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**

<table>
<tr><td colspan="2">Course Type: Major (Theoretical & Practical)</td><td colspan="2">Course Details: MJC-1</td><td colspan="2">L-T-P: 3 – 0 – 4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

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 limiton 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

<table>
<tr><td rowspan="2">Course Type: Minor (Theoretical & Practical)</td><td colspan="3" rowspan="2">Course Details: MNC-1</td><td colspan="2" rowspan="2">L-T-P: 3- 0- 4</td></tr>
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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.

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- 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 limiton 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 agraph, 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**

<table>
<tr><td rowspan="2">Course Type: SE (Practical)</td><td colspan="2" rowspan="2">Course Details: SEC-1</td><td colspan="2" rowspan="2">L-T-P: 0-0-6</td></tr>
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<tr><td>30</td><td></td><td>20</td><td></td></tr>
</table>

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

<table>
<tr><td rowspan="2">Course Type: Multi-disciplinary (Theoretical)</td><td rowspan="2" colspan="2">Course Details: MDC-1</td><td rowspan="2">L-T-P: 3 – 0 – 0</td></tr>
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<tr><td></td><td>15</td><td></td><td>35</td></tr>
</table>

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 tomeasure 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. Helfrickand William D. Cooper, Modern Electronics Instrumentation & Measurement Techniques, Pearson Education.
- JosephJ. 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

<table>
<tr><td rowspan="2">Course Type: Major (Theoretical & Practical)</td><td colspan="3" rowspan="2">Course Details: MJC-2</td><td colspan="2" rowspan="2">L-T-P: 3 – 0 – 4</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

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-election 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 ofSchottky 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 offand 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 Ed. 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.

MINOR COURSE - 2

Course Name **: SOLID STATE ELECTRONICS**

Course Code **: BSCELCMN201**

<table>
<tr><td>Course Type: Minor (Theoretical & Practical)</td><td colspan="2">Course Details: MNC-1</td><td colspan="2">L-T-P: 3- 0- 4</td></tr>
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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-election 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

Inputand output characteristics of transistor in CE and CB configurations, Regions of operation (active, cut offand 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.

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- 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.
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- David A. Bell, Electronic Devices and Circuits, 5th Ed. 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.
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- Zbar, Basic Electronics: A Text Lab Manual, TMH.
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- 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**

<table>
<tr><td>Course Type: SE
(Practical)</td><td colspan="2">Course Details: SEC-2</td><td colspan="2">L-T-P: 0-0-6</td></tr>
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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

<table>
<tr><td>Course Type: Multi-disciplinary (Theoretical)</td><td colspan="2">Course Details: MDC-2</td><td colspan="2">L-T-P: 3 – 0 – 0</td></tr>
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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 globalbest 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, 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 & 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**

<table>
<tr><td colspan="2">Course Type: Minor (Theoretical & Practical)</td><td colspan="2">Course Details: MNC-3</td><td colspan="2">L-T-P: 3- 0- 4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

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. Shyammohan, "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

<table>
<tr><td>Course Type: Major (Theoretical & Practical)</td><td colspan="2">Course Details: MJC-6</td><td colspan="2">L-T-P: 3 – 0 – 4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

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

<table>
<tr><td colspan="2">Course Type: SE
(Practical)</td><td colspan="2">Course Details: SEC-3</td><td colspan="2">L-T-P: 0-0-6</td></tr>
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<tr><td>30</td><td></td><td>20</td><td></td></tr>
</table>

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.

SEMESTER- V

MAJOR COURSE - 7

Course Name : ANALOG ELECTONICS II

Course Code : BSCELCMJ501

<table>
<tr><td colspan="2">Course Type: Major (Theoretical & Practical)</td><td colspan="2">Course Details: MJC-7</td><td colspan="2">L-T-P: 3 – 0 – 4</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- Describe the behavior of FET.
- Reproduce the I-V characteristics of FET devices.
- Explain the concepts of feedback amplifiers and tuned amplifiers.
- Gain detailed knowledge about sinusoidal oscillators.
- Emphasis on operational amplifier and its applications such as integrator, differentiator, adder, converter, comparator, Schmitt trigger etc.

ANALOG ELECTRONICS II

[Credits: 3; Lecture Hours: 45]

Unit-I [10 Hours]

Field Effect Transistors: Transverse Field Effect and Channel Isolation, Categories of FETs.

JFET: Construction & characteristics, Channel Formation, Pinch-off and Saturation Voltage.

