Syllabus

For

B.Sc. (Honours) Electronics

Submitted to

KAZI NAZRUL UNIVERSITY

Under

Choice Based Credit System
(From Session 2019-2020)

Department of Electronics
Kazi Nazrul University
Asansol, Burdwan, W.B.

Semester-I

Course Name: Mathematical Methods -I and Solid State Electronics -I
Course Code: BSCHELCC101

Course Type: **Core (Theoretical)**	Course details: **CC-1**			L-T-P: **5-1-0**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Able to solve all the related problems.
- Able to solve industrially applicable problems.
- Able to understand fundamentals of Electrodynamics and semiconductor physics
- Get an exposure to modern physics topics like Electron Transport in Semiconductor, Semiconductor Device

Content/Syllabus:

Mathematical Methods-I

Vector Analysis

Basic operations vector addition and subtraction, Product of Vectors – Scalar (dot) & Vector (cross), important identities, Cartesian, Cylindrical and Spherical co-ordinates, Differentiation and integration of vectors, gradient, Divergence, Curl, Gauss', Stokes, and Green's theorems.

Differential Equation

Solutions of homogeneous and inhomogeneous (first and second order) equations – constant and variable coefficients, Power series solution, illustration by Bessel, Special Partial differential equation, solution by separation of variables, Laplace transformation technique of solving differential equation

Fourier Series

Set of functions – linear independence and completeness, Fourier's Theorem, Analysis of simple waveforms using Fourier series, Fourier Transform (Idea only).

Text and References:

Mathematical Methods: Vector analysis, Spiegel - TMH
Higher Engineering Mathematics - B S Grewal, Khanna pub.
Advanced Engineering Mathematics, Kreyszig, John Wiley
Mathematical methods for physicists, Weber and Arfken , and Harris, Elsevier.
Mathematical Physics, Ghatak, Goyal and Chua, Macmillan
Mathematical Methods, M.C. Potter and J. Goldberg, PHI

Solid State Electronics-I

Classification of solids as metals, insulators and semiconductor, intrinsic and extrinsic semiconductor, degenerate and non-degenerate, direct and indirect band gap, drift and diffusion process, elemental and compound semiconductors, donor and acceptor, ionization energy of impurity semiconductor, Fermi–Dirac Statics and electron distribution in solids, Density of states and Fermi energy, Fermi distribution function, Electron scattering and source of resistance in metals, Variation resistivity with temperature and pressure, Schottky effect.

Photoconduction in semiconductors.

Semiconductor diodes - Band structure, Majority and minority carriers, Junction formation, Laws of Junction, Einstein relation,V-I Characteristics, junction capacitance, breakdown phenomena,Clipper and Clamper circuit, Voltage doubler, Diode as rectifier with and without filter (Half and Full wave), Zener diode, load and line regulations, regulated power supply.

Text and References:

Introduction to Solid State Physics, C.Kittel, John Wiley
Integrated Electronics, Millman and Halkias , TMH
Foundations of Electronics ,Chattopadhyay and Rakshit, New Age
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson
Basic Electronics & Linear Circuits, Bhargava, Kulashretha Gupta, TMH
Solid State electronic devices, Streetman & Banerjee, PHI
Solid State Electronic Devices- 2nd Edition, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.
Semiconductor Devices, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Course Name: Classical Mechanics & Thermal and Statistical Physics

Course Code: BSCHELCC102

Course Type: **Core (Theoretical)**	Course details: **CC-2**			L-T-P: **5-1-0**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- After successfully completed course, student will be able to define and understand basic mechanical concepts related to discrete and continuous mechanical systems.
- After successfully completed course, student will be able to describe and understand the vibrations of discrete and continuous mechanical systems.
- Identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, and partition functions.
- Use the statistical physics methods, such as Boltzmann distribution, Gibbs distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in some physical systems.

Content/Syllabus:

Classical Mechanics

Mechanics of single particle: Tangential and normal components of velocity and acceleration, radial and cross radial components, Time and path integral of force, work, energy, forces, potential, conservative and non-conservative forces, conservation laws, Motion under different types of forces.

Mechanics of system of particles:Center of mass and its motion, Simple collision problems, Linear momentum, angular momentum, torque of system of particles, Energy of system of particles, conservation laws.

Rotational motion: Conservation of angular momentum, Moment of inertia, radius of gyration, energy of rotating bodies, Central force, Kepler’s laws of planetary motion.

Kinetic Theory of Gases: Maxwell's law of velocity distribution, Mean free path and equipartition theorem, Degrees of freedom, Generalized Co-ordinates, Generalized motion, Variational Principle and Lagrangian formulation, Conservative and non conservative systems, Hamiltonian variational principal, Concept of Lagrange and equation of motion, Hamiltonian formulation of Mechanics, Phase space.

Text and References:

Introduction to Classical Mechanics, Takwale and Puranik ,TMH
Classical Mechanics, Goldstein, Pearson
Theoretical Mechanics, Spiegel, TMH
Mechanics: Berkeley Physics Course, Vol-1, Berkeley, TMH
Mechanics-R K Shukla and Srivastava, New Age International

Thermal& Statistical Physics

Thermal Physics

Heat conduction in solids, Conductivity and diffusivity, Steady state solution of one-dimensional and three dimensional, heat flow equation, Heat flow in spherical and cylindrical geometry,Ingen-Hausz experiment, Periodic flow of heat in one dimension, Wiedemann-Franz law.

First law of thermodynamics and its applications, Equipartition of energy, Mean free path, Reversible and Irreversible processes, Isothermal and adiabatic changes, Carnot's cycle, Second law of thermodynamics, Entropy, Enthalpy, Joule-Thomson effect, Gibb's paradox, T-S diagrams.

Statistical Mechanics

Macro and Micro states: thermodynamic probability, MB, BE and FD statistics, Classical limit of quantum statistics, Application of statistical mechanics of Plank's law, Rayleigh-Jean's law, Wien's law.

Text and References:

Thermal Physics-Zimensky, TMH.
A treatise on Heat, Saha&srivastava, The India press.
Thermal Physics, A P Gupta & H P Roy, Books& allied Pub
Fundamentals of Statistical and thermal physics , Reif, Waveland Press.
Statistical Mechanics , Agarwal, B K , Eisner, M. , *New Age.*
Fundamentals of Statistical Mechanics ,B B Laud, New Age.
Statistical Mechanics ,Pathria and Beale ,Academic Press.

Interdisciplinary/Generic Elective (G.E.) for Other Departments

Course Name: Basic Electronics

Course Code: BSCHELCGE101

Course Type: **GE (Theoretical)**	Course details: **GE-1**			L-T-P: **5-1-0**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Demonstrate and explain electrical components, electrical circuits and DC network theorems
- Apply the knowledge of series, parallel and electromagnetic circuits.
- 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 pn junction diodes, Zener diode, Varactor diode, BJT, rectifiers and different diode circuits.
- Compute different parameters for characterizing different circuits like rectifiers, regulators etc. using diodes and BJTs.

Content/Syllabus:

GE - I: Basic Electronics

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, Bisection theorem, Image impedance, T to Π and Π to T transformations.

Direct currents: Growth and decay of current in LR circuit, charging and discharging of capacitors in CR and LCR Circuits, oscillation, discharge, time constant, measurement of high resistance, energy stored in inductance, induction coil, Ballistic Galvanometer, Problems on transients.
Alternating currents: LR, CR and LCR circuits in sinusoidal application of imaginary operator.
Structure and characteristics of p-n junction diode, breakdown in junction diodes, Zener diode.

Bipolar Junction Transistor (BJT): Current flow mechanism, Current components, Ebers- Moll Model, Transistor as two port network, Z, Y and h parameters, CE, CB and CC configurations, comparison and their equivalent circuits, Determination of h-parameters from static characteristics, Transistor Biasing.

References:

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

Course Name: Sensors and Transducers

Course Code: BSCHELCGE102

Course Type: **GE (Theoretical)**	Course details: **GE-1**			L-T-P: **5-1-0**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Use concepts in common methods for converting a physical parameter into an electrical quantity
- Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light.
- Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.
- Predict correctly the expected performance of various sensors
- Locate different type of sensors used in real life applications and paraphrase their importance

Content/Syllabus:

Definition of sensors/ transducers, sensing principles, physical and chemical transduction principles, classification. Basic characteristics of sensors – static and dynamic characteristics.

Characterization of sensors: electrical, mechanical, thermal, optical/biological characterization, castrophic failure of sensor, the buth-tub curve.

