

1. Study of Zener diode Characteristics in reverse bias, to determine breakdown voltage and acresistance at breakdown.
2. Study of Transistor input & output characteristics (CE & CB Modes). To determine d.c. & a.c. resistances and current gain.
3. Study of half & full wave rectifier with junction diode with (capacitor) and without filter.
4. Study of voltage regulation using Zener diode.

Reference Books:

- Zbar, Basic Electronics: A Text Lab Manual, TMH.
- Bell, Laboratory Manual for Electronic Devices and Circuits, PHI.
- Bell, Laboratory Manual for Electric Circuits, PHI.

- J. Edminister and M. Nahvi, Electric Circuits: Schaum's Outlines, TMH.
- Ghosh, Advanced Practical Physics Volume II B. New Central Book Agency.
- Chattopadhyay and Rakshit, An Advanced Course in Practical Physics, New Central Book Agency Pvt. Ltd.

MINOR COURSE - 2

Course Name : SOLID STATE ELECTRONICS

Course Code : BSCELCMN201

Course Type: Minor (Theoretical & Practical)	Course Details: MNC-1		L-T-P: 3- 0- 4		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

(After the completion of course, the students will have ability to) :

- Learn about semiconductor physics.
- Describe the behavior of semiconductor devices such as diodes, transistor, FET etc.
- Reproduce the I-V characteristics of Diodes/BJT/FET devices.
- Learn about the applications of p-n junction diodes.

SOLID STATE ELECTRONICS

Unit-I: Semiconductor Physics

The atomic structure, Energy band diagram and classifications of solids, Metals insulators and semiconductors (Qualitative discussions only), Generation of hole-electron pairs at room-temperature and intrinsic semiconductor, Energy band diagram, carrier density; doping and impurity semiconductor, majority and minority carriers, p-type and n-type semiconductors,

advantage of silicon over germanium as semiconductor device material, Transport parameters, Current flow in semiconductors, Diffusion and Drift current.

Unit-II: Junction Diode and its applications

p-n junction and its properties (depletion region, barrier voltage, barrier width, junction capacitance and junction resistance), Junction diode, forward and reverse biased characteristics, diode equation (I-V expression only), a.c. and d.c. resistances of a diode, Zener and avalanche breakdown. Qualitative idea of Schottky diode. Use of diode as rectifier, calculation of ripple factor and efficiency of half and full wave rectifier, Filter- capacitor and inductance filters, their role in power supply, output waveform and working, Regulation- Line and load regulation, Zener diode as voltage regulator.

Unit-III: Bipolar Junction Transistor

Input and output characteristics of transistor in CE and CB configurations, Regions of operation (active, cut off and saturation), Current gains α and β , Relations between α and β , dc load line and Q point, Simple problems. Biasing of BJT (PNP and NPN), idea of bias stability, Factors affecting Stability, Stability factor, Study of Fixed, Self and Voltage divider biasing.

Reference Books:

- C. Kittel, Introduction to Solid State Physics, Wiley.
- Millman and Halkias, Integrated Electronics, TMH.
- Chattopadhyay and Rakshit, Foundations of Electronics, New Age.
- B. L. Theraja, Basic Electronics -Solid State, S. Chand, (Current Edition).
- V. K. Mehta, Principles of Electronics, S. Chand, (Current Edition).
- R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- Bhargava, Kulashretha, Gupta, Basic Electronics & Linear Circuits, TMH.
- Streetman & Banerjee, Solid State Electronic Devices, PHI.
- Salivahanan, Electronic Devices and Circuits, TMH.
- David A. Bell, Electronic Devices and Circuits, 5th Edition 2015, Oxford University Press.
- D.L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill.

SOLID STATE ELECTRONICS (Practical), LAB – II

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Study P-N Junction diode characteristics, to calculate dc and ac resistances.
- Study Zener diode Characteristics in reverse bias, to determine breakdown voltage and acresistance at breakdown.
- Study Transistor input & output characteristics (CE & CB Modes). To determine dc & acresistances and current gain.
- Study half & full wave rectifier with junction diode with (capacitor) and without filter.
- Study voltage regulation using Zener diode.

