Curriculum for Undergraduate Degree (B.Tech.) in Electrical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Third Semester (Second Year)

Course Name:	**Electric Circuit Theory**		
Course Code:	PC-EE301	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	04
L-T-P:	3-1-0	**Pre-Requisites:**	Basic Electrical & Electronics Engineering (ES-EE 201) and Mathematics (BS-M 101, BS-M 201)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the structure and properties of different type of electrical circuits, networks and sources.
2	To apply different mathematical tools & techniques for analyzing electrical networks.
3	To apply circuit analysis techniques to simplify electrical networks..
4	To solve problems of electrical circuits.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction**: Continuous & Discrete, Fixed & Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks and systems. Independent & Dependent sources, Step, Ramp, Impulse, Sinusoidal, Square, Saw tooth signals.	4L
2	**Graph theory and Networks equations:** Concept of Tree, Branch, Tree link, Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials. Duality, Solution of Problems	4L
3	**Coupled circuits:** Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modeling of coupled circuits, Solution of problems.	3L

4	**Laplace transforms:** Impulse, Step & Sinusoidal response of RL, RC, and RLC circuits. Transient analysis of different electrical circuits with and without initial conditions. Concept of Convolution theorem and its application. Solution of Problems with DC & AC sources.	8L
5	**Fourier method of waveform analysis:** Fourier series and Fourier Transform (in continuous domain only). Application in circuit analysis, Solution of Problems	5L
6	**Network Theorems:** Formulation of network equations, Source transformation, Loop variable analysis, Node variable analysis. Network theorem: Superposition, Thevenin's, Norton's & Maximum power transfer theorem. Millman's theorem and its application in three phase unbalanced circuit analysis. Solution of Problems with DC & AC sources. Dependent and independent voltage and current source and numerical problems.	8L
7	**Two port networks analysis:** Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and their inter relations. Driving point impedance & Admittance. Solution of Problems	5L
8	**Filter Circuits:** Analysis and synthesis of Low pass, High pass, Band pass, Band reject (first order only) using operational amplifier. Solution of Problems	3L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the behavior of different signals and systems.
2	Apply Laplace and Fourier transforms for solving different electrical problems.
3	Understand the fundamental of different network theorems to solve basic numerical problem.
4	Apply graph theory for solving electrical problem in a simplified way.
5	Determine different parameters from a given two port electrical network.
6	Understand the application of active filters for different electric circuit.

Learning Resources:	
Recommended Text books:	
1	Network Analysis, M.E. Valkenburg, Pearson Education
2	Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
3	Networks and Systems, D. Roy Chowdhury, New Age International Publishers
Alternative Text Books:	
4	Circuit and Networks: Analysis and synthesis, A. Sudhakar & S.S. Palli4th edition. Tata Mc Graw Hill Education Pvt. Ltd.
5	Networks & Systems, Ashfaq Husain, Khanna Book Publishing, New Delhi
6	Problems and Solutions of Electric Circuit Analysis, R.K. Mehta & A.K. Mal,

	CBS, New Delhi
Reference Books:	
7	Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand
8	Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin, The Mc Graw Hill Company
9	Network Analysis and Synthesis, C.L. Wadhwa, New Age International Publishers

Course Name:	**Analog Electronics**		
Course Code:	PC-EE302	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	03
L-T-P:	3-0-0	**Pre-Requisites:**	Physics (10+2) and Basic Electrical & Electronics Engineering (ES-EE 201)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the structure and properties of different components of analog electronics.
2	To explain principle of operation of analog electronics components and circuits.
3	To understand the application of operational amplifier
4	To solve problems of analog electronic components and circuits
5	To analyze amplifiers, oscillators and other analog electronic circuits.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Filters & Regulators:** Half wave and full wave rectifier with Capacitor filters, π-section filter, ripple factor, regulated power supply.	3L
2	**BJT circuits:** Structure and I-V characteristics of a BJT; BJT as a switch. biasing circuits, BJT as an amplifier: small-signal model, biasing circuits, common-emitter, common-base and common-collector amplifiers; Multistage amplifier, Small signal equivalent circuits, concept of high frequency model.	8L
3	**MOSFET circuits:** MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common- source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance.	8L
4	**Feedback amplifier & Oscillators:** Concept of Feedback, Negative & Positive feedback, Voltage/Current, Series/Shunt feedback, Berkhausen criterion, Colpit , Hartley's, Phase shift, Wien bridge oscillators.	4L