MOSFET: MOS Capacitor, Channel Formation, Threshold Voltage (Ideal and Real), Current-Voltage Relation, Depletion and Enhancement Type MOSFET, idea of CMOS & NMOS.

MOSFET Circuits: Biasing of MOSFETs, Small Signal Parameters, Common Source Amplifier Circuit Analysis.

Unit-II [15 Hours]

Op-Amp fundamentals & Applications: Block diagram, symbol, characteristics of ideal and practical op-amp. The concept of virtual ground, positive feedback and negative feedback. Offset voltage adjustment range, differential and common mode gain, CMRR, Slew rate, supply voltage rejection ratio. Frequency Response, Inverting, Non-Inverting, Summing and Difference Amplifiers, Integrator, Differentiator, Op-amp as buffer, Voltage to Current and Current to Voltage Convertor.

Comparators: Basic Comparator, Level Detector, Schmitt Trigger.

Unit-III [10 Hours]

Signal Generators using Op-Amp: Phase Shift Oscillator, Wien Bridge Oscillator, Square Wave Generator, Saw Tooth Wave Generator.

Timers Circuits: Multivibrators (IC 555), Functional Block Diagram, Astable and Monostable Multivibrator Circuits and Applications.

Unit-IV [10 Hours]

Fixed and Variable IC Regulators: IC 78xx and IC 79xx (Concepts only), IC LM317.

Analog Active Filters (Qualitative idea): Sample and Hold Systems, Low Pass Filter, High Pass Filters, Band Pass Filter, Band Reject Filter, All Pass Filter, Log and Antilog Amplifiers.

ANALOG ELECTRONICS II (Practical)

[Credits: 2; Lecture Hours: 60]

Course Learning Outcomes:

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

- Design application circuits related to JFET.
- Design an amplifier of given gain for an inverting and non-inverting configuration using an Op -Amp.
- Design analog adder and subtractor circuit.

- Design an integrator using op-amp for a given specification and study its frequency response.
- Design a differentiator using op-amp for a given specification and study its frequency response.

Hardware Laboratory (Any 8 of the following)

[Credits: 2; Lecture Hours: 60]

1. Study of the I-V Characteristics of JFET.
2. Designing of an Amplifier of given Gain for an Inverting and Non-Inverting Configuration using an Op-Amp
3. Designing of Analog Adder and Subtractor Circuit.
4. Designing of an Integrator using Op-Amp for a given Specification and Study its Frequency Response.
5. Designing of a Differentiator using Op-Amp for a given Specification and Study its Frequency Response.
6. Design of Buffer circuit using Op-Amp.
7. Designing of active Low-Pass Filter using Op-Amp.
8. Designing of active High-Pass Filter using Op-Amp.
9. Study of IC 555 as Astable Multivibrator.
10. Study of IC Voltage Regulators using 78 Series and 79 Series.

Reference Books:

- Boylestead and Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- Sedra and Smith, Microelectronic Circuits, Oxford.
- Millman and Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw Hill.
- Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson.
- Coughlin and Driscoll, Operational Amplifiers and Linear Integrated Circuits, Pearson.
- D. Chattopadhyay & P.C. Rakshit, Electronics Fundamentals & Applications, New Age International Publishers.
- B. Ghosh, Fundamental Principles of Electronics, Books & Allied (P) Ltd.
- Malvino, Electronic Principals, Tata McGraw-Hill.
- Bel, Operational Amplifiers and Linear ICs, Oxford.

MAJOR COURSE - 8

Course Name : DIGITAL ELECTRONICS I

Course Code : BSCELCMJ502

<table>
<tr><td colspan="2">Course Type: Major (Theoretical & Practical)</td><td colspan="2">Course Details: MJC-8</td><td colspan="2">L-T-P: 3 – 0 – 4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- Understand and represent numbers in powers of base and converting one from the other.
- Carry out arithmetic operations using number systems.
- Understand basic logic gates.
- Understand concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions.
- Analyze and design combinational as well as sequential circuits.

DIGITAL ELECTRONICS I

[Credits: 3; Lecture Hours: 45]

Unit-I [15 Hours]

Number System and Codes: Decimal, Binary, Hexadecimal and Octal Number Systems, Base Conversions and Arithmetic (Addition, Subtraction by Complement Method, Multiplication), Representation of Signed and Unsigned Numbers, Weighted and Non-weighted Codes.

