DEPARTMENT OF ELECTRICAL ENGINEERING

B.tech 3rd Sem Structure and Detailed Syllabus

Theory course

Sl. No	Course Type	Course code	Name of the Course	Hours per week			Credit
				L	T	P	C
1	BSC	BMA23113T	Mathematics III	3	1	0	4
2	PCC	BEL23201T	Electrical Circuit Analysis	3	0	0	3
3	PCC	BEL23202T	Analog Electronics	3	0	0	3
4	PCC	BEL23203T	Electrical Machines I	3	0	0	3
5	PCC	BEL23204T	Electrical Instruments and Measurements	2	2	0	3
6	ESC	BCS23207T	Computer Programming using Python	3	0	0	3
7	HSMC	BCH23112T	Environmental Science	2	0	0	0
				19	**3**	**0**	**19**

Practical course

Sl. No	Course Type	Course code	Name of the Course	Hours per week			Credit
				L	T	P	C
1	PCC	BEL23202P	Analog Electronics Lab	0	0	2	1
2	PCC	BEL23203P	Electrical Machines I Lab	0	0	2	1
3	PCC	BEL23204P	Electrical Instruments and Measurements Lab	0	0	2	1
				0	**0**	**6**	**3**

BMA23113T	MATHEMATICS-IIIA	L	T	P	C
		3	1	0	4

Pre-requisite: Calculus, ODE theory and basic algebra

Course Objectives

- To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
- To provide an overview of probability and statistics to engineers

Course Outcome

After successful completion of this course, the students will be able to

CO1: solve field problems in engineering involving PDEs

CO2: formulate and solve problems involving random variables.

CO3: apply statistical methods for analyzing experimental data

Module 1: Partial Differential Equations (PDE)	**20 hours**

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, Separation of variables method to simple problems in Cartesian coordinates. D'Alembert's solution of the wave equation; One dimensional diffusion equation and its solution.

Module 2: Probability	**20 hours**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Continuous random variables and their properties, distribution functions, Bayes' rule

Module 3: Statistics	**20 hours**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi- square test for goodness of fit and independence of attributes

Total Lecture hours	**60 hours**

Text Book(s)

1	Bali, N. P., Goyal M., A text book of engineering Mathematics, Laxmi Publications, Reprint, 2014

2	AICTE Prescribed Textbook: Mathematics – II (Probability and Statistics), ISBN: 978-93-91505- 41-7 2.
Reference Book(s)	
1	Kreyszig E, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2	Garg R., Engineering Mathematics, Khanna Book Publishing Company, 2022.
3	Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021
4	Hoel P. G., Port S. C and Stone C. J., Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint)

Course name: Electrical Circuit Analysis

Course Code: BEL23201T **L:T:P::3:0:0**

Course Objectives:

1. To apply various network theorems such as Thevenin's theorem, Norton's theorem, and superposition theorem to analyze and solve electrical circuits effectively.
2. To design networks using graph theory principles and analyze them for transient response.
3. To evaluate various networks using concepts such as impedance matrices, transmission parameters, and scattering parameters to analyze signal flow and interactions within the network.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. apply the understanding of Network theorems for solving electrical circuits.
2. design networks using Network graph theory and analyse given networks for their transient response.
3. utilize the concept of two-port networks, their characteristics, and mode of interconnection to evaluate various networks.
4. apply Laplace transforms to solve and analyse electrical circuits.

Module No	Module Title	Details	Lecture hours
1	**Network Theorems**	Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, and Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis	10
2	**Steady state and Transient phenomenon**	Forcing functions - impulse, step, and ramp functions, Steady state and transient state response, initial and final conditions in network elements, time constants, Study and solution of simple circuits undergoing transient disturbances.	10
3	**Network Graph Theory**	Elementary graph theory as applied to electrical networks. Matrices of graph: Incidence matrix, circuit matrix, cut set matrix. Mutual coupled circuits, Dot Convention in coupled circuits.	10
4	**Electrical Circuit Analysis Using Laplace Transforms**	Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform, Inverse Laplace transform, transformed network with initial conditions. Poles and Zeros. Frequency response analysis.	9

5	**Two Port Network and Network Functions**	Two Port Networks, the relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.	6
		Total	**45**

Text / References:

1. M. E. Van Valkenburg, —Network Analysis‖, Prentice Hall, 2006.

2. D. Roy Choudhury, —Networks and Systems‖, New Age International Publications, 1998.

3. W. H. Hayt and J. E. Kemmerly, —Engineering Circuit Analysis‖, McGraw Hill Education, 2013.

4. C. K. Alexander and M. N. O. Sadiku, —Electric Circuits‖, McGraw Hill Education, 2004.

5. K. V. V. Murthy and M. S. Kamath, —Basic Circuit Analysis‖, Jaico Publishers, 1999.

Course name: Analog Electronics

Course Code: BEL23202T **L:T:P::3:0:0**

Course Objectives:

1. To develop a thorough understanding of the characteristics, behaviors, and applications of diodes and transistors in electronic circuits.
2. To apply theoretical knowledge to solve practical problems related to circuit performance and efficiency.
3. To understand the operational principles of Operational Amplifiers (OP-AMPs) and demonstrate competence in designing circuits that utilize OP-AMPs for specific applications.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of diodes and transistors.
2. Design and analyse various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP-based circuits.

Module No	Module Title	Details	Lecture hours
1	**Diode circuits**	Semiconductor Materials, Semiconductor Diode, Equivalent Circuits, Diode Testing, Zener Diodes, Load Line Analysis, Rectifier Circuits, Wave Shaping Circuits, clamping and clipping circuits. Circuit simulation using P-SIM or any open source software	4
2	**BJT circuits**	Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits, BJT types, region of operation, biasing methods	8
3	**MOSFET circuits**	MOSFET structure and I-V characteristics, MOSFET as a switch, Transistors Biasing, Transistors Small Signal Analysis, Transistor Amplifier Circuits	8
4	**Differential, multi-stage and operational amplifiers**	Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)	8

5	**Linear applications of op-amp**	Idealized analysis of op-amp circuits, Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift), Analog to Digital Conversion.	8
6	**Nonlinear applications of op-amp**	Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector, Monoshot	6
7	**Circuit Simulation**	Demonstration and Practice of Diode, BJT, MOSFET, OpAmp (linear and nonlinear) circuits using open source simulator circuit	3
		Total	**45**

Text Book:

1. S. Sedra and K. C. Smith, —Microelectronic Circuits‖, New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, —Introduction to Operational Amplifier theory and applications‖, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, —Microelectronics‖, McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, —The Art of Electronics‖, Cambridge University Press, 1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, —Analysis and Design of Analog Integrated Circuits‖, John Wiley & Sons, 2001.
6. D Roy Choudhury, Sahil B Jain, -Linear Integrated Circuits, New Age International Publisher, 2010.

References:

1. S. Salivahanan, N S Kumar, A Vallavaraj, - Electronic Devices and Circuits || The McGraw Hill Companies, 2009
2. JJ Cathy, - Electronic Devices and Circuits, The McGraw Hill, 2nd edition, 2006
3. L K Maheswari, M M S Anand- Analog Electronics|| Prentice Hall of India Pvt. Ltd, 2005

Course name: Electrical Machines-I

Course Code: BEL23203T **L:T:P::3:0:0**

Course Objectives:

To study and understand different types of DC generators, Motors and Transformers, their construction, operation, and applications.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. explain Electromechanical Energy conversion and electromagnetic induction
2. explain the operation of DC machines and their constructional features
3. explain the operation of a transformer and its construction.
4. analyze the characteristics of DC Generators and Motors

Module No	Module Title	Details	Lecture hours
1	Electromechanical Energy Conversion	Review of magnetic circuits, MMF, Electromagnetic induction, magnetically induced e.m.f., Electromechanical Energy Conversion, Rotating Electrical Machines-Motor and Generators	5
2	Transformers	Principles of operation of the transformer, voltage, and current ratios, Construction – shell type, and core type, E.m.f. equation and output equation, Magnetic circuit, leakage flux and leakage reactance, Phasor diagram, Open circuit and short tests, Regulation, losses and efficiency, maximum efficiency, all-day efficiency, Auto-transfer, Three phase transformer	13
3	DC Machines-Generators	Constructional features, Details of Armature windings, Methods of excitations-shunt, series, and compound. E M F equation, Armature reaction, Inter-poles and compensatory windings, Commutation, Characteristic of generators, Efficiency, and Regulation.	15