List of Experiments:

1. Study of Zener diode Characteristics in reverse bias, to determine breakdown voltage and acresistance at breakdown.
2. Study of Transistor input & output characteristics (CE & CB Modes). To determine d.c. & a.c. resistances and current gain.
3. Study of half & full wave rectifier with junction diode with (capacitor) and without filter.
4. Study of voltage regulation using Zener diode.

Reference Books:

- Zbar, Basic Electronics: A Text Lab Manual, TMH.
- Bell, Laboratory Manual for Electronic Devices and Circuits, PHI.
- Bell, Laboratory Manual for Electric Circuits, PHI.
- J. Edminister and M. Nahvi, Electric Circuits: Schaum’s Outlines, TMH.
- Ghosh, Advanced Practical Physics Volume II B. New Central Book Agency.
- Chattopadhyay and Rakshit, An Advanced Course in Practical Physics, New Central BookAgency Pvt. Ltd.

SKILL ENHANCEMENT COURSE - 2

Course Name : DESIGN AND FABRICATION OF ELECTRONIC CIRCUIT II

Course Code : BSCELCSE201

Course Type: SE (Practical)	Course Details: SEC-2		L-T-P: 0-0-6
Credit: 3		CA Marks	ESE Marks

	Full Marks: 50	Practical	Theoretical	Practical	Theoretical
		30		20	

DESIGN AND FABRICATION OF ELECTRONIC CIRCUIT II (Practical)

Course Learning Outcomes:

After the completion of course, the students will have ability to:

- Construct electronic circuit for square wave generator and explain its working
- Design of radio receiver and explain its working

Design and fabrication of electronic circuits

1. Study and construction of square wave generator.
2. Construction of radio receiver.

MULTI-DISCIPLINARY COURSE - 2

Course Name : E-WASTE MANAGEMENT

Course Code : MDC212

Course Type: Multi-disciplinary (Theoretical)	Course Details: MDC-2		L-T-P: 3 – 0 – 0		
Credit: 3	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			15		35

E-WASTE MANAGEMENT

Unit – I: Introduction

E-Waste Definition and its Importance, Sources of E-Waste, Categories of E-Waste, Composition and Generation of E-Waste, Global and Indian Scenario of E-Waste, Possible Hazardous Substances Present in E-Waste, Environmental and Health implications; Beyond the Environment – Data Security and Privacy in E-Waste Recycling, How E-Waste Results in Data Theft?

Unit – II: End-of-Life Management of E-Waste

E-Waste Management Process, Methods of E-Waste Disposal – Dumping, Burning, Acid Washing and Landfill; Recycling and Recovery – Sorting, Crushing, Separation; Emerging Recycling and Recovery Technologies, Formal Metal Extraction Processes from E-Waste, Environmentally Sound Treatment Technology for E-Waste, Guidelines for Establishment of Integrated E-Waste Recycling and Treatment Facility, E-waste in the space orbits due to satellites and space crafts and their management.

Unit – III: E-Waste Management in India

Status of E-Waste Management in India, Challenges for E-waste Management in India, Improvement of E-waste Management in India, How we can Create Robust E-waste Management in India? Popular E-Waste Disposal Methods in India, Occupational and Environmental Health Perspectives of Recycling E-Waste in India.

Unit – IV: E-Waste Legislation

Regulatory regime for e-waste in India, The hazardous waste (Management and Handling) rules 2003, E- waste management rules 2015, Regulatory compliance including roles and responsibility of different stakeholders – producer, manufacturer, consumer etc., Proposed reduction in the use of hazardous substances (RoHS), Extended producer responsibility (EPR).