Logic Gates and Boolean Algebra: Basic Postulates and Fundamental Theorems of Boolean Algebra, Switching Equivalent Circuits of Basic Gates, Truth Tables and Symbolic Representation of OR, AND, NOT, NAND, NOR, XOR, XNOR Gates, Universal Logic Gates, Circuit Representation using Universal Logic Gates.

Unit-II [10 Hours]

Combinational Logic Analysis: Standard Representation of Logic Functions (SOP and POS),

Karnaugh Map Minimization, Multiplexers and Demultiplexers, Encoder and Decoder, Implementation of Logic Functions with Multiplexer, De-multiplexer, Half & Full Adder and Subtractor, Comparator.

Unit-III [10 Hours]

Sequential Logic : Latches and Flip Flops(S-R, J-K, Master Slave, D,T), Registers, Counters, State Table, State Diagrams.

Unit-IV [10 Hours]

Memory (Qualitative study): Memory Technology, Types of Memory, Volatile and Non-Volatile, ROM, RAM, Concept of Primary, Secondary and Cache Memory.

DIGITAL ELECTRONICS I (Practical)

[Credits: 2; Lecture Hours: 60]

Course Learning Outcomes:

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

- Design and study the Logic Gates.
- Design complex digital logic circuits using universal gates.
- Design and study combinational and sequential circuits.

Hardware Laboratory

1. To verify basic logic gates and universal gates.
2. To verify and design basic logic gates using Universal gates.
3. To design and realize a Boolean Expression using Logic Gates.
4. Design Half and Full Adder.
5. Design Half and Full Subtractor.
6. Design 4 × 1 Multiplexer using Gates.
7. To Build Flip-Flop Circuits (RS, Clocked RS, D-type) using Elementary Gates.

Software Simulation Lab (Optional)

Experiments in VHDL (Circuit Simulation)

1. Write Code to Realize Basic and Derived Logic Gates.
2. Half Adder and Full Adder using Basic and Derived Gates.
3. Half Subtractor and Full Subtractor using Basic and Derived Gates.
4. Clocked D FF, T FF and JK FF (with Reset Inputs).
5. Multiplexer (4×1) and Demultiplexer using Logic Gates.

Reference Books:

• Mano and Cileti, Digital Design: With an Introduction to Verilog HDL, Pearson.

• Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw Hill.

• Flyod, Digital Fundamentals, Pearson.

• Raychaudhuri, Digital Circuits, Vol. 1&2, Platinum.

• Gothmann, Digital Electronics: An Introduction to Theory and Practice, PHI.

• Salivahanan and Kumar, Digital Circuits and Design, Vikas.

• Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson.

• Pedroni, Circuit Design and Simulation with VHDL, PHI.

• Bhasker, A VHDL Primer, Pearson.

MAJOR COURSE - 9

Course Name : **ANALOG COMMUNICATION**

Course Code : BSCELCMJ503

<table>
<tr><td>Course Type: Major (Theoretical & Tutorial)</td><td colspan="2">Course Details: MJC-9</td><td colspan="2">L-T-P: 4 – 1 – 0</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td></td><td>30</td><td></td><td>70</td></tr>
</table>

Course Learning Outcomes:

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

- Understand the basic concepts of a communication system.
- Understand transmission techniques.
- Understand baseband pulse modulation.

ANALOG COMMUNICATION

[Credits: 4; Lecture Hours: 60]

Unit-I [15 Hours]

Electronic Communication: Block Diagram of an Electronic Communication System, Electromagnetic Spectrum, Need for Modulation, Concept of Channels and Base-Band Signals, Concept of Noise,

Types of Noise, Signal to Noise Ratio.

Unit-II [20 Hours]

Amplitude Modulation: Amplitude Modulation, Modulation Index and Frequency Spectrum, Generation of AM (Linear), Amplitude Demodulation (Diode Detector), Concept of Double Side Band

Suppressed Carrier (DSBC), Single Side Band Suppressed Carrier (SSBC) (Balanced Modulation),

Block Diagram of AM Transmitter and Receiver (Super Heterodyne Receiver, Advantages over TRF,

utility of Heterodyning).

Unit-III [15 Hours]

Angle Modulation: Frequency and Phase Modulation, Modulation Index and Frequency Spectrum, Equivalence between

FM and PM, Generation of FM (Direct and Indirect Methods), Block Diagram of FM Transmitter and

Receiver, Comparison among AM, FM and PM, Conversion from FM to PM and vice-versa.