4	DC Machines-Motors	Torque equation of motors, Speed and Torque characteristic curves of shunt, series and compound motors, Starting of D.C motors – Starters, Speed Control Methods, Losses and Efficiency, Testing – Swinburne's test, Back to backtest, Retardation test and Brake test.	12
Total			**45**

Text Book:

1. Mehta V.K. and Mehta, R. "Principle of Electrical Machines", S. Chand and Co.
2. Nagrath D.P. & Kothari I.J, " Electrical Machines", Tata McGraw Hill Education
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Course name: Electrical Instruments and Measurements

Course Code: BEL23204T **L:T:P::3:0:0**

Course Objectives:

1. To comprehend the fundamental principles of electrical measurements, including measurement units, accuracy, and precision.
2. To analyze and compare various electrical measurement techniques and instruments, understanding their advantages, limitations, and applications.
3. To apply knowledge to design and implement measurement setups using electronic instruments for practical electrical engineering applications.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. explain the fundamental principles of electrical measurements, including terminology, standards, and measurement uncertainties.
2. compare different measurement techniques, critically analyzing their suitability for specific electrical parameters and conditions.
3. design and implement measurement setups using electronic instruments to accurately measure electrical quantities, demonstrating practical application skills.
4. analyze information obtained from measurements, draw conclusions, and make recommendations based on the analysis of electronic instrument data.

Module No	Module Title	Details	Lecture hours
1	**Characteristics of instruments and measuring systems**	Static characteristics – accuracy, sensitivity, reproducibility, drift, static error and dead zone, Dynamic characteristics, Errors occurring in measurement, and Types of errors.	5
2	**Measuring Instruments**	Electro-dynamic type ammeters and voltmeters – construction, operation, errors and compensation, Electro-dynamic and induction type watt meters, Single phase induction type energy meter, Synchroscope	6
3	**Measurement of Resistance, Inductance and capacitance**	Wheatstone bridge method – sensitivity of the Wheatstone Bridge – precautions to be taken while making precision measurements, Limitations, Carey-Foster slide Wire Bridge. Measurement of low resistance – Kelvin's Double Bridge. Measurement of high resistance – direct deflection method. Measurement of volume and surface receptivity. Loss of charge method. Measurement of insulation resistance with power on	7

4	**Potentiometers**	D. C. potentiometer – basic principle. Laboratory-type potentiometer. Methods of standardization. Applications- calibration of ammeters and voltmeters, measurement of resistance and power - calibration of watt meters. Volt ratio box, A. C. potentiometers – the difference between A. C. and D. C. potentiometers. Types - polar and coordinate type. Application of A. C. potentiometer.	7
5	**A.C. Bridges**	General principle, Balance equation. Sources and Detectors used in A. C. Bridges. Balance condition and Phasor diagrams of Maxwell's bridge, Anderson's bridge, Owen's bridge, De Sauty's bridge, Low voltage Schering Bridge, Heavy-side mutual inductance Bridge.,Wein's bridge	7
6	**Transducers**	Introduction to sensors, transducers, types of transducers- strain gauges, LVDT, capacitive transducers, piezoelectric transducers, Hall effect transducers	4
7	**Instrument Transformer**	Use of instrument transformers – ratio, burden. Theory and operation of CTs and PTs – errors and compensation – CT testing – mutual inductance method, Silbee's method. PT testing – comparison method. Power and energy measurement using CTs and PTs.	6
8	**C.R.O and DSO**	Basic construction, main parts, principle of operation, Applications	3
		Total	**45**

Text Books:

1. J.B. Gupta- A Course in Electronics and Electrical Measurements and Instrumentation.

2. A.K. Sawhney – Electrical and Electronic Measurements and Instrumentation.

3. K. Krishna Reddy- Electrical Measurements.

Course name: COMPUTER PROGRAMMING USING PYTHON

Course Code:BCS23207T **L:T:P::3:0:0**

Course Outcomes:

1. Identify the basic concepts of Python programming and its real-time use.
2. Apply the concepts of conditional and looping statements, functions, and strings.
3. Elaborate the methods to create Python programs using data structures like lists, dictionaries, tuples, and sets.
4. Develop suitable programs using Python language for problem solving.