Mechanical and electromechanical sensors: resistive potentiometers, strain gauge, strain gauge materials and their properties, semiconductor strain gauges, inductive sensor, sensitivity and linearity of the sensor, electromagnetic transducer, magnetostrictive transducers, capacitive sensors, electrostatic transducer, Tachometer.

Piezo-electric crystals, piezo-electric materials, deformation modes and multimorphs, the PZT family, stress tensors using quartz resonators, ultrasonic sensors.

Electroanalytical sensors: electrochemical cell, sensor electrodes – metal electrodes and membrane electrodes. Electroceramic in gas media: Zircomia, NASICON, β-alumina, titania (TiO_2), smart sensors (idea only).

Recent trends in sensor technologies: introduction, film sensors, microelectromechanical systems (MEMS), nano sensors.

Sensor – their applications, Home appliance sensor, sensor for manufacturing medical diagnostic sensor, sensor for environmental monitoring.

References:

Sensors and Transducers (2nd Edn), D. Patranabi, PHI Learning Pvt. Ltd., New Delhi 2009.
Transducers and Instrumentation (2nd Edn), DVS Murty, PHI Learning Pvt. Ltd., New Delhi 2009.
Electrical engineering materials and electronic components, K.B. Raina, S.K. Bhattacharya, T. Joneja, S.K. Kataria& Sons, Delhi 2010.
Electrical engineering materials, A.J. Dekker, PHI Learning Pvt. Ltd., New Delhi 2010.

Semester-II

Course Name: Electromagnetics

Course Code : BSCHELCC201

Course type**: Core (Theoretical)**	Course details: **CC-3**			L-T-P : **5-1-0**	
Credit: **6**	Full marks:	CA Marks		ESE Marks	
	50	Practical	Theoretical	Practical	Theoretical
		……..	**10**	**……..**	**40**

Course Learning Outcomes:

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

- Learn about effects of both Electrostatic and magnetic fields.
- Learn basic laws of electromagnetism**.**
- Solve Laplace's equation.
- Solve all the related problems.
- Learn about physical interpretation Maxwell's equation and solve problems in different media.
- Understand the propagation of an electromagnetic wave.

Content/ Syllabus:

Electromagnetics

Fundamental relations of the electrostatics field, Gauss law, Potential function, Equipotential Surfaces, Divergence theorem, Poisson's equation and Laplace equation, electric dipoles, Capacitance, Electrostatics Energy.

Theories of the Magnetic Field, Biot-Savart's law, Magnetic flux density, Electromagnetic Induction, Faraday's laws, motional emf, self and mutual inductance.

Permeability, Energy stored in Magnetic Field, Magnetic vector potential, Analogies between Electric and Magnetic field.

Maxwell's Equations: Displacement current, Maxwell's equations in differential and integral forms , Poynting vector, Plane electromagnetic waves, wave equations in isotropic dielectrics and in conducting media, attenuation constants , reflection and refraction of plane waves at the boundary of two dielectrics.

Waveguides: Propagation of waves in two parallel conducting plates, modes of waves, propagation of waves in rectangular cavity, resonator, Half wave antenna.

Rayleigh scattering and Thompson scattering, examples of these scatterings.

References:
Electricity and Magnetism, Rakshit & Chattapadhyay, Books& Allied Pub .
Electricity and Magnetism, B Ghosh, Books& Allied Pub.
Electricity and Magnetism, D C Tayal , Books& Allied Pub.
Introduction to Electrodynamics, D.J. Griffiths, PHI.

Course Name: Network Analysis and Circuit Theory

Course Code: BSCHELCC202

Course type**: Core** **(Theory + Practical)**	Course details: **CC-4**			L-T-P : **4-0-4**	
Credit: **6**	Full marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

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

- Understand DC transient analysis.
- Solve Problems of transients.
- Understand AC circuit analysis.
- Study basic circuit concepts in a systematic manner suitable for analysis and design.
- Analyze the electrical circuit using network theorems.
- Understand the two port network parameters.

Content/ Syllabus:

Network Analysis and Circuit Theory

DC Transient Analysis: Growth and decay of currents inRL circuit, RC Circuit- Charging and discharging with initial charge, DC Response of Series RLC Circuits, S

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, Power in AC Circuits, Instantaneous Power, Average Power, Reactive Power, Power Factor.
Energy stored in inductance, induction coil, Ballistic Galvanometer ,Transformer - construction, equivalent circuit simple problems.
Sinusoidal Circuit Analysis for RL, RC and RLC Circuits, Resonance in Series and Parallel RLC Circuits, Frequency Response, Quality Factor(Q) and Bandwidth, Selectivity.
Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.

Electronic Network: 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, Bisection theorem, Image impedance, T to Π and Π to T transformations.
Generalized Wheat-stone bridge , Anderson bridge, Maxwell's bridge, Schering bridge, Wien bridge, simple problems.
Transmission lines: Line equation, Characteristic impedance and propagation constant.

Text and References:
A Text book on electrical Technology Vol-1, BL Theraja& R K Theraja. S. Chand.
Network analysis, Van Valkenburg, Pearson.
Integrated Electronics,Millman and Halkias, TMH.
Electronic Circuits, Schilling and Belove, TMH.
Electronic Devices and Circuits, Salivahanan, TMH .
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson.
Basic Electronics Engineering, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.
Basic Electrical and Electronics Engineering – Vols.1 & 2, Jyoti Prasad Bandyopadhyay , Vikas Publishing House Pvt. Ltd.
Electric Circuits and Electron Devices By Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Network Analysis and Circuit Theory (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.
- Measure self-inductance by Anderson bridge.
- Measure magnetic flux by using a search coil and a Ballistic Galvanometer.
- Investigate inductance in ac circuits.

- Verify the current voltage relationship for an inductance in a.c.circuit and hence measure the value of the inductance.
- To measure the reactance of an inductance coil in LCR circuit.
- Study the variation of reactance of an inductive coil with frequency of the a.c. source and hence to measure its inductance
- Investigate capacitance in an alternating current circuit – To measure the reactance and loss factor of a Capacitor of a C-R circuit.
- Study the variation of reactance of a capacitor with frequency of the alternating current source and hence to measure the capacitance.
- Draw resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.

Content/ Syllabus:

Network Analysis and Circuit Theory (Practical), Lab – I

1. Verification of network theorems using resistive networks and D.C. sources -
a) Thevenin's theorem,
b) Norton's theorem,
b) Superposition theorem.
c) Maximum power transfer theorem.

2. Measurement of self-inductance by Anderson bridge. Determination of mutual inductance of two coils in series and estimation of the coefficient of coupling.

3. To Measure of magnetic flux by using a search coil and a Ballistic Galvanometer.

4. Investigation of inductance in ac circuits
i) to verify the current voltage relationship for an inductance in a.c.circuit and hence measure the value of the inductance.
ii) to measure the reactance of an inductance coil in LCR circuit
iii) to study the variation of reactance of an inductive coil withfrequency of the a.c. source and hence to measure its inductance.

5. i) Investigation of capacitance in an alternating current circuit – To measure the reactance and loss factor of a Capacitor of a C-R circuit.
ii) to study the variation of reactance of a capacitor with frequency of the alternating current source and hence to measure the capacitance.

6. To draw resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.

References:
Basic Electronics: A Text Lab Manual, Zbar, TMH.

Laboratory Manual for Electronic Devices and Circuits, Bell, PHI .
Laboratory Manual for Electric Circuits , Bell, PHI.
Electric Circuits: Schaum's Outlines, J. Edminister and M. Nahvi, TMH.
Practical Physics,Rakshit and Chattopadhyay.
Advanced Practical Physics, Volume II, B. Ghosh, New Central Book Agency.
Basic Electronics Engineering , Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.
Basic Electrical and Electronics Engineering, Vols.1 &2, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Interdisciplinary/Generic Elective (G.E.) to be taken by other Departments. (Any one of the following)

Course Name: Circuit Theory
Course Code: BSCHELCGE201

Course type**: GE(Theoretical)**	Course details: **GEC-2**			L-T-P : **5-1-0**	
Credit: **6**	Full marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		……..	**10**	**……..**	**40**

Course Learning Outcomes:

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

- Understand DC transient analysis.
- Solve Problems of transients.
- Understand AC circuit analysis.
- Study basic circuit concepts in a systematic manner suitable for analysis and design.
- Analyze the electrical circuit using network theorems.
- Understand the two port network parameters.