Unit-IV [10 Hours]

Pulse Analog Modulation (Qualitative Idea): Channel Capacity, Sampling Theorem, PAM, PDM, PPM Modulation and Detection Techniques, Multiplexing, TDM and FDM.

ANALOG COMMUNICATION (Tutorial)

[Credits: 1; Lecture Hours: 15]

Course Learning Outcomes:

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

- Solve complex problems based on analog communication.

ANALOG COMMUNICATION Tutorial

- Solve various problems based on topics covered during the course.

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.

- Dr. Sanjay Sharma, Analog Communication Systems, Katson Books.

- Bel, Operational Amplifiers and Linear ICs, Oxford.

MINOR COURSE - 5

Course Name **: DIGITAL ELECTRONICS**

Course Code **:** BSCELCMN501

<table>
<tr><td>Course Type: Major (Theoretical & Practical)</td><td colspan="2">Course Details: MNC-5</td><td colspan="2">L-T-P: 3 – 0 – 4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- Understand and represent numbers in powers of base and converting one from the other.
- Carry out arithmetic operations using number systems.
- Understand basic logic gates.
- Understand concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions.
- Analyze and design combinational as well as sequential circuits.

DIGITAL ELECTRONICS

[Credits: 3; Lecture Hours: 45]

Unit-I [20 Hours]

Number System and Codes: Decimal, Binary, Hexadecimal and Octal Number Systems, Base Conversions and Arithmetic (Addition, Subtraction by Complement Method, Multiplication), Representation of Signed and Unsigned Numbers, Weighted and Non-weighted Codes.

Logic Gates and Boolean Algebra: Basic Postulates and Fundamental Theorems of Boolean Algebra, Switching Equivalent Circuits of Basic Gates, Truth Tables and Symbolic Representation of OR, AND, NOT, NAND, NOR, XOR, XNOR Gates, Universal Logic Gates, Circuit Representation using Universal Logic Gates.

Unit-II [15 Hours]

Combinational Logic Analysis: Standard Representation of Logic Functions (SOP and POS),

Karnaugh Map Minimization, Multiplexers and Demultiplexers, Encoder and Decoder, Implementation of Logic Functions with Multiplexer, De-multiplexer, Half & Full Adder, Comparator.

Unit-III [10 Hours]

Sequential Logic: Latches and Flip Flops (S-R, J-K, Master Slave, D, T), State Table, State Diagrams.

DIGITAL ELECTRONICS I (Practical)

[Credits: 2; Lecture Hours: 60]

Course Learning Outcomes:

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

- Design and study the Logic Gates.
- Design complex digital logic circuits using universal gates.
- Design and study combinational and sequential circuits.

Hardware Laboratory

1. To verify basic logic gates and universal gates.
2. To verify and design basic logic gates using Universal gates.
3. To design and realize a Boolean Expression using Logic Gates.
4. Design Half Adder.

Reference Books:

• Mano and Cileti, Digital Design: With an Introduction to Verilog HDL, Pearson.

• Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw Hill.

• Flyod, Digital Fundamentals, Pearson.

• Raychaudhuri, Digital Circuits, Vol. 1&2, Platinum.

• Gothmann, Digital Electronics: An Introduction to Theory and Practice, PHI.

• Salivahanan and Kumar, Digital Circuits and Design, Vikas.

SEMESTER- VI

MAJOR COURSE - 10

Course Name **: DIGITAL ELECTRONICS II**

Course Code **:** BSCELCMJ601

Course Type: **Major (Theoretical & Practical)**	Course Details: **MJC-10**		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:

- Proficiency of CMOS logic circuits.
- Learn about the internal architecture of microprocessor, microcontroller and functions of each functional blocks of these
- Learn to solve basic binary arithmetic and logical operations using microprocessor 8085
- Learn about embedded system programming.

DIGITAL ELECTRONICS II

[Credits: 3; Lecture Hours: 45]

Unit-I [7 Hours]

A-D and D-A Conversion: Circuit and Working of 4 Bit Binary Weighted Resistor Type and R-2R Ladder Type D-A Conversion, Circuit of A-D Conversion, Characteristics.

Unit-II [10 Hours]

CMOS Logic Circuits: General CMOS logic structure, VTC of inverter, noise margin, Different types of inverter (enhancement and depletion n-MOS load and CMOS), Switching, NAND, NOR.

Unit-III [18 Hours]

Microprocessors 8085 and 8086- Pin description, memory, data structure/ access. Overview of microcomputer systems and their building blocks, concepts of interrupts, instruction sets of microprocessors (with examples of 8085/and 8086).