References:

- Fowler B, Electronic Waste – 1st Edition (Toxicology and Public Health Issues), 2017 Elsevier.
- Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009.
- Johri R., “E-waste: implications, regulations, and management in India and current global best practices”, TERI Press, New Delhi.
- M. N. Mundada, S. Kumar, and A. V. Shekdar; E-Waste: A New Challenge for Waste Management in India. 61(3), 265–279, 2004, Journal of Environmental Studies. <https://doi.org/10.1080/0020723042000176060>
- <https://hindrise.org/resources/e-waste-management-in-india/>

SEMESTER- III

MAJOR COURSE - 3

Course Name : NETWORK ANALYSIS AND CIRCUIT THEORY

Course Code : BSCELCMJ301

Course Type: Major (Theoretical & Practical)	Course Details: MJC-3		L-T-P: 3 – 0 – 4		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Understand the difference between response of basic electrical components and circuits, under DC & AC excitation.
- Apply Laplace transform for steady state and transient analysis.
- Appreciating the operation of passive filters.
- Understanding two-port networks.

NETWORK ANALYSIS AND CIRCUIT THEORY

[Credits: 3; Lecture Hours: 36]

Unit-I [8 Hours]

DC transient Analysis: Transient response of R, L, C, series RL, and RC under DC Excitation.

Unit-II [16 Hours]

AC Circuit Analysis: Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values, Voltage-Current Relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Sinusoidal Circuit Analysis for RL, RC, RLC in Series and Parallel, Power in AC Circuits, Instantaneous Power, Average Power, Reactive Power, Power Factor. Resonance in Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth.

Passive Filters: Low Pass, High Pass, Band Pass and Band Stop Filters.

Unit-III [8 Hours]

Analysis of circuits using Laplace transforms: Definition of Laplace transform, Expression of circuit elements using Laplace transform, Analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms.

Unit-IV [4 Hours]

Two Port Networks: Qualitative idea of Impedance (Z), Admittance (Y) and Transmission (ABCD) Parameters. Symmetric T and π network.

NETWORK ANALYSIS AND CIRCUIT THEORY (Practical), Lab– III

[Credits: 2; Practical Hours: 40]

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Proficiency in designing basic passive filter circuits.
- Interpretation of frequency response characteristics of basic passive networks under AC excitation.
- Analyzing and interpreting the characteristic response of a series LCR circuit.

List of Experiments:

1. Designing of a Low Pass RC Filter and study of its Frequency Response.
2. Designing of a High Pass RC Filter and study of its Frequency Response.
3. Design and study of frequency response of RC circuit.
4. 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.

Reference Books:

- Bel, Electronic Circuits, Oxford.
- DeCarlo and Lin, Linear Circuit Analysis, Oxford.
- Sadiku, Musa and Alexander, Applied Circuit Analysis, Tata McGraw-Hill.
- Nasar, Electric Circuits, Schaum's Solved Problems Series, Tata McGraw Hill.
- Nahvi and Edminister, Electric Circuits, Schaum's Outline Series, Tata McGraw Hill.
- Van Valkenburg, "Network analysis", Prentice Hall of India, 2000.
- Sudhakar, S. P. Shyammohan, "Circuits and Network", Tata McGraw-Hill New Delhi, 1994.

MAJOR COURSE - 4

Course Name : MATHEMATICAL METHODS AND STATISTICAL MECHANICS

Course Code : BSCELCMJ302

Course Type: Major (Theoretical & Tutorial)	Course Details: MJC-4		L-T-P: 4 – 1 – 0		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			30		70

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Knowledge of basic mathematical methods.
- Basic idea about various statistical distribution functions.

MATHEMATICAL METHODS AND STATISTICAL MECHANICS

[Credits: 4; Lecture Hours: 48]

Unit-I [12 Hours]

Ordinary Differential Equation: 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.

Unit-II [12 Hours]

Matrices: Introduction to Matrices, Determinant of a matrix, Adjoint of a matrix, Transpose of a matrix, Matrix addition, Matrix subtraction, Matrix multiplication, Real and Complex Matrices, Symmetric, Skew Symmetric, Hermitian, Skew Hermitian, Unitary Matrices, System of Linear Algebraic Equations, Cramer's Rule, Gaussian Elimination Method, Gauss-Seidel Method, Eigenvalues and Eigenvectors, Linear Transformation, Properties of Eigenvalues and Eigenvectors, Diagonalization, Powers of a Matrix.