Content/ Syllabus:

GE – II: Circuit Theory

DC Transient Analysis:RC circuit-charging and discharging with initial charge, DC response of series RL and RLC circuits,Problems on transients.

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, Power in AC Circuits, Instantaneous Power, Average Power, Reactive Power, PowerFactor.
Alternating current: LR, CR and LCR circuits in sinusoidal application of imaginary operator, phase diagram, power factor, series and parallel resonant circuits, Q-factor, selectivity, Sinusoidal circuit analysis for RL, RC and RLC Circuits, Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits,Quality Factor(Q) and Bandwidth.

Energy stored in inductance, induction coil, Ballistic Galvanometer, Transformer - construction, equivalent circuit, simple problems.
Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.

Electronic Network: 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.

Text and References:

A Text book on electrical Technology Vol-1, BL Theraja& R K Theraja. S. Chand.
Network analysis, Van Valkenburg, Pearson Integrated Electronics.
Millman and Halkias , TMH.
Electronic Circuits, Schilling and Belove, TMH.
Electronic Devices and Circuits, Salivahanan, TMH .
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson.

Course type**: GE(Theoretical)**	Course details: **GEC-2**		L-T-P : **5-1-0**	
Credit: **6**	Full marks: **50**	CA Marks	ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		……..	**10**	**……..**	**40**

Course Name: Electronic Measurements
Course Code: BSCHELCGE202

Course Learning Outcomes:

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

- Learn about qualities of measurement, Specifications of instruments, their static and dynamic characteristics, Errors.
- Learn about Basic Measurement Instruments such as PMMC instruments, galvanometer, voltmeter, ammeter etc.
- Learn about various types of probes and connectors.
- Measure resistance and impedance using different bridges.
- Learn about oscilloscopes.

Content/ Syllabus:

GE – II: Electronic Measurements

Qualities of Measurement: Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis, Statistical analysis ofdata and curve fitting.

Basic measurement instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system (different modes and universal counter).

Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc.

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

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

References :

Semiconductor Opto Electronic Devices, P. Bhattacharya .
Networks, Lines and Field , J. Ryder.
Electronic and Radio Engineering , F. E Terman.

Semester III

(Discipline Centric Core Papers)

Course Name: Mathematical Methods –II & Quantum Mechanics

Course Code: BSCHELCC301

Course type**: Core(Theoretical)**	Course details: **CC-5**			L-T-P : **5-1-0**	
Credit: **6**	Full marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		……	**10**	**……**	**40**

Course Learning Outcomes:

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

- Solve all the related problems.
- Learn about matrix algebra, complex variables, special functions.
- Apply principles of quantum mechanics to calculate observables on known wave functions.
- Solve time-dependent and time-independent SchrÖdinger equation for simple potentials.
- Solve quantum mechanical tunneling related problems.

Content/ Syllabus:

Mathematical Methods –II & Quantum Mechanics

MATHEMATICAL METHODS-II

Matrix Algebra

Definitions and rules: Matrix inversion and diagonalisation, Eigen values and Eigen vectors of real symmetric matrix (Elementary concept only), Matrix notation of linear simultaneous equations and solution technique.

Complex Variables

Complex numbers – polar form, Argand diagram, Functions of complex variables – single and multi valued functions; analytic functions, complex line integrals, Cauchy's integral theorem (no proof is required), Cauchy's integral formula (statement only), Singular points, Poles Essentials singularity, Residue as a pole of order m, Cauchy's residue theorem (statement), Evaluation of simple integrals.

Special Functions

The Gamma function and its characteristics, Beta functions, Relation between Gamma and Beta functions.

References :

Mathematical Methods: Vector analysis, Spiegel - TMH
Higher Engineering Mathematics - B S Grewal, Khanna pub
Advanced Engineering Mathematics, Kreyszig, John Wiley
Mathematical methods for physicists, Weber and Arfken ,
Elsevier Mathematical Physics, Ghatak, Goyal and Chua, Macmillan
Mathematical Methods, M.C. Potter and J. Goldberg, PHI

Quantum Mechanics

Plank's hypothesis, radiation formula, photoelectric effect, Compton scattering. Wave nature of material particles, de-Broglie hypothesis, phase and group velocity, wave particle duality in nature, de-Broglie wavelength, wave packet, Heisenberg's uncertainty principle.

Concepts of wave function of particle system, postulates of quantum mechanics, time independent and dependent Schrödinger equation, probability current density, dynamical variables as operator, Hermitian operators, Stationary states, Superposition of States, Schrodinger representation of position, momentum and angular momentum operators.

Schrodinger equations, Expectation values, Bound state wave functions. Discrete energy levels in one-dimensional box with rigid walls, (extension to three-dimensional box), free particle solution, one dimensional step potential, transmission of particles through a potential barrier, linear harmonic oscillator, wave functions and energy eigen values, Quantum mechanical Tunneling, application to potential problems, Unitary operator .

References :

Quantum Physics, Eisberg and Reisnick, John Wiley,
Basic Quantum Mechanics, A. Ghatak, Macmillan India,
Quantum mechanics, G. S. Chaddha, New Age,

Quantum mechanics, J. Singh, John Wiley & sons.

Course Name: Solid State Electronics -II

Course Code: BSCHELCC302

Course type**: Core(Theoretical)**	Course details: **CC-6**			L-T-P : **5-1-0**	
Credit: **6**	Full marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		……..	**10**	**……..**	**40**

Course Learning Outcomes:

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

- Describe the behavior of semiconductor devices such as transistor, FET etc.
- Reproduce the I-V characteristics of BJT/FET devices.
- Explain and calculate small signal parameters of semiconductor devices.
- Learn about transistor as an amplifier.
- Explain the concepts of feedback amplifiers and tuned amplifiers.

Content/ Syllabus:

Solid State Electronics –II

Transistors: Current flow mechanism, Current components, Ebers-Moll Model, Transistor as two port network, Z, Y and h parameters, CE, CB and CC configurations, comparison and their equivalent circuits, Determination of h parameters from static characteristics, Transistor Biasing and stabilization- different methods, h-parameter equivalent circuit, small signal amplifiers,

Transistor amplifier analysis, frequency response: cut-off frequencies, emitter follower. Metal

semiconductor contact, Schottky diode, JEFT structures and characteristics, Biasing of FET,

Small signal AC Equivalent circuit of FET, FET as an amplifier,

Amplifiers: Transistor as an amplifier, R-C coupled amplifier Feed back in Amplifier: General theory of feedback, negative and positive feedback, advantages of negative feedback, types of negative feedback in transistor amplifiers, current series, voltage series, current shunt - voltage amplifiers, Darlington amplifier.

Tuned Amplifier: Frequency selective networks, LC circuits, single and double tuned amplifiers, Analysis of voltage gain and selectivity, RF and IF amplifiers.

References :

Introduction to Solid State Physics, C.Kittel, John Wiley
Integrated Electronics, Millman and Halkias , TMH
Foundations of Electronics ,Chattopadhyay and Rakshit, New Age
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson
Basic Electronics & Linear Circuits, Bhargava, Kulashretha Gupta, TMH
Solid State electronic devices-Streetman & Banerjee, PHI

Course Name: Analog Electronics –I
Course Code: BSCHELCC303

Course type**: Core (Theory + Practical)**	Course details: **CC-7**			L-T-P : **4-0-4**	
Credit: **6**	Full marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

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

- Gain detailed knowledge of power amplifiers.
- Gain detailed knowledge about sinusoidal oscillators.
- Emphasis on operational amplifier and its applications such as integrator, differentiator, adder, converter, comparator, Schmitt trigger etc.

Content/ Syllabus:

Analog Electronics –I : Power amplifiers: Class A, B, C and AB amplifiers, Direct coupled amplifier, Transformer coupled amplifier, Push pull amplifiers, Class A & B Push pull circuits, Harmonic distortion, complementary symmetry amplifier.

Sinusoidal Oscillators: Positive feedback and oscillation, Barkhausen Principle, Hartley, Colpitt, Wien Bridge and phase shift oscillators, Crystal Oscillator. Collector Tuned Oscillator,

Operational Amplifier: Ideal OPAMP characteristics, offset current and offset voltage, inverting and non-inverting amp1ifiers, Transfer characteristics, Differential amplifiers, CMRR, Basic OP-AMP applications, adder, phase shifter, scale changer, voltage to current and current to voltage

converters, analog integration and differentiation, Comparator, Schmitt trigger, AC coupled amplifier, AC voltage follower.