Unit-IV [10 Hours]

Embedded Software: Programming concept in ALP (assembly language programming) and High level

language-C, Processor directives, functions and macros and other programming elements, Embedded C++ concept only.

DIGITAL ELECTRONICS II (Practical)

[Credits: 2; Lecture Hours: 60]

Course Learning Outcomes:

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

- Learn to write ALP.

Hardware Lab

Write an Assembly Language Programme in 8085 to perform the following:

1. Program to Transfer a Block of Data.
2. Program for 8-bit Addition & Subtraction.
3. Program to Multiply Two 8 Bit Numbers.

4. Program to Search a given Number in a given List.

5. Program to find Minimum and Maximum among N Numbers.

6. Program to Sort Numbers in Ascending/Descending Order.

Reference Books

- Kang, eblebici and Kim, CMOS Digital Integrated Circuit: Analysis and Design, Tata McGraw Hill.
- Rabey, Chandrakasan and Nikolic, Digital Integrated Circuits: A Design perspective, Pearson.
- Weste and Eshraghian, Principles of CMOS VLSI Design: A System Perspective, Addison Wesley.
- Pucknell and Eshraghian, Basic VLSI Design, PHI.
- R. Jacob Baker, Harry W. Li, David E. Boyce, CMOS Circuit Design, PHI,2003.
- Ajay V. Deshmukh, Microcontrollers Theory and Application, TMH, 2011.
- Embedded Systems: Architecture, Programming & Design, Raj Kamal, TMH, 2011 319
- Embedded System Design: A unified Hardware/ Software Introduction, by Frank Vahid, Willey, 2011.
- R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A,Penram International Publishing, 1996
- B. Ram, Fundamentals of Microprocessors and Microcontrollers, Dhanpat Rai Publications.
- Keneth Ayala, keneth. J. Ayala- The 8086 Microprocessor: Programming

and interfacing the PC-West Pub.

MAJOR COURSE - 11

Course Name : **OPTOELECTRONIC DEVICES**

Course Code : BSCELCMJ602

Course Type: **Major (Theoretical & Tutorial)**	Course Details: **MJC-11**		L-T-P: **4 – 1 – 0**	
Credit: **5**	Full Marks: **100**	CA Marks	ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			30		**70**

Course Learning Outcomes:

Deeper understanding of the fundamental theories, characterization and applications of novel optoelectronic devices.

OPTOELECTRONIC DEVICES

[Credits: 4; Lecture Hours: 60]

Unit-I [15 Hours]

Optoelectronic materials & properties: Semiconductors, compound semiconductors, III-V and II-VI compounds, Direct and indirect band gap, electronic properties of semiconductors, Fermi level, density of states, life time and mobility of carriers, invariance of Fermi level at equilibrium, diffusion, continuity equation, Quasi-Fermi levels.

Unit-II [17 Hours]

Optical device & properties: theory of recombination, radiative and non-radiative, absorption edge, photoconductivity, light emitting diodes, LED, device configuration and efficiency, LED structures, light current characteristics and device performance, frequency response and modulation band width, Blue LED, White light.

Unit-III [12 Hours]

Laser diodes: basic concepts, heterojunction and injection lasers, output characteristics.

Unit-IV [16 Hours]

Photodiode & Solar cells: performance criteria of a photodiode, quantum efficiency (Qualitative idea), responsivity, photoconductors, PIN diodes.

Solar cell-and their properties. quantum efficiency - measurements of solar cell parameters; I-V curve.

OPTOELECTRONIC DEVICES (Tutorial)

[Credits: 1; Lecture Hours: 15]

Course Learning Outcomes:

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

- Proficiency in calculation of optoelectronic device parameters

OPTOELECTRONIC DEVICES (Tutorial)

- Practice sums related to the course employing standard simulation software.

REFERENCES

• Amnon Yariv, Optical Electronics, Holt Rine hart & Winston, Philadelphia, 1991

• Ben G. Streetmann & Sanjay Banerjee, Solid State Electronic Devices, 5thEdn, 2000.

• Bhattacharya P., Semiconductor Optoelectronic Devices, PHI, New Delhi.1995

• Martin A. Green, Solar Cells: Operating principles, Technology and System Applications, Prentice-Hall Inc, Englewood Cliffs, NJ, USA, 1981

• Bahaa E. A Saleh & Malvin Carl Teich, Fundamentals of Photonics, John Wiley & Sons, 1991

• Ghatak A. and Thyagarajan K., Optical Electronics, Cambridge University Press, New Delhi, 1994.