Unit-III [12 Hours]

Complex Variables and Functions: Complex Variable, Complex Function, Continuity, Differentiability, Cauchy-Riemann (C-R) Equations, Exponential Function, Trigonometric Function, Hyperbolic Function, Series and Power Series, Taylor's Series, Zeroes and Poles.

Unit-IV [12 Hours]

Statistical Mechanics: Macroscopic and Microscopic States, Concept of Phase Space and Density of States, Statistical Interpretation of Entropy, Quantization of Phase Space, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Distribution Functions and their Importance.

MATHEMATICAL METHODS AND STATISTICAL MECHANICS (Tutorial)

[Credits: 1; Lecture Hours: 15]

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Proficiency of a standard simulation software.
- Developing standard problem-solving skills.

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 Addition and/ Subtraction of Two Matrix.
4. Solution of Linear System of Equations using Gauss Elimination Method.
5. Solution of Fermi-Dirac distribution function.

Reference Books:

- Kreyszig, Advanced Engineering Mathematics, Wiley.
- Spiegel, Lipschutz, Schiller and Spellman, Schaum's Outline of Complex Variables, Schaum Outline Series, Tata McGraw Hill.
- Pal and Bhunia, Engineering Mathematics, Oxford.
- Garg and Gupta, Engineering Mathematics Volume I & II, Pearson.
- Dass and Verma, Higher Engineering Mathematics, S. Chand.
- Eisberg and Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Wiley.
- Pillai, Solid State Physics, New Age.
- Kasap, Principles of Electronic Materials and Devices, Tata McGraw Hill.
- Roy, Fundamentals of Classical and Statistical Thermodynamics, Wiley.

MINOR COURSE - 3

Course Name : NETWORK ANALYSIS AND CIRCUIT THEORY

Course Code : BSCELCMN301

Course Type: Minor (Theoretical & Practical)	Course Details: MNC-3		L-T-P: 3- 0- 4		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Understand the difference between response of basic electrical components and circuits, under DC & AC excitation.
- Understanding two-port networks.

NETWORK ANALYSIS AND CIRCUIT THEORY

[Credits: 3; Lecture Hours: 28]

Unit-I [8 Hours]

DC transient Analysis: Transient response of R, L, C, series RL, and series Circuits under DC Excitation.

Unit-II [16 Hours]

AC Circuit Analysis: Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values, Voltage-Current Relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Sinusoidal Circuit Analysis for RL, RC, Series and Parallel RLC Circuits, Power in AC Circuits, Instantaneous Power, Average Power, Reactive Power, Power Factor. Resonance in Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth.

Unit-III [4 Hours]

Two Port Networks: Qualitative idea of Impedance (Z), Admittance (Y) and Transmission (ABCD) Parameters.

NETWORK ANALYSIS AND CIRCUIT THEORY (Practical), Lab– III

[Credits: 2; Practical Hours: 26]

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Interpretation of frequency response characteristics of basic passive networks under AC excitation.
- Analyzing and interpreting the characteristic response of a series LCR circuit.

List of Experiments:

1. Design and study of frequency response of RC circuit.
2. 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.

Reference Books:

- Bel, Electronic Circuits, Oxford.
- DeCarlo and Lin, Linear Circuit Analysis, Oxford.
- Sadiku, Musa and Alexander, Applied Circuit Analysis, Tata McGraw-Hill.
- Nasar, Electric Circuits, Schaum's Solved Problems Series, Tata McGraw Hill.
- Nahvi and Edminister, Electric Circuits, Schaum's Outline Series, Tata McGraw Hill.
- Van Valkenburg, "Network analysis", Prentice Hall of India, 2000.
- A. Sudhakar, S. P. Shyamohan, "Circuits and Network", Tata McGraw-Hill New Delhi,

SEMESTER- IV

MAJOR COURSE - 5

Course Name : ELECTROMAGNETIC THEORY

Course Code : BSCELCMJ401

Course Type: Major (Theoretical & Tutorial)	Course Details: MJC-5		L-T-P: 4 – 1 – 0		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			30		70

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Apply the concepts of Electrostatics and Magnetostatics based on the problem.
- Improvise the concepts of wave propagation in various media.