References :

Integrated Electronics, Millman and Halkias, TMH.
Electronic Principles, Malvino, TMH .
Electronic Devices and Circuit theory, Robert L. Boylestad& Louis Nashelsky, PHI.
Electronic Circuits, Schilling and Belove, TMH.
Electronic Devices and Circuits, Salivahanan , TMH .
OP-Amp and Linear Integrated circuits, Gaykwad, Pearson.
Foundations of Electronics ,Chattopadhyay and Rakshit New Age International.
Modern Electronic Instrumentation and Measurement Techs, Helfrik & Cooper, Pearson.
Analog Electronics : Devices and Circuits , B.C. Sarkar and S. Sarkar, Damodar Group, Burdwan.

Core course – VII , Analog Electronics – I (Practical), Lab-2

Course Learning Outcomes:

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

- Draw and learn static characteristics of P-N-P and N-P-N transistors in CB, CC, CE modes.
- Find the hybrid parameters of BJTs in D. C. mode.
- Measure the inductance and Capacitance using AC bridge circuit.
- Draw resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.
- Study JFET characteristics. (Static and frequency response) and measurement of FET parameters.

Content/ Syllabus:

Analog Electronics – I (Practical)

1. To draw the static characteristics of P-N-P and N-P-N transistors in CB, CC, CE modes.

2. To find the hybrid parameters of BJTs in D. C. mode.

3. To measure the inductance and Capacitance using AC bridge circuit.

4. To draw resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.

5. To study JFET characteristics. (Static and frequency response) and measurement of FET parameters.

References:

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

Course Name: ANALOG ELECTRONICS
Course Code: BSCHELCGE301

<table>
<tr><td>Course type: GE
(Theory + Practical)</td><td colspan="2">Course details: GEC-3</td><td colspan="2">L-T-P : 4-0-4</td></tr>
<tr><td rowspan="3">Credit: 6</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>10</td><td>20</td><td>40</td></tr>
</table>

Course Learning Outcomes:

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

- Describe the behavior of semiconductor devices such as diodes, transistors, FET etc.
- Reproduce the I-V characteristics of diodes/BJT/FET devices.
- Explain and calculate small signal parameters of semiconductor devices.

- Learn about transistor as an amplifier.
- Explain the concepts of feedback amplifiers**,** power amplifiers**,** tuned amplifiers.
- Explain concepts of different oscillators.

Content/ Syllabus:

I) ANALOG ELECTRONICS (Theory)

Diode: PN junction diode, Zener diode, use of diode as rectifier, half and full wave rectifier, calculation of ripple factor and efficiency. Capacitor and inductor filter, Voltage regulation, Line and load regulation, Zener Diode as voltage regulator, Idea of power supply, Inverter and UPS.
Transistor: Bipolar Junction Transistor (n-p-n and p-n-p), Concept of load line (DC & AC), operating point, idea of Biasing, h-parameter model of BJT, CE amplifier, voltage and power amplifiers (idea of Class A, B, C amplifiers), basic idea of feedback in amplifier, Positive and negative feedback, advantages of negative feedback, types of negative feedback intransistor amplifiers, principle of oscillation, Tuned collector, Crystal and RC phase shift oscillators (qualitative discussions only), JFET and its applications.

References :
Integrated Electronics, Millman and Halkias, TMH.
Electronic Principles, Malvino, TMH .
Foundations of Electronics ,Chattopadhyay and Rakshit New Age International.
Analog Electronics : Devices and Circuits , B.C. Sarkar and S. Sarkar, Damodar Group, Burdwan.
Basic Electronics, Sanjay Sharma.
Electronics, B.Ghosh.
Electronics, V.K.Mehta.
Basic Electronics, B.L.Theraja

ANALOG ELECTRONICS (Practical)

Course Learning Outcomes:

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

- Draw the static characteristics of P-N-P and N-P-N transistors in CB mode.
- Draw the static characteristics of P-N-P and N-P-N transistors in CE mode.
- Study the performance of a BJT amplifier in CE mode.

- Study JFET characteristics.

Content/ Syllabus:

ANALOG ELECTRONICS (Practical)

1. To draw the static characteristics of P-N-P and N-P-N transistors in CB mode.
2. To draw the static characteristics of P-N-P and N-P-N transistors in CE mode.
3. To study the performance of a BJT amplifier in CE mode.
4. To study JFET characteristics.

References:

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

SEMESTER–III (SKILL ENHANCEMENT COURSE : AEEC – I)

Course Name: Design and fabrication of electronic circuits I.

Course Code: BSCHELCSE301

Course type**: SE**	Course details: **SEC-1**		L-T-P : **0-0-8**
Credit: **4**	Full marks: **50**	CA Marks	ESE Marks

		Practical	Theoretical	Practical	Theoretical
		30	……	**20**	**……**

SKILL ENHANCEMENT COURSE : AEEC – I

Design and fabrication of electronic circuits I

Course Learning Outcomes:

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

- Gain knowledge different of electronic/ electrical components.
- Design 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.

Content/ Syllabus:

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.

Semester – IV

Course Name: ANALOG ELECTRONICS –II
Course Code: BSCHELCC401

<table>
<tr><td colspan="2">Course type: Core
(Theoretical + Practical)</td><td colspan="2">Course details: CC-8</td><td colspan="2">L-T-P : 4-0-4</td></tr>
<tr><td rowspan="3">Credit: 6</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>10</td><td>20</td><td>40</td></tr>
</table>

Course Learning Outcomes:

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

- Gain knowledge about non-sinusoidal oscillators such as multivibrators, Schmitt trigger etc.
- Explain different modulation techniques such as AM, FM, PM.
- Gain knowledge about demodulation.
- Gain knowledge about microwave devices such as Tunnel diode, Gunn diode etc.

Content/ Syllabus:

ANALOG ELECTRONICS -II

Non-sinusoidal Oscillators: Multivibrators (using transistors and 555 timers),

Saw tooth generator, Schmitt trigger.

Modulation and Demodulations: Theory and Systems

Modulation technique, Classification - AM, FM, PM, Modulation index of AM, Frequency spectrum – AM-modulator, side bands and bandwidth, FM modulator - Frequency spectrum of FM and its bandwidth, Modulation index, Conversion of FM to PM and vice versa, AM demodulators linear and square law, FM-demodulator – limiter, discriminator, ratio detector, Comparison between AM and FM, Concept of phase-locked loop (PLL).

Microwave Devices: Tunnel diode, Gunn diode, IMPATT diode, PIN diode, LED, Photo Diode , Solar Cell, Semiconductor Junction Laser.

References :

Integrated Electronics, Millman and Halkias, TMH,
Electronic Principles, Malvino, TMH ,
Electronic Devices and Circuit theory, Robert L. Boylestad & Louis Nashelsky, PHI,
Electronic Circuits, Schilling and Belove, TMH,
Electronic Devices and Circuits, Salivahanan , TMH ,
Foundations of Electronics , Chattopadhyay and Rakshit New Age International,
Modern Electronic Instrumentation and Measurement Techs, Helfrik & Cooper, Pearson.

Core course – VIII , Analog Electronics - II(Practical), Lab-3

Course Learning Outcomes:

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

- Study the Op-Amp characteristics: CMRR and Slew rate.
- 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.

Content/ Syllabus:

Analog Electronics - II(Practical)

1. Study of Op-Amp characteristics: CMRR and Slew rate.

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.

Course Name: DIGITAL ELECTRONICS – I
Course Code: BSCHELCC402

Course type**: Core** **(Theoretical + Practical)**	Course details: **CC-9**			L-T-P : **4-0-4**	
Credit: **6**	Full marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

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.

Content/ Syllabus:

DIGITAL ELECTRONICS – I

Number Systems: Decimal numbers, binary number, octal numbers,hexadecimal numbers, BCD numbers (weighted and unweighted codes),Excess three code, Gray code, parity conversions, arithmetic operations,ASCII, Extended ASCII codes, 9's and 10's complement code.

Boolean algebra: Boolean relations, commutative, associative anddistributive laws, OR, AND, and NOT operations, De Morgan theorems.

Logic Gates: Inverters, OR, AND and NOR gates, EX-OR and EX-NORgates, Simplification of Boolean expressions using Boolean algebra andDe-Morgan's theorems, sum of products and products of sum forms,Karnaugh-map, NAND and NOR gates as universal building blocks.

Logic Families : Digital integrated circuits, levels of integration, DTL andTTL circuits, DTL , TTL TTL, DCTL, RTL (comparisons only),7400series, TTL characteristics, TTL,CMOS comparison.