5	**Operational amplifier & Application of Operational amplifiers:** Characteristics of Ideal OPAMP, Constant current source (Current mirror etc.), CMRR, Open & closed loop circuits, Inverting & non-inverting Amplifiers, Voltage follower/Buffer circuits, Level shifter, Voltage to current & Current to Voltage converter, Adder, Differential amplifier, Integrator & Differentiator, Comparator, Log & Antilog amplifier, Schmitt Trigger, Transconductance amplifier, Instrumentation amplifier, Multiplier/Divisor using OPAMP.	10L
6	**Power amplifier:** Class A, B, AB, C	2L
7	**Multivibrator: Monostable,** Bistable multivibrator, Monostable & Astable operation using 555 timer, Introduction to VCO and PLL.	2L
8	Introduction to VCO and PLL	2L
Total		39L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the operation of rectifier, filter and voltage regulator.
2	Analyze the operation of transistor circuits as analog building block.
3	Understand the operation of OPAMPs as different active linear circuits.
4	Interpret the operation of feedback in amplifiers and oscillators.
5	Understand operational amplifier based circuits for different applications.

Learning Resources:	
Recommended Text Books:	
1	Malvino and Bates, Electronic Principles, McGraw-Hill Education
2	D Chattopadhyay, P C Rakshit, Electronics Fundamentals and Applications, New Age International Publisher
3	Gayakwad R.A -- OpAmps and Linear IC's, 4/e, Pearson-PHI
4	Microelectronic Circuits by SEDRA and SMITH, Oxford
Alternative Text Books:	
5	Floyd, Electronic Devices, Pearson
6	Bell, Electronic Devices and Circuits, Oxford
7	Nagrath, Electronics: Analog and Digital, PHI, 2004
8	Millman & Halkias – Integrated Electronics, Tata McGraw Hill
9	Boyle'stead , Nashelsky: & Kishore, Electronic Devices & Circuit theory, 1/e, PHI/Pearson
10	D. Roy Choudhury, Linear Integrated Circuits, New Age International Publisher
Reference Books:	
11	Maheshwari and Anand , Analog Electronics, PHI
12	Natarajan, Microelectronics: Analysis & Design, 1/e 2005, TMH
13	Nagchoudhuri , Microelectronic Devices, 1/e, Pearson Education, 2001

14	A.K. Maini, Analog Electronics, Khanna Publishing House, 2019
15	Mottershed, Electronics Devices & Circuits, Wiley Eastern

Course Name:	**Electromagnetic field theory**		
Course Code:	PC-EE303	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical & Electronics Engineering (ES-EE 201), Mathematics (BS-M101, BS-M201) and Physics (BS-PH201)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the basic mathematical tools to deal with Electromagnetic field Problem.
2	To understand properties and application of Electric and magnetic field.
3	To analyze electromagnetic wave propagation.
4	To solve problem related to Electromagnetic field.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Vector calculus:** DEL operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Strokes theorem, Laplacian of a scalar, Classification of vector fields, Helmholtz's theorem. Solution of problems	4L
2	**Introduction to Coordinate System:** Co-ordinate systems and transformation, Cartesian coordinates, circular cylindrical coordinates, Spherical coordinates & their transformation. Differential length, area and volume in different coordinate systems. Solution of problems	4L
3	**Electrostatic field:** Coulomb's law, field intensity, Gauss's law, Electric potential and Potential gradient, Relation between E and V, an Electric dipole and flux lines. Energy density in electrostatic field. Boundary conditions: Dielectric-dielectric, Conductor –dielectric, Conductor-free space. Poisson's and Laplace's equation, General procedure for solving Poisson's and Laplace's equation. Solution of problems.	8L
4	**Magneto static fields:** Biot- savart law, Ampere's circuit law, Magnetic flux density, Magnetic static and Vector potential, Forces due to magnetic field, Magnetic torque and moments, Magnetization in material, Magnetic boundary condition, Inductor and Inductances, Magnetic energy, Force on magnetic material. Solution of problems.	8L