ELECTROMAGNETIC THEORY

[Credits: 4; Lecture Hours: 54]

Unit-I [10 Hours]

Vector Analysis, Poisson’s Equation and Laplace Equation: Scalars and Vectors, Unit Vector and Vector Components, Vector Field, Vector Algebra, Rectangular (Cartesian) Coordinate, Curvilinear Coordinates, Unit Vectors and Scalar Factors, Cylindrical Coordinate and Spherical Coordinate; Differential Length, Area and Volume, Line, Surface and Volume Integrals, Del Operator, Gradient of a Scalar, Divergence of a Vector and Divergence Theorem, Curl of a Vector and Stokes’s Theorem, Green’s Theorem, Laplacian of a Scalar.

Unit-II [12 Hours]

Electrostatics: Coulomb’s Law, Electric Field and Electric Potential due to Discrete and Continuous Charge Distributions, Electric Flux Density, Gauss’s Law – Maxwell’s Equation and Applications, Electric Dipole, Electric Fields in Different Materials, Current and Current Density, Polarization, Dielectric Constant, Boundary Conditions, Poisson’s and Laplace’s Equations Uniqueness Theorem, Electrostatic Energy and Forces, Energy Density.

Unit-III [10 Hours]

Magnetostatics: Biot Savart’s Law, Magnetic Dipole, Ampere’s Circuital Law – Maxwell’s Equation, Magnetic Flux and Magnetic Flux Density – Maxwell’s Equation, Scalar and Vector Magnetic Potentials. Magnetization in Materials and Permeability, Magnetic Boundary Conditions.

Unit-IV [10 Hours]

Time-Varying Fields and Maxwell's Equations: Faraday's Law of Electromagnetic Induction – Maxwell's Equation, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Maxwell's Equations in Differential and Integral Form, Potential Functions, Lorentz Gauge, Coulomb Gauge, Wave Equations for EM fields, Concept of Retarded Potentials, Electromagnetic Boundary Conditions.

Unit-V [12 Hours]

Electromagnetic Wave Propagation: Electromagnetic Spectrum, Wave Equation in a Source Free Isotropic Homogeneous Media, Qualitative Idea of Uniform Plane wave in different media, Skin Effect, Wave Polarization, Reflection and Transmission of Plane Waves at Normal and Oblique Incidence, Snell's Law, Fresnel's Equation, Brewster's Angle, Concept of Phase and Group Velocity, Electromagnetic Power and Poynting Vector and Poynting Theorem.

ELECTROMAGNETIC THEORY (Tutorial)

[Credits: 1; Lecture Hours: 15]

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Analyze and visualize the concepts established in the Electromagnetic theory through standardized simulation software.

Scilab/Matlab/Any Other Similar Simulation Software:

1. Understanding and Plotting Vectors.
2. Transformation of Vectors into Various Coordinate Systems.
3. Representation of the Gradient of a Scalar Field, Divergence and Curl of Vector Fields.
4. Plots of Electric Field and Electric Potential due to Charge Distributions.
5. Solutions of Poisson and Laplace Equations - Contour Plots of Charge and Potential Distributions.

Reference Books:

- Spiegel, Lipschutz and Spellman, Vector Analysis, Schaum's Outline Series, Tata McGraw Hill.
- Ida, Engineering Electromagnetics, Springer.
- Sadiku, Elements of Electromagnetics, Oxford.
- Hayt, Buck and Akhtar, Engineering Electromagnetics, Tata McGraw Hill.
- Cheng, Field and Wave Electromagnetics, Pearson.
- Edminster, Electromagnetics, Schaum's Outline Series, Tata McGraw Hill.