References :

Digital Logic and Computer Design, Mano , Pearson ,
Digital Computer Electronics, Malvino and Brown, Tata McGraw Hill ,
Digital Principles, Leach and Malvino , TMH,
Modern Digital Electronics, Jain, TMH ,
Digital Circuits, Vol-I and II, D.RoyChaudhuri, Platinum publishers ,
A text book of Digital Electronics, Sedha, S. Chand.

Core course- IX, Digital Electronics- I (Practical), Lab-4

Course Learning Outcomes:

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

- Study the Logic Gates.
- Design complex digital logic circuits using universal gates.
- Verify de Morgan's theorems.
- Simplify a given SOP & POS circuits.
- Study Karnaugh map.

Content/ Syllabus:
Digital Electronics- I (Practical), Lab-4

1. Study of Logic Gates.
2. Designing of complex digital logic using universal gates.
3. Verification of de Morgan's theorems.
4. Simplification of SOP & POS circuits.
5. Study of Karnaugh map.

References of Lab III and IV .

Basic Electronics: A Text Lab Manual, Zbar, TMH ,
Laboratory Manual for Electronic Devices and Circuits, Bell, PHI,
Laboratory Manual for Electric Circuits , Bell, PHI,
Electric Circuits: Schaum's Outlines, J. Edminister and M. Nahvi, TMH,
Practical Physics , Rakshit and Chattopadhyay ,
Advanced Practical Physics Volume II B. Ghosh, New Central Book Agency.
Laboratory Manual for Op-amp and Linear ICs, Bell, PHI.

Course Name: ELECTRONIC COMMUNICATION

Course Code: BSCHELCC403

Course type**: Core(Theoretical)**	Course details: **CC-10**		L-T-P : **5-1-0**	
Credit: **6**	Full marks: **50**	CA Marks	ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		……..	**10**	**……..**	**40**

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.

Content/ Syllabus:

ELECTRONIC COMMUNICATION

Analogy between vectors and signals, orthogonal functions (Elementary ideas), Representation of a periodic function by Fourier series over the time interval, The Fourier transform, Time-domain and frequency-domain representations of a signal, Convolution theorem, time convolution, frequency convolution, convolution properties, Fourier transforms of some useful functions (single sided exponential signal, double exponential signal, Gate function), Gaussian pulse, Triangular pulse, exponential pulse, sampling function, Fourier transforms for following cases : Impulse function, a constant, step function u(t), periodic functions Sinwt, Coswt,etc., properties of FT, symmetry property, linearity property, scaling property, frequency shifting property, time shifting property. Signal transmission through 1inear systems, the filter characteristics of linear systems,

distortion less transmission, Bandwidth of system, ideal filters, the energy density spectrum, interpretation of energy density, the power density spectrum, power density, and spectrum of a periodic signal.

DIGITAL COMMUNICATION

Pulse modulation, PAM, transmission of PAM signal, other forms of pulse modulation. Baseband digital modulation, Pulse amplitude modulation, pulse time modulation, PCM, DM, ADM, Error probability, Signaling rate, Pass band digital modulation – ASK, FSK, PSK, QPSK, DPSK , Radiotelegraphy-transmitter.

References :

Communication Electronics, Control Theory, High frequency Devices: Electronic
Communication Systems, Kennedy, TMH ,
Communication systems, Singh and Sapre, TMH ,
Communication systems, Haykin, John Wiley ,
Communication systems, Lathi, Oxford Electronic communication Systems,
Roddy and Coolen, Pearson,
Microwave Devices and Circuits, Liao, Pearson ,
Microwave, Sisodia and Gupta, New Age,
Microwave Engineering, Das, TMH ,
Power Electronics, Bimbhra, Khanna Pub. .

Generic Elective (GE–IV) (Credit – 6)

Course Name: DIGITAL ELECTRONICS (Theory)

Course Code: BSCHELCGE401

Course Type: GE (Theory + Practical)	Course details: GE-4			L-T-P: 4-0-4	
Credit: 6	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	10	20	40

Course Learning Outcomes:

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

- Learn about various number systems, conversion of numbers, arithmetic operations, ASCII codes
- Understand the properties of Boolean algebra and its implementation in digital logic design
- Familiar with properties of basic logic gates like AND, OR, NAND, NOR, NOT etc. and their use in digital circuit
- Learn the use and importance of Boolean algebra and K-Map for simplification of a Boolean expression
- Understand the basic difference between combinational and sequential circuit and design of digital logic circuits like adder, MUX, DeMUX, Encoder, Decoder, Latch, flip-flop etc.

Syllabus:

Number Systems: Decimal numbers, binary number, octal numbers, hexadecimal numbers, BCD numbers (weighted and unweighted codes), Excess three code, Gray code, parity conversions, arithmetic operations, ASCII, Extended ASCII codes, 9's and 10's complement code.

Boolean algebra: Boolean relations, commutative, associative and distributive laws, OR, AND, and NOT operations, De Morgan theorems.

Logic Gates: Inverters, OR, AND and NOR gates, EX-OR and EX-NOR gates, Simplification of Boolean expressions using Boolean algebra and De-Morgan's theorems, sum of products and product of sums forms, Karnaugh-map, NAND and NOR gates as universal building blocks.

Combinational Logic & Sequential Circuits: Binary adder, half adder, full adder, Decoder and Encoder, Multiplexer and Demultiplexer.

Latches, edge triggered flip-flops, R-S flip-flop, J-K flip-flop, Master -slave flip-flop, D flip-flop, T flip-flop.

References :

Digital Logic and Computer Design, Mano , Pearson.
Digital computer electronics, Malvino and Brown, Tata McGraw Hill.
Digital Principles, Leach and Malvino , TMH.
Modern Digital Electronics, Jain, TMH.
Digital Circuits, Vol-I and II, D.RoyChaudhuri, Platinum publishers .
A text book of digital electronics, Sedha, S. Chand.

DIGITAL ELECTRONICS (Practical), Lab.

Course Code: BSCHELCGE401

Course Learning Outcomes:

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

- Familiar with basic logic gates, universal logic gates
- Get hand-on experience of designing digital logic circuit using Digital IC trainer kit
- Learn verification of basic logic gates, universal logic gates experimentally
- Learn how to study K-map experimentally

Syllabus:

1. Study of basic logic gates.
2. Study of universal logic gates.
3. Simplification of SOP & POS circuits.
4. Study of Karnaugh map.

SKILL ENHANCEMENT COURSE: AEEC-II

Course Code: BSCHELCSE401

Course Type: SE	Course details: SEC-II	L-T-P: 0-0-8

Credit: 4	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:

- 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.

Semester - V

Core course-XI: DIGITAL ELECTRONICS–II

Course Code: BSCHELCC501

Course Type: CC (Theory + Practical)	Course details: CC-11			L-T-P: 4-0-4	
Credit: 6	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	10	20	40

Course Learning Outcomes:

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

- Learn basic of digital circuits and design digital logic circuits
- Gain knowledge about working of various types of sequential logic design like Flip-Flop, counter, registers etc.
- Explain, design and analyze any digital electronic circuit used in electronic devices
- Get exposure of basic of computer architecture, specially about memory units like ROM, RAM, PROM etc.

Syllabus:

Combinational Logic: Circuits of AND, OR, NOT, NAND, NOR gate using TTL and CMOS, Binary adder, half adders, full adders, BCD adder, half subtractors, full subtractor, Decoder and Encoder, Multiplexer and Demultiplexer, Comparator, Code converter (Binary to BCD, Binary to Gray, Gray to Binary, BCD to Excess three).

Sequential Circuits: Latches, edge triggered flip-flops, R-S flip-flop, J-K flip-flop, Master - Slave flip-flop, D-flip-flop, T flip-flop, registers, counter: Design of Asynchronous and synchronous counters, Different mod N counters, Ripple counters, ring counters, Johnson Counter

Memory: RAM, ROM, PROM, EPROM

Basics of Computer organisation

References :

Digital Logic and Computer Design, Mano , Pearson ,
Digital Computer Electronics, Malvino and Brown, Tata McGraw Hill ,
Digital Principles, Leach and Malvino , TMH,
Modern Digital Electronics, Jain, TMH ,
Digital Circuits, Vol-I and II, D.RoyChaudhuri, Platinum publishers ,
A text book of Digital Electronics, Sedha, S. Chand.