5	**Electromagnetic fields:** Faraday's law, Transformer and motional emf, Displacement current, Maxwell's equations, Time varying Potential, Time harmonic fields. Solution of problems	6L
6	**Electromagnetic wave propagation:** Wave equation, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good conductor, Skin effect, Skin depth, Power & Poynting vector, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarisation. Solution of problems.	6L
7	**Transmission line:** Concept of lump & distributed parameters, Line parameters, Transmission line equation & solutions, Physical significance of solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Solution of problems	4L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the Knowledge of Coordinate transformation with the concept of Vector Calculus and several Theorems (Divergence theorem, Strokes theorem and Helmholtz's
2	Apply the knowledge of Coulomb's law & Gauss's law to solve boundary condition problems with the concept of Poisson's & amp; Laplace's Equation.
3	Apply the knowledge of Biot- savart's Law and Ampere's circuital Law to solve problems related to Magnetic Circuits.
4	Determine the effects of Transformer EMF and Motional EMF, wave equation, skin effect, skin depth having the concept of Maxwell's equation and Pointing Theorem.
5	Determine the Transmission Line Parameters, Propagation Constant, Characteristic Impedance, Wavelength and velocity of propagation by solving Transmission line equations.

Learning Resources:	
Recommended Text Books:	
1	Engineering Electromagnetic, W.H. Hyat & J.A. Buck, 7th Edition, TMH
2	Elements of Electromagnetic, Mathew N.O. Sadiku, 4th edition, Oxford university press
Alternative Text Books:	
3	Vector Analysis, Schaum Series, Murray R. Spiegel, McGraw-Hill
4	Electromagnetic Field Theory, S. P. Ghosh, Tata Mc Graw-Hill
Reference Books:	
5	Theory and problems of Electromagnetic, Edminister, 2nd Edition, TMH
6	Electromagnetic field theory fundamentals, Guru & Hizroglu, 2nd edition, Cambridge University

Course Name:	**Mathematics-III**		
Course Code:	BS-M302	**Category:**	Basic Science Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	High school mathematics and Mathematics-I (BSM-

			101)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand probability theory and its applications
2	To know the concept of Complex Analysis
3	To learn Fourier series & transform.
4	To use the concept of generating function in solving recurrence relation.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Basic Probability:** **Probability** (i) Definition of random experiment, sample space, events and probability. (ii) Basic theorems (Statement only) of probability. (iii) Conditional probability and independent events; Multiplication theorem; Baye's theorem (statement only) and related problems. **Probability Distribution:** (i) Definition of random variable; Discrete and continuous random variable; Probability mass function (p.m.f.) and probability density function (p.d.f.) of single random variable; Cumulative distribution function (c.d.f.); Applications. (ii) Expectation and variance of random variable; Properties and applications. (iii) **Some special types of distributions** ➢ **Discrete probability distribution:** Binomial and Poisson distributions; Mean and variance (no proof) and examples. ➢ **Continuous probability distribution:** Uniform, Exponential and Normal distributions; Mean and variance (no proof) and examples	10L
	Fourier Series and Fourier Transforms: • **Fourier Series** (i) Periodic function and periodic extension of a function; Odd and even functions. (ii) **Special wave forms:** square wave, half wave rectifier, full wave rectifier, saw-toothed wave, triangular wave (graphical	