- Griffiths, Introduction to Electrodynamics, Pearson.
- Jordan and Balmain, Electromagnetic Waves and Radiating Systems, Pearson.

MAJOR COURSE - 6

Course Name : ANALOG ELECTONICS I

Course Code : BSCELCMJ402

Course Type: Major (Theoretical & Practical)	Course Details: MJC-6		L-T-P: 3 – 0 – 4		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Design and analyze various analog circuits.
- Analyze circuits with devices for specific applications.

ANALOG ELECTRONICS I

[Credits: 3; Lecture Hours: 45]

Unit-I [7 Hours]

Diode Circuits: Clipping and Clamping Circuits, Eber's-Moll Equation.

Special Junction Diodes & applications: Varactor Diode, Solar Cell (open circuit voltage & short circuit current), Zener Diode as a Voltage Regulator.

Unit-II [8 Hours]

Bipolar Junction Transistor Circuits: Transistor as a Switch, Darlington Pair, BJT Amplifier, Voltage and Power Amplifier, DC and AC Load Line Analysis, Hybrid Model of CE Configuration, Quantitative Study of Frequency Response of CE Amplifier and Multi-stage amplifiers.

Unit-III [12 Hours]

Feedback Amplifiers: Concept of Feedback, Negative and Positive Feedback, Barkhausen Criterion, Types of Feedback Circuits, Advantages and Disadvantages of Negative Feedback, Voltage (Series and Shunt) and Current (Series and Shunt), Feedback Amplifiers, Effect of Negative Feedback on Gain, Input and Output Impedances, Bandwidth and Distortion.

Oscillators (Qualitative Study): Basic concept of oscillation, Hartley Oscillator, Colpitts Oscillator, Phase Shift Oscillator, Wien Bridge Oscillator, Piezoelectric Crystal Oscillator.

Unit-IV [10 Hours]

Power Amplifiers: Difference between Voltage and Power Amplifier, Classification of Power Amplifiers, Class A, Class B, Class C, Class AB and their Comparisons, Operation of Class A Single Ended Power Amplifier, Operation of Transformer Coupled Class A Power Amplifier, Efficiency calculation, Operation of Complementary Symmetry Class B Push Pull Power Amplifier, Crossover Distortion-

Modulation: Qualitative Idea on Modulation.

Unit-V [8 Hours]

Introduction to Power Devices: Need for Semiconductor Power Devices, Power Diodes, Enhancement of Reverse Blocking Capacity.

Silicon Controlled Rectifier (SCR): Structure, Two Transistor Analogy, I-V Characteristics, Turn-On and Turn-Off characteristics, Application.

UJT: Working Principle & Applications.

ANALOG ELECTRONICS I (Practical)

[Credits: 2; Lecture Hours: 60]

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Design and analyze analog circuits.

Experiments:

1. Design of Clipping and Clamping Circuits.
2. Designing and Testing of 5V/9V DC Regulated Power Supply and find its Load Regulation.
3. Designing of a Single Stage CE Amplifier.
4. Study of the Phase Shift Oscillator.
5. Study of the I-V Characteristics of the SCR.

Reference Books:

- Sze, Semiconductor Devices: Physics and Technology, Wiley.
- Streetman and Banerjee, Solid State Electronic Devices, Pearson.
- Neamann and Biswas, Semiconductor Physics and Devices, Tata McGraw Hill.
- Boylestead and Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- Bell, Electronic Devices and Circuits, Oxford.
- Schilling and Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill.
- Millman and Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw Hill.
- Cathey, 2000 Solved Problems in Electronics, Schaum's Outline Series, Tata McGraw Hill.
- Sedra and Smith, Microelectronic Circuits, Oxford.
- Rashid, Electronic Devices and Circuits, Cengage.

MINOR COURSE - 4

Course Name : ANALOG ELECTONICS

Course Code : BSCELCMN401

Course Type: Minor (Theoretical & Practical)	Course Details: MNC-4		L-T-P: 3- 0- 4		
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Design and analyze various analog circuits.
- Analyze circuits with devices for specific applications.