• Joachim Piprek, Semiconductor Optoelectronic Devices, Academic Press, 2003

• R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004

• Rampal V.V., Photonics Elements and Devices, Wheeler, Allahabad,1992.

MAJOR COURSE - 12

Course Name **: CONTROL SYSTEM**

Course Code **:** BSCELCMJ603

<table>
<tr><td>Course Type: Major (Theoretical & Tutorial)</td><td colspan="2">Course Details: MJC-12</td><td colspan="2">L-T-P: 4 – 1 – 0</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td></td><td>30</td><td></td><td>70</td></tr>
</table>

Course Learning Outcomes:

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

- Learn about basic components of a control systems, real life examples of control system
- Learn about open loop system, close loop system and understand the effect of feedback in control system on parameters like gain, sensitivity, noise of the system
- Explain the transient performance of a system using time domain analysis
- Explain the nature of stability, steady state error of a control system from frequency domain analysis for standard inputs

OPTOELECTRONIC DEVICES

[Credits: 4; Lecture Hours: 60]

Unit-I [20 Hours]

Introduction to Control Systems: Open Loop and Closed Loop Control Systems, Transfer Function, Block Diagram Representation and Signal Flow Graph, Reduction Technique, Mason's Gain Formula, Effect of Feedback on Control Systems.

Unit-II [20 Hours]

Time Domain Analysis: Time Domain Performance Criteria, Transient Response of Systems, Steady State Errors and Static Error Constants.

Concept of Stability: Routh-Hurwitz Criterion, Relative Stability Analysis, Idea of Root Locus Plots and Applications.

Unit-III [20 Hours]

State Space Analysis: Definitions of State, State Variables, State Space, Representation of Systems, Solution of Time Invariant, Homogeneous State Equation, Concept of Compensation, Lag, Lead and Lag-Lead Networks.

CONTROL SYSTEM (Tutorial)

[Credits: 1; Lecture Hours: 15]

Course Learning Outcomes:

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

- Proficiency in understanding concepts of control systems.

CONTROL SYSTEM (Tutorial)

- Practice sums related to the course employing standard simulation software.

REFERENCES

• Nagrath and Gopal, Control System Engineering, New Age.

• Ogata, Modern Control Engineering, Pearson.

• Golnaraghi and Kuo, Automatic Control System, Wiley.

• Anand Kumar, Control Systems, PHI.

• Venkatesh and Rao, Control Systems, Cengage.

MAJOR COURSE - 13

Course Name **: OPTICAL COMMUNICATION**

Course Code **:** BSCELCMJ604

Course Type: **Major**	Course Details: **MJC-13**	L-T-P: **4 – 1 – 0**

(Theoretical & Tutorial)					
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:

- Learn about wave propagation.
- Identify the types of optoelectronics devices and explain their characteristics and working principle.
- Learn basic of optical sources, modes in optical fibers, LED, etc.
- Learn principle of operation of WDM networks.

OPTICAL COMMUNICATION

[Credits: 4; Lecture Hours: 60]

Unit-I [10]

Introduction to vector nature of light, propagation of light (reflection and refraction), propagation of light in a cylindrical dielectric rod, ray and wave model (Qualitative idea).

Unit-II [15]

Material and construction of optical fiber, Different types of optical fibers, Step-index and graded-index optical fiber, Causes and effects of dispersion and attenuation in optical fiber.

Unit-III [20]

Optical sources (Qualitative idea) - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, optical receivers.

Optical switches - coupled mode analysis of directional couplers, electro optic switches.

Optical amplifiers (Qualitative idea) - EDFA, Raman amplifier. WDM and DWDM systems.

Unit-IV [15]

Principles of WDM networks. Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity, and dispersion.

OPTICAL COMMUNICATION (Tutorial)

[Credits: 1; Lecture Hours: 15]

Course Learning Outcomes:

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

- Proficiency in understanding concepts of optical communication.

OPTICAL COMMUNICATION (Tutorial)

- Practice sums related to the course employing standard simulation software.

Reference Books:

- A. Ghatak, K. Thyagarajan, Introduction to fiber optics, Cambridge University Press.
- J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
- T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-

Verlag, 1975.

- J. Gowar, Optical communication systems, Prentice Hall India, 1987.
- S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
- G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
- G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997
- F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).