Core course –XI Practical: DIGITAL ELECTRONICS – II, Lab – V

Course Code: BSCHELCC501

Course Learning Outcomes:

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

- Get hand-on experience on design of digital logic circuits like binary adder, subtractor, flip-flop, counters etc.
- Learn how to analyze, debug, verify a digital logic circuit

Syllabus:

1. Study of half adder, and full adder.
2. Study of half subtractor.
3. Study of R-S flip flop, J-K flip flop.
4. Study of sequential counters.

Core Course XII: Credit: 06

OPTICAL COMMUNICATION (Theory)

Course Code: BSCHELCC502

Course Type: CC (Theory)	Course details: CC-12			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Learn basics of optoelectronic processes
- Identify the types of optoelectronics devices and explain their characteristics and working principle
- Learn basic of optical fiber communication, optical fiber materials, structure, modes in optical fibers etc.
- Familiarized with optical fiber losses, attenuation, dispersion, EM wave propagation

Syllabus:

Optoelectronics: Characteristics of optical emission, electro-luminescence. LED: Power and efficiency calculation, Structure of LED and its characteristics, Hetero-junction LED, Photo diode: PIN photodiode, hetero junction diode, Avalanche Photo diode, Phototransistor. LDR, photovoltaic cells, photo emissive cells - types, materials, construction, response, opto-couplers – characteristics, noise figures, applications in analogue and digital devices. Semiconductor junction laser.

Fiber optics: Optical fibre – materials, construction, step index and graded index fibres, ray propagation, attenuation. Modes in optical fibres, intermodal dispersion, single mode fibre-working principle, attenuation, dispersion and bandwidth. Multimode fibre- attenuation, dispersion. Propagation of EM waves, Fibre coupling.

References :

Semiconductor Opto Electronics Devices, P. Bhattacharya .

Optoelectronics and Fiber Optic Communication, D C Sarkar and C K Sarkar, New Age.
Photonics : A Yariv and P Yeh. Oxford.
Optical Electronics : By Ghatak and Thyagrajan , Cambridge University Press.

Discipline Specific Elective (DSE) Papers

Semester V: (Any two from following)

DSE – I & II: Each of credit 06

i) **Radio and television**
ii) **Basic Control systems**
iii) **Microprocessor and Microcontroller**
iv) **Numerical analysis and computer**

i) RADIO AND TELEVISION: Credit – 06
Course Code: BSCHELCDSE501

Course Type: DSE (Theory)	Course details: DSE			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Learn basics features of communication system, especially radio communication, types of radio waves, classification of radio receivers
- Understand the electromagnetics of radio wave, modes of propagation, free space propagation, ionospheric wave propagation and their characteristics
- Acquire knowledge about basic Television system, television broadcasting, coverage of television, scanning principles etc.

Radio Communications: Introduction, basic requirements of radio communications, communication systems, basic features of communication: transmitter, transmission circuit receiver, modulation, bandwidth, communication channel, classification of radio waves, ordinary receiver and super heterodyne receiver.

Radio wave propagation: Introduction, electromagnetic or radio waves, free space propagation, modes of propagation, ground wave and surface wave, sky wave or ionospheric wave, space wave propagation, tropospheric scatter propagation, structure of atmosphere, characteristics of different ionized regions, sky wave propagation, effect of earth's magnetic field on ionospheric radio wave propagation, lowest usable frequency, maximum usable frequency, skip distance duct propagation.

Television: Introduction – Historical development, television broadcasting, coverage of television, Basic television system and scanning principles, Essentials of colour television.

References:

Antenna and wave propagation, K D Prasad, SatyaPrakashan.
Electromagnetic field theory, K AGangadhar, P M Ramanathan, Khanna Publication.
Electromagnetic field theory, S P Ghosh, McGraw Hill.
Principles of electromagnetics, M.N.O. Sadiku, Oxford.
Monochrome and colour television, R.R. Gulati, New Age International.
Television and video engineering, A M Dhake, Tata McGraw Hill.
Colour television, principles and practice, R RGulati, New Age International.

Electrical engineering materials, A.J. Dekker, PHI Learning Pvt. Ltd., New Delhi 2010.

ii) BASICS of CONTROL SYSTEMS

Course Code: BSCHELCDSE502

Course Type: DSE (Theory)	Course details: DSE			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

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

Introduction: Basic components of a control system, examples of control system applications, open loop and closed loop control systems.

Feedback and its effects: effect of feedback on overall gain, effect of feedback on stability, effect of feedback on sensitivity, effect of feedback on noise.

Mathematical foundation: complex variables, functions of a complex variable, analytic function, singularities and poles of a function, zeroes of a function.

Differential equations: linear ordinary differential equations, non-linear differential equations, first order differential equations, state equations.

Laplace transform: partial fraction expansion, application of α.T. to the solution of linear ordinary differential equations.

Matrix algebra, difference equations, z transform, application of z transform to the solution of linear difference equations.

Transfer functions, Block diagrams, signal flow graphs, impulse response.
Control system components: error sensors, potentiometers, synchros, tachometer, servometers.

Time domain analysis: standard input signals, impulse function, step function, ramp functions, parabolic function.

References:

Automatic control systems, B.C. Kuo, PHI New Delhi 2004.
Control systems – P Purkait, Satpati, G.R. Mallik, U. Mondal, Tata McGraw HillEdn. Pvt Ltd., New Delhi
Control system engineering, I.J. Nagrath and M. Gopal, New Age International Publishers, New Delhi.
Control System, K.R. Varmach, Tara McGraw Hill, Edn. Pvt. Ltd., New Delhi.
Linear control systems with Matlab applications, B.S. Manke, Khanna Publishers, New Delhi, Ogata

iii) MICROPROCESSOR AND MICROCONTROLLER
Course Code: BSCHELCDSE503

Course Type: DSE (Theory)	Course details: DSE			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Learn evolution history of microprocessor, digital computers, computer generations, hardware, software and firmware
- 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 the assembler, machine language, high level language, assembly language and 8085 microprocessor instructions set
- Gain knowledge about the microprocessor applications, peripheral devices and their applications

Introduction: Word length of a computer/ μ processor, evaluation of μp, evolution of digital computer, computer generations, single chip μp, embedded μp, hardware, software and firmware.

CPU: ALU, timing and control unit, registers, memory – semiconductor memory, magnetic memory, optical disks, CCD, cache, memory hierarchy, program and data memory, destructive and non-destructive read out, direct access storage device, serial access storage device, online and offline memory devices, real and virtual memory.

Busses: memory addressing capacity of a CPU, Bus architecture operating systems – multiprogramming, multiusers or time shared system, multitasking, computer network LAN, MAN and WAN.

Types of µp: Vector processor, array processor or SIMD processor, scalar or super scalar processor, RISC and CISC processors and EPIC, digital signal processor (DSP), symbolic processors, I/O processors, co-processors.

µp architecture: Intel 8085, ALU, timing and control unit, registers, data and address bus, pin configuration, Intel 8085 instructions, opcodes and operands, instruction word size, instruction cycle – fetch O/P, execute O/P, machine cycle and state, instruction and data flow, timing diagram.

Instruction set of 8085 and programming of µp: address modes, status flags, assembly language, high level language, stacks, subroutines, system software.

Peripheral devices and their applications, µp applications.

Microcontrollers: Intel 8051 series µcontrollers (MCS-51), registers, pins of 8051, I/O lines, 8051 interrupts, timer/counter, Boolean processor, instruction set, pulse-width modulation (PWM), serial port, multiprocessor communication, power saving, brief description of some 8051 µcontroller, memory organization, addressing modes, 8051 instruction, data transfer, arithmetic and logical instructions, assembly language programme examples, Atmel µcontroller and PIC µcontrollers, Intel 8096 series of µcontroller (MCS-96).

References:

Fundamentals of µprocessors and µcontrollers, B. Ram, Dhanpat Rai Publications.
µprocessor architechture, programming and applications with the 8085, R.C. Gaonkar, Penram International Publishing (India) Pvt. Ltd.

µcontrollers – architecture, programming interfacing and system design, Rajkamal – Pearson.
Advanced µprocessors and peripherals, A K Ray and K M Bhurchandi, Tata McGraw Hill.
µprocessors and interfacing – programming and hardware, Douglas V. Hall, Tata McGraw Hill.
µprocessors – principles and applications, Charles M Gilmore, Tata McGraw Hill.
µprocessors and interfacing, N Marriwala, S.K. Kataria & Sons.
The Intel µprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium & Pentium processor, architecture, programming & interfacing, Barry M Brey, Prentice Hall of India.

iv) NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING

Course Code: BSCHELCDSE504

Course Type: DSE (Theory)	Course details: DSE			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Learn various methods to find solution of non-linear equations
- Familiar with interpolation and calculation of error, curve fitting procedure etc.
- Familiar with numerical methods to solve integration and differentiation numerically, and thereby calculation of errors with respect to actual result
- Learn computer programming language ‘C’ and its use for numerical analysis

Syllabus:

Errors in numerical calculations: Introduction – Computer and numerical software, computer languages, software packages, mathematical preliminaries, errors and their computations.