ANALOG ELECTRONICS

[Credits: 3; Lecture Hours: 37]

Unit-I [7 Hours]

Junction Diode and its applications: p-n junction and its properties, Junction diode, forward and reverse biased characteristics, Zener and avalanche breakdown. Use of diode as rectifier, Zener diode as voltage regulator, Varactor Diode, Solar Cell (open circuit voltage & short circuit current).

Unit-II [8 Hours]

Bipolar Junction Transistor: Bipolar Junction Transistor (BJT): p-n-p & n-p-n transistor, transistor operation, CE, CB and CC configurations, Transistor Biasing fundamentals, Input and output characteristics of transistor in CE and CB configurations, Regions of operation, Relations between current gains, dc load line and Q point, operation of transistor as an amplifier and a switch, idea of biasing and stability, Voltage and Power Amplifier, DC and AC Load Line Analysis.

Unit-III [12 Hours]

Feedback Amplifiers: Concept of Feedback, Negative and Positive Feedback, Barkhausen Criterion, idea of oscillation, Types of Feedback Circuits, Advantages and Disadvantages of Negative Feedback, Voltage (Series and Shunt) and Current (Series and Shunt), Feedback Amplifiers, Effect of Negative Feedback on Gain, Input and Output Impedances, Bandwidth and Distortion.

Unit-IV [10 Hours]

Power Amplifiers: Difference between Voltage and Power Amplifier, Classification of Power Amplifiers, Class A, Class B, Class C, Class AB and their Comparisons, Operation of Class A Single Ended Power Amplifier, Operation of Transformer Coupled Class A Power Amplifier.

ANALOG ELECTRONICS (Practical)

[Credits: 2; Lecture Hours: 60]

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Design and analyze analog circuits.

Experiments:

1. Study p-n Junction diode characteristics, to calculate dc and ac resistances.
2. Study Zener diode Characteristics in reverse bias, to determine breakdown voltage and ac resistance at breakdown.

3. Study Transistor input & output characteristics (CE & CB Modes). To determine d.c. & a.c. resistances and current gain.

4. Study voltage regulation using Zener diode.

5. Designing of a Single Stage CE Amplifier.

Reference Books:

- Sze, Semiconductor Devices: Physics and Technology, Wiley.
- Streetman and Banerjee, Solid State Electronic Devices, Pearson.
- Neamann and Biswas, Semiconductor Physics and Devices, Tata McGraw Hill.
- Boylestead and Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- Bell, Electronic Devices and Circuits, Oxford.
- Schilling and Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill.
- Millman and Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw Hill.
- Cathey, 2000 Solved Problems in Electronics, Schaum’s Outline Series, Tata McGraw Hill.
- Sedra and Smith, Microelectronic Circuits, Oxford.
- Rashid, Electronic Devices and Circuits, Cengage.

SKILL ENHANCEMENT COURSE - 3

Course Name : COMMUNICATION LAB

Course Code : BSCELCSE401

Course Type: SE (Practical)	Course Details: SEC-3		L-T-P: 0-0-6		
Credit: 3	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30		20	

Course Learning Outcomes:

(After the completion of course, the students will have ability to):

- Design and analyze various basic analog communication circuits.

COMMUNICATION LAB

[Credits: 3; Lecture Hours: 40]

Hardware and/or Simulation Software Laboratory:

1. Design and/or Study of Amplitude Modulation.
2. Design and/or Study of Amplitude Demodulation.
3. Design and/or Study of Frequency Modulation.
4. Design and/or Study of Frequency Demodulation.

Reference Books:

- Kennedy, Electronic Communication Systems, Tata McGraw Hill.
- Roddy and Coolen, Electronic Communications, Pearson.
- Haykin, Communication Systems, Wiley.
- Lathi and Ding, Modern Digital and Analog Communication Systems, Oxford.
- Frenzel, Principles of Electronic Communication Systems, Tata McGraw Hill.
- Kundu, Analog and Digital Communications, Pearson.
- Couch, Digital and Analog Communication Systems, Pearson.