2	illustration only). (iii) Euler's formulae for Fourier series; Fourier series of functions of period 2π; Fourier series of functions of period $2l$; Dirichlet's conditions and related problems. (iv) Half range Sine and Cosine series and related problems. (v) Parseval's identity (statement only) and related problems. • **Fourier Transforms** (i) Definition of Fourier transforms; Properties of Fourier transforms: Linearity, Shifting, Change of scale property; Fourier transforms of some elementary functions; Fourier transforms of derivatives. (ii) Fourier sine and cosine transforms and related problems. (iii) Inverse Fourier transforms and convolution theorem; related problems.	10L
3	**Differential Calculus of Complex Variables:** • **Introduction to differential calculus of function of complex variable** (i) Function of complex variable. (ii) Concept of Limit, continuity and differentiability. (iii) Analytic function; Cauchy-Riemann equations (Statement only); Sufficient conditions for a function to be analytic; Harmonic function and Conjugate Harmonic function; related problems. (iv) Construction of Analytic function; Milne-Thomson Method; related problems.	6L
4	**Integral Calculus of Complex Variables:** • **Complex Integral Calculus** (i) Zeros and singularities of an analytic function: Zeros of an analytic function; Singularities of an analytic function, Nature and Location of Singularities, Pole; Examples. (ii) Concept of simple curve, closed curve, smooth curve and contour; Line integrals along a piecewise smooth curve; Examples. (iii) Cauchy's Theorem (statement only), Cauchy-Gousrsat Theorem (statement only), Examples. (iv) Cauchy's Integral Formula; examples. (v) Taylor's series, Laurent's series; examples. (vi) Residues of a given function. (vii) Cauchy's Residue Theorem (statement only); evaluation of definite integrals involving sine and cosine.	6L

5	**Recurrence Relation & Difference Equation- z-Transforms & Generating Function:** • **z-Transforms** (i) Definition of z-transforms; Properties of z-transforms: Linearity, Shifting, Change of scale property and examples. (ii) Region of Convergence (ROC) of finite and infinite duration signals; related problems. (iii) Inverse z-transforms, Convolution theorem and related problems. (iv) Solution of Difference Equations by z-transforms. • **Generating Function** (i) Introduction to generating function (ii) Some standard generating functions (iii) Solution of recurrence relations by generating functions	8L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Learn the ideas of probability and random variables, various discrete and continuous probability distributions with their properties and their applications in physical and engineering environment.
2	Apply statistical tools for analyzing complex field.
3	Learn the tools of Fourier transform to analyze engineering problems and apply the concept of convergence of infinite series in many approximation techniques in engineering disciplines.
4	To solve engineering problems using z transform and probability theory.

Learning Resources:	
1	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2	Michael Greenberg, Advanced Engineering Mathematics, Pearson
3	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning
5	Reena Garg, Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishers
6	N.G. Das, Statistical Methods (Combined Volume), Tata-McGraw Hill
7	S. Ross, A First Course in Probability, Pearson Education India
8	W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley.

Course Name:	**Numerical Methods**		
Course Code:	BS-M304	**Category:**	Basic Science Courses
Semester:	Third	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Some concepts from basic math – algebra, geometry, pre-calculus and statistics
Full Marks:	100		

Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To compute different numerical errors in computations.
2	To learn interpolation techniques.
3	To apply the techniques for solving integrations, ODEs.
4	Solve linear and non-linear equations.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Approximation in numerical computation:** Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.	2L
2	**Interpolation:** Newton's Forward Interpolation, Newton's Backward Interpolation, Lagrange's Interpolation, Newton's Divided Difference Interpolation.	4L
3	**Numerical integration:** General Quadrature Formula, Trapezoidal Rule, Simpson's 1/3 Rule, Expression for corresponding error terms.	3L
4	**Numerical solution of a system of linear equations:** Gauss Elimination Method, Matrix Inversion, LU Factorization Method, Gauss-Seidel Iterative Method.	6L
5	**Numerical solution of Non-Linear equation:** Bisection Method, Regula-Falsi Method, Newton-Raphson Method.	4L
6	**Numerical solution of ordinary differential equation:** Euler's Method, Runge-Kutta Methods, Predictor-Corrector Methods, Finite Difference Method	5L
7	**Measure of Central Tendency and Dispersion:** Mean, median, mode and S.D.	3L
8	**Curve Fitting by Method of Least Square:** Fitting a straight line of the form $y = a + bx$, Fitting a curve of the form $y = ax + bx^2$, $y = ab^x, y = ae^{bx}, y = ax^b$.	3L
Total		**30L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2	Apply numerical methods to obtain approximate solutions to mathematical problems.
3	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations
4	Analyze and evaluate the accuracy of common numerical methods.