Solution of algebraic and transcendental equations: Introduction – bisection method, the method of false position, the iteration method, Newton Raphson method, Ramanujan's method, the secant method, the Muller method.

Interpolation: errors in polynomial interpolation, finite differences – forward differences, backward differences, central differences, Newton's formula for interpolation, Gauss' central difference formula, Lagrange's interpolation formula, Newton's general interpolation formula.

Least square curve fitting procedure, fitting a straight line, non-linear curve fitting, curve fitting by a sum of exponentials.

Numerical differentiation and integration – errors in numerical differentiation, the cubic spline method, numerical integration, trapezoidal rule, Simpson's 1/3 rule.

Introduction to computer system – computer organization, introduction to computer languages.

Problem solving on a computer – analysis of the problem, mathematical modeling of the problem, development of suitable algorithm, algorithm, flowchart.

Getting started, what is C, character set, constants, variables and keywords, rules for various construction of different constants, compilation and execution, C instructions, control instruction in C.

Design control structure.
Functions and pointers, Structures, Console input/output, File input/ output,
Windows.

References:

Introductory methods numerical analysis, S.S Sastry, PHI.
Numerical methods, Babu Ram, Pearson.
A text book of numerical analysis, D. C. Sayal and K.C. Das, U Dhar & Sons.
Numerical analysis and computational procedure, S A Mollah, Books & Allied (P) Ltd.
Numerical methods, E Balaguruswamy, Tata McGraw Hill.

Numerical Analysis, Kalyan Kr. Mukherjee, New Central Book Agency (P) Ltd.
Numerical methods for scientists, Rao, PHI.
Computer programming and numerical analysis – an integrated approach, N Datta, Universities Press.
Numerical methods with programs in C, T Veerarajan & T Ramachandran, Tata McGraw Hill.
Numerical analysis and algorithms, Pradip Neyogi, Tata McGraw Hill.
C Language and Numerical methods, C Xavier, New Age International.
Let us C, Yashavanta Kanitkar, BPB Publication.
Programming with C, B S Gottfired, TMH.
Computer fundamentals and programming in C, Pradip Dey and Manas Ghosh, Oxford.
Computer programming in C, V Rajaraman.
Programming in C. Reema Thareja, Oxford.

Semester -VI

Core course- XIII: INSTRUMENTATION & MEASUREMENTS

Course Code: BSCHELCC601

Course Type: CC (Theory + Practical)	Course details: CC-13			L-T-P: 4-0-4	
Credit: 6	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	10	20	40

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
- Know about the conversion principle, basic circuit and applications of ADC (Analog to Digital Converter) and DAC (Digital to Analog Converter)
- Gain knowledge about the functional blocks of a CRO and do analysis, measurements of waveform display

Syllabus:

Qualities of Measurement: Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting.

Basic Measuring Instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, Ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system (different modes and universal counter).

Connectors and Probes: Low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc.

A-D and D-A Conversion: 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder, A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope,

References :

Modern Electronic Instrumentation and Measurement Techniques, Helfrick and Cooper,Prentice-Hall of India, Reprint 1988.
Instrumentation Measurement and Feedback, Jones, B.E., Tata McGraw-Hill, 1986.
Electrical Measurement and Measuring Instruments, Golding, E.W., 3rd Edition, Sir Issac Pitman and Sons,
t Systems: Application and Design, DoebelinE.O. , McGraw Hill Book - Fifth Edition (2003).
Principles of Electrical Measurements, Buckingham, H. and Price, E.N., 1961.Test and measuring instruments
Electronic Instrumentation, Kalsi, Tata McGraw Hill (2006)
A Course on Electrical and Electr*1960.*
Measuremen onic Measurements and Instrumentations, A K Sawhney, DhanpatRai& Sons

Core course - XIII (Practical):

INSTRUMENTATION & MEASUREMENTS, LAB – VI

Course Code: BSCHELCC601

Course Learning Outcomes:

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

- Acquire knowledge on working of various electronic instruments and bridges (Wheatstone's Bridge, Anderson bridge etc.)
- Measure the low resistance, inductance and capacitance using suitable bridge
- Gain hand-on experience to construct the experimental setup of a CRO to measure the voltage, phase and frequency of a waveform

Syllabus: -

1. Measurement of low resistance, inductance and capacitance by bridges.
2. Measurement of voltage, frequency and phase difference by CRO.

Core course–XIV:

SENSOR, TRANSDUCER AND ELECTRONIC MATERIALS.

Course Code: BSCHELCC602

Course Type: CC (Theory)	Course details: CC-14			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Get familiarized with various types sensors, transducers and their working principles.
- Know the characteristics, performance and failure mechanism of sensor and transducer
- Identify the sensor and transducer types found in real applications
- Get to know about some special electronic materials and their unique properties along with their applications

Introduction: Definition of sensors/ transducers, sensing principles, physical and chemical transduction principles, classification. Basic characteristics of sensors – static and dynamic characteristics.

Characterization of sensors: electrical, mechanical, thermal, optical/ biological characterization, catastrophic failure of sensor, the buth-tub curve.

Mechanical and Electromechanical Sensors: resistive potentiometers, stream gauge, strain gauge materials and their properties, semiconductor stream gauges, inductive sensor, sensitivity

and linearity of the sensor, electromagnetic transducer, magnetostrictive transducers, capacitive sensors, electrostatic transducer, Tachometer.

Piezo-electrics: Piezo-electric crystals, piezo-electric materials, deformation modes and multimorphs, the PZT family, stress tensors using quartz resonators, ultrasonic sensors.

Electroanalytical Sensors: The electrochemical cell, sensor electrodes – metal electrodes and membrane electrodes. Electroceramic in gas media: Zircomia, NASICON, β-alumina, titania (TiO_2), Smart sensors (idea only).

Materials: Classification of materials, conducting materials, semiconducting materials, insulating materials, dielectric materials, magnetic materials, materials for special purse.

References:

Sensors and Transducers (2nd Edn), D. Patranabis, PHI Learning Pvt. Ltd., New Delhi 2009.

Transducers and Instrumentation (2nd Edn), DVS Murty, PHI Learning Pvt. Ltd., New Delhi 2009.

Electrical engineering materials and electronic components, K.B. Raina, S.K. Bhattacharya, T. Joneja, S.K. Kataria & Sons, Delhi 2010.

Electrical engineering materials, A.J. Dekker, PHI Learning Pvt. Ltd., New Delhi 2010.

Discipline Specific Elective (DSE) Papers (Any two from following)

DSE – III & DSE-IV Credit – 06

i) **Satellite communication**
ii) **Microwave and optoelectronic devices**
iii) **Antenna and wave propagation**
iv) **Power electronics**

i) SATELLITE COMMUNICATION:
Course Code: BSCHELCDSE601

Course Type: DSE (Theory)	Course details: DSE			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Know about brief history of satellite communication and working of satellite communication
- Acquire knowledge about the satellite orbits mechanics, launching methodologies and locating satellite in orbits
- Describe satellite components/subsystems used for communications
- Gain knowledge about satellite link design for uplink and downlink
- Get to know about various digital signal processing and transmission technologies i.e, sampling, quantization, modulation, demodulation, multiplexing, compression and expansion etc.

Syllabus:

Introduction: Background, A brief history of satellite communication, satellite communication in 2000, overview of satellite communication, orbital mechanism and launches, orbital mechanics, development of equation of the orbit, Kepler's laws of planetary motions, describing the orbit of a satellite, locating the satellite in the orbit, locating the satellite with respect to the earth orbital elements, examples.
Geostationary satellites, visibility test, examples, orbital perturbations, orbital determination, launches and launch vehicles, placing satellite in geostationary orbit, orbital effects in common system performance, Doppler shift, range variation, solar eclipse, sun transit outage.