Module No	Module Title	Details	Lecture hours
1	**Introduction**	Python Programming: Python IDE, Python Scripts, Basics: Data types, Variables, Expressions, Identifiers, Reserved words, Indentation, Comments, Operators: Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators	8
2	**Conditionals and Loops**	Control Structures: – if, if-else, nested if, if–elif ladder statements. Loops: for, while, Nested loops, else in loops, break, continue and pass statements	8
3	**Data structures**	List: Create, Access, Slicing, Negative Indices, List Methods, and comprehensions. Tuples: Create, Index, and Slicing, Operations on tuples. Dictionary: Create, add, and replace values, and operations on dictionaries. Sets: Create and operations on set.	8
4	**Functions and Strings**	Functions: Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments, Scope of variables: Local and global scope, Recursion and Lambda functions Strings: Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings	8

5	**NumPy Basics**	NumPy Basics: Arrays and Vectorized Computation- The NumPy ND array- Creating ND arrays- Data Types for ND arrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing- Boolean Indexing-Transposing Arrays and Swapping Axes. Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting Unique and Other Set Logic, Data Visualization	8
6	**Programming using Python**	a. Familiarization with basics of Python programming along with Python IDE and Scripts b. Simple computational problems using expressions and operators c. Problems involving if, if-else, nested if, if–elifstatements d. Problems involving loops and break and continue statements e. Programs illustrating lists, tuples, dictionaries, sets f. Simple programs describing functions and strings g. Programs related to NumPy basics with ND array.	5
		Total	**45**

Text Book

1. S.Gowrishankar and A.Veena, “Introduction to Python Programming”, 1st Edition, CRC Press/Taylor
2. Vamsi Kurama, “Python Programming: A Modern Approach”, Pearson
3. Mark Lutz, “Programming Python”, 4th Edition, O'Reilly Media
4. John V Guttag, “Introduction to Computation and Programming Using Python”, MIT Press

Reference Books

1. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem Solving Focus”, Wiley India Edition
2. P. Gries, J. Campbell and J. Montojo, “Practical Programming: An Introduction to Computer Science using Python 3ll”,2ndedition, Pragmatic Programmers, LLC.
3. John Zelle, “Python Programming: An Introduction to Computer Science,” 3rd edition, Franklin, Beedle

BCH23112T	ENVIRONMENTAL SCIENCE	L	T	P	C
		2	0	0	0

Pre-requisite: Biology, Sociology, Chemistry

Course Objectives: The objectives of this course are to:

1. To examine the concept of environment and ecosystem.
2. To understand the different types of natural resources and the concept of biodiversity and itsimportance for the environment.
3. To examine the concept of different types of environmental problems such as pollution, climate change, population growth and its causes, effects on environment and to find out thesolution to control the environmental degradation.

Course Outcome: After successful completion of this course, the students will be able to

CO1 : Understand the basic concept of environment and ecosystem.
CO2: Value the natural resources, conservation of biodiversity and its importance.
CO3: Evaluate the problems of environmental issues such as pollution, population growth,climate change and its impact on human and environment and the control measures.

Module1: Concepts of Environmental Science — **3 hours**

Definition of environment, scope and importance of environmental studies; Need for publicawareness; Structure and functions in an ecosystem.

Module 2: Natural Resources — **6 hours**

Renewable and Non-renewable Resources;
Forest, water, minerals, food and land resources (with example of one case study); Energy,growing energy needs, energy sources (conventional and alternative).

Module 3: Biodiversity And Its Conservation — **5 hours**

Biodiversity at global, national and local levels; India as a mega diversity nation;Threats to biodiversity (biotic, abiotic stresses), and strategies for conservation.

Module 4: Environmental Pollution — **8 hours**

Types of pollution-Air, water (including urban, rural, marine), soil, noise, thermal, nuclear; Pollution prevention; Management of pollution –Rural /Urban/Industrial waste management[with case study of any one type, e.g., power (thermal/nuclear), fertilizer, tannin, leather, chemical, sugar], Solid/Liquid waste management, disaster management.

Module 5: Social Issues and Environment — **8 hours**

From unsustainable to sustainable development; Problems relating to urban environment-