Learning Resources:	
1	C.Xavier: C Language and Numerical Methods
2	A. K. Jalan and Utpal Sarkar, Numerical Methods-A Programming Based Approach, Orient Blackswan Private Ltd.
3	Dutta & Jana: Introductory Numerical Analysis.
4	J.B.Scarborough: Numerical Mathematical Analysis.
5	Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).
6	Balagurusamy: Numerical Methods, Scitech
7	Baburam: Numerical Methods, Pearson Education.
8	N. Dutta: Computer Programming & Numerical Analysis, Universities Press
9	Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
10	Srimanta Pal: Numerical Methods, OUP.

Course Name:	**Biology**		
Course Code:	BS-BIO301	**Category:**	Basic Science Course
Semester:	Third	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Physics (BS-PH201), Chemistry (BS-CH101) and Mathematics (BS-M101)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Bring out the fundamental differences between science and engineering
2	Discuss how biological observations of 18th Century that lead to major discoveries

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Module 1- Introduction to Biology:** To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.	2L

2	**Module2-Classification System in Biology:** The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E. coli, S. cerevisiae, D. melanogaster, C. elegance, A. thaliana, M. musculus.	2L
3	**Module 3: Genetics:** To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be given not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Importance of stem cell research..	2L
4	**Module 4: Biomolecules**: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA	4L
5	**Module 5: Enzymes:** To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Discuss at least two examples.	2L
6	**Module 6: Information Transfer:** The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	4L
7	**Module 7: Macromolecular analysis:** ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.	4L
8	**Module 8: Metabolism:** ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.	2L
9	**Module 9: Microbiology:** Concept of microscopic organisms. Concept of species and strains. Identification and classification of microorganisms. Sterilization and media compositions. Growth kinetics. Microscopy: simple, compound, phase-contrast, SEM, TEM, Confocal: principle and applications..	2L

Total	**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	State different engineering applications from biological perspective.
2	Classify biological systems and identify different organisms and microorganisms depending on their morphological, biochemical and ecological criterion.
3	Explain the concept of recessiveness and dominance during the passage of genetic material from parent to offspring and describe DNA as a genetic material in the molecular basis of information transfer.
4	Discuss structures of different biomolecules starting from basic units and hence understand different biological processes at the reductionistic level.
5	Describe protein structures and enzymology and also compare different mechanisms of enzyme action.
6	Describe energy transformation processes in biological systems.

Learning Resources:	
1	Biology for Engineers. Arthur T. Johnson. CRC Press.
2	Biology and Engineering of Stem Cell Niches. A K Vishwakarma and Jefferey Karp, Elsevier
3	Environmental Biology for Engineers and Scientists. David A. Vaccari, P. P. Storm and J. F Alleman. ELBS
4	Biology for Engineers. G. K. Suraishkumar. Oxford

Laboratory

Course Name:	**Electric Circuit Theory Laboratory**		
Course Code:	PC-EE391	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To simulate electrical circuit experiments using suitable software.
2	To determine different electrical circuit parameters using hardware.
3	To get frequency response of different filters using simulation and hardware technique.
4	To verify different network theorems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Transient response of R-L and R-C network: simulation with software & hardware	2
2	Transient response of R-L-C series and parallel circuit: simulation with software & hardware	2
3	Determination of Impedance (Z) and Admittance (Y) parameter of two-port network: simulation & hardware.	2
4	Frequency response of LP and HP filters: simulation & hardware	2
5	Frequency response of BP and BR filters: simulation & hardware.	2
6	Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form.	2
7	Determination of Laplace transform and Inverse Laplace transform using MATLAB.	2
8	Amplitude and Phase spectrum analysis of different signals using MATLAB.	2
9	Verification of Network theorems using software & hardware	2
Total		**18P**

Course Outcomes:	
After completion of the course, students will be able to:	
1.	Demonstrate transient response of different electrical circuit .
2.	Determine different parameters from a two port network.
3.	Demonstrate frequency response of different active filter circuit.
4.	Simulate different operation of signals for output waveform using MATLAB
5.	Determine Laplace and inverse Laplace transform of different functions using MATLAB
6.	Analyze different network theorems.