Satellites: Satellite subsystem, altitude and orbital control systems (AOCS), telemetry, tracking, command and monitoring (TTC&M), Paner system, communication subsystem, Description of communication subsystem, transponders, concept of satellite antennae

Satellite link design – basic transmission theory,Ku band uplink design, Ku band downlink design, rain effect, path blockage at L band, Modulation and multiplexing techniques for satellite links, fm, analog fm transmission of satellites, digital transmission, digital modulation and demodulation, probability of a symbol error, BPSK/QPSK bit error rate, generation of QPSK.

Digital transmission of analog signals sampling and quantization, compression and expansion, Time division multiplexing, low earth orbit and non geostationary satellite systems, basics of satellite navigation and GPS (Global Positioning System).

References:

Satellite communications, Timothy Pratt, Charles W Bostian, Jeremy Allnutt, John Wiley & Sons.
Satellite communications, Anil K Maini, Varsha Agrawal, Wiley
Satellite communications, Dennis Roddy, McGraw Hill.
Digital satellite communication, Tri T Ha, McGraw Hill.
Satellite communication, DC Agarwal reviewed by A K Maini, Khanna Publisher.

ii) MICROWAVE AND OPTOELECTRONIC DEVICES: Course Code: BSCHELCDSE602

Course Type: DSE (Theory)	Course details: DSE			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Acquire knowledge about basic electromagnetics (Maxwell equation, wave equations, plane TEM wave etc.)
- Identify types of microwave devices used in any application and explain working of passive microwave devices, vacuum tube microwave devices and solid-state microwave devices
- Get familiarized with various optoelectronic devices and understand the fundamental semiconductor physics with regard to optoelectronic process.

Syllabus:

Introduction: µwave frequencies, µwave devices, µwave system, µwave units of measure.

Basic electromagnetics: Maxwell equations, wave equations (in free space), plane TEM waves in conducting and low-loss dielectric medium, poynting vector.

Passive µwave devices: Terminators, attenuators, phase shifters, directional coupler, hybrid junctions (magic T), dividers, circulator.

µwave vacuum tube devices: Klystron, TWT Amplifier, Backward wave oscillator, magnetron oscillator.

Microwave solid state devices: Diodes, Gun diodes, Avalanche transit time devices, tunnel diodes, varactor diodes, parametric amplifiers IMPATT diode.

Optical processes in semiconductors: Electron-hole pain formation and recombination, absorption, Franz-Keldysh and stark effects quantum confined stark effects, Kramers-Kronig relatins, radiation in semiconductors.

Junction theory: p-n junctions, schottky barriers and ohmic contacts, semiconductor heterojunctions, light emitting diodes, laser operating principles and structure and properties,

photodetection, solar cells, optoelectronic integrated circuits.

References:

μwave engineering, David M Pozzar, Willey.
Foundation of μwave engineering, Robert E Collin, Willey.
μwave devices and circuits, Samuel Y Liao, PHI.
μwave circuits and passive devices, M.L. Sisodia & G.S. Raghuvansi, New Age International.
μwave enginering, Annapurna Das and Sisir K Das, Tata McGraw Hill.
Fundamentals of μwave and radar engineering, Er. K.K. Sharma, S. Chand.
Semiconductor Optoelectronic devices, Pallab Bhattachary, Pearson (Prentice Hall).
Optical fiber communications – principles and practice, John M Senior, Pearson Education.
Optical fiber communications, Gerd Keiser, McGraw Hill.
Solid state electronic devices, Ben G Streetman and Sanjay Banerjee, PHI.
μwave engineering, Monojit Mitra, Dhanpid Roy & Co.
Microwaves, K. C. Gupta, New Age International Publications.

v) Antenna and Wave Propagation
Course Code: BSCHELCDSE603

Course Type: DSE (Theory)	Course details: DSE			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Understand basic of radio wave communication, components of a communication system, satellite communication, sky wave propagation etc.

- Explain the parameters and characteristics of antenna like directivity, resolution, beam width, antenna aperture, effective height, radiation pattern etc.
- Get familiarized with various antenna structure and their working.
- Identify types of antennas along with specifications to be used in a particular communication system

Syllabus:

Introduction: radio communication, transmitter, transmission circuit, receiver, modulation, bandwidth.

Antenna basics: Parameters, patterns, beam area, beam efficiency, directivity D and gain G, directivity and resolution, antenna aperture, effective height, radio communication link, fields from oscillating dipole, linear, elliptical and circular polarization, pointing vector.

The antenna family: Loops, dipoles and slots, coaxial line antennas, aperture type antenna, flat-sleet reflector antenna, parabolic dish and dielectric lens antenna, end-fire antennas, Broad bandwidth antennas: conical, spiral and log periodic antenna, patch antenna.

Electric dipoles, thin linear antennas and array of dipole and aperture.

Loop, slot, patch and horn antennas, small loop, square loop, slot antennas, radiation efficiency, Q, bandwidth and signal to noise ratio.

Electromagnetic fields and its radiation Maxwell equations, em waves in homogeneous medium, wave equations for free space/ loss less/ non conducting medium, em wave equation for a conducting medium, wave polarization.

Radio wave propagation: fundamental equations, moods of propagation, structure of atmosphere, characteristics of different ionized regions, sky wave propagation, effect of earth's magnetic field on ionospheric radio wave propagation, lowest usable frequency, skip distance, ionospheric abnormalities, ionospheric absorption, multi-hop propagation, duct propagation, satellite communication.

References:

Antenna and wave propagation, K.D. Prasad, Satya Prakashan, New Delhi.
Antenna for all applications, John D Kraus, Ronald J Marthefka, Ahmad S Khan, Tata McGraw Hill.
Principles of Electromagnetics, Matthew N. O., Sadiku, Oxford University Press.

Antenna Theory, analysis and design, Constantine, A. Balanis, Wiley.
Detailed solutions in Electronics and Communication for competitions, Satish K Karna, Galgotias.

iv) Power Electronics
Course Code: BSCHELCDSE604

Course Type: DSE (Theory)	Course details: DSE			L-T-P: 5-1-0	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…..	10	……	40

Course Learning Outcomes:

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

- Familiarized with the basic concepts of power electronics, power applications and power electronics devices and systems
- Understand device structure, characteristics, applications of various power electronics diodes and transistors in power electronics circuit and system
- Understand the characteristics of thyristor, turn on methods, thyristor protection and know about thyristor converter and inverter circuits
- Familiarized with some important applications of thyristor like UPS, circuit breaker, relays, induction heating etc.

Syllabus:

Introduction: Concept of power electronics, Application of power electronics, power electronic systems, power semiconductor devices, power electronic modules.

Power semiconductor diodes and transistors: The p-n junction, basic structure of power diodes, characteristics of power diode, types of power diodes power-transistors, bipolar junction

transistors, steady state characteristics, BJT switching performance, safe operating area.

Power MOSFET, insulated gate bipolar transistor (IGBT), static induction transistor (SIT), MOS controlled thyristor (MCT).

Diode circuits and rectifiers: single phase half wave, full wave rectifier, three phase rectifier.

Thyristor: Introduction, static IV characteristics of a thyristor, turn on methods, switching characteristics, thyristor gate characteristics, two transistor model of a thyristor, thyristor rating, thyristor protection, improvement of thyristor characteristics, healing, cooling and monitoring of thyristor, series & parallel operations of thyristor, other members of thyristor family (like PJT, SUS, SCS, light activated thyristor, diac, triac, etc.).

Phase controlled rectifiers, converters half and full wave single phase, inverters: Single phase voltage source inverters, steady state analysis, force commutated thyristor inverters.

AC voltage controller and cyclo converter principles &thyristor circuits.

Application of thyristor: SMPS, UPS, DC transmission, static switches, circuit breaker, relays, induction heating.

References:

Power ElectronicsP.S. Bimbhra, Khanna Publication.
Power Electronics, Circuits, Devices and Applications, Muhammad H Rashid, Pearson.
Power Electronics, P.C. Sen, Tata McGraw Hill.
Power Electronics Devices, Circuits & Industrial Applications, V.R. Moorthi, Oxford.
Power Electronics, M D Singh & K.B. Khanchandani, Tata McGraw Hill.
Power Electronics, VedamSubrahmanyam, New Age International.

v) PROJECT/DISSERTATION
Course Code: BSCHELCDSE605

Course Type: DSE (Project)	Course details: DSE	L-T-P: 0-0-12

Credit: 6	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:

- Gains in-depth knowledge on the topic of project/dissertation
- Learn how to read research articles, journals and integrate data from multiple sources in appropriate manner
- Learn how to present a topic effectively in oral, written and graphical forms
- Develop ability to write project report