Course Name:	**Analog electronic laboratory**		
Course Code:	PC-EE392	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make the students concept about to design, experiment, analyze, interpret in the core field.
2	To provide knowledge based on the needs of society and industry by providing hands on experience.
3	To provide the clear concept of theoretical knowledge's by providing practical experiments.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Study of ripple and regulation characteristics of full wave rectifier with and without capacitor filter.	2
2	Study of Zener diode as voltage regulator. Study of characteristics curves of B.J.T & F.E.T.	2
3	Construction of a two-stage R-C coupled amplifier & study of its gain & Bandwidth.	2
4	Study of timer circuit using NE555 & configuration for Monostable & Astable Multivibrator	2
5	Construction of a simple function generator using IC.	2
6	Realization of a V-to-I & I-to-V converter using Op-Amps.	2
7	Realization of a Phase Locked Loop using Voltage Controlled Oscillator (VCO).	2
8	Study of D.A.C	2
9	Study of A.D.C.	2
Total		**18P**

Course Outcomes:	
After completion of the course, students will be able to:	
1.	Construct a full wave rectifier circuit and voltage regulator using discrete components and study their performance.
2.	Construct the circuits of different amplifier, ADC, DAC and waveform generator using 555 timer and study their performance.
3.	Determine characteristics curve of BJT and FET
4.	Construction of function generator using IC

Course Name:	**Numerical Methods Laboratory**		
Course Code:	BS-M394	**Category:**	Basic Science Course
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To compute different numerical errors in computations.
2	To learn interpolation techniques
3	To apply the techniques for solving integrations, ODEs(Ordinary Differential Equation).
4	Solve linear and non-linear equations

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Assignments on Interpolation: Newton's Forward Interpolation, Newton's Backward Interpolation, Lagrange's Interpolation	4
2	Assignments on Numerical Integration: Trapezoidal Rule, Simpson's 1/3 Rule	4
3	Assignments on Solution of Transcendental Equations: Bisection Method, Regula-Falsi Method, Newton-Raphson Method	4
4	Assignments on ODEs: Euler's Method, Runge-Kutta Method of Order Four	4
5	Curve Fitting by the Method of Least Squares: Fitting a straight line of the form , Fitting a curve of the form ,	4
6	Measure of Central Tendency: Mean and Standard Deviation, Median and Mode	2
7	Assignments on Numerical Solution of a system of Linear Equations: Gauss Elimination Method, Gauss-Seidel Method	2
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1.	Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to intractable mathematical problems.
2.	Apply numerical methods to obtain approximate solutions to mathematical problems.
3.	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations,

	and the solution of differential equations.
4.	Analyse and evaluate the accuracy of common numerical methods

Course Name:	**Constitution of Indian**		
Course Code:	MC372	**Category:**	Noncredit course
Semester:	Third	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 100		

Course Objectives:	
1	Develop an understanding of the nation's constitution.
2	Develop knowledge about the various levels of governance in the country.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** : Sources and Constitutional history. Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.	3L
2	**Union Government and its Administration :** Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Lok Sabha, Rajya Sabha Supreme Court	6L
3	**State Government and its Administration** Governor.Role and Position, CM and Council of ministers High Court	6L
4	**Local Administration District's Administration head:** Role and Importance, Municipalities: Introduction, Mayor, and role of Elected Representative. Pachayati raj: Introduction, Zila Pachayat, Elected officials and their roles. Importance of grass root democracy	6L
5	**Election Commission Election Commission:** Role and Functioning, Chief Election Commissioner	2L
Total		**23L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Gain an understanding of the constitution of India.
2	Become aware of the various levels of governance in the country.

Learning Resources:	
1	'Indian Polity' by Laxmikanth
2	'Indian Administration' by Subhash Kashyap

3	'Indian Constitution' by D.D. Basu
4	'Indian Administration' by Avasti and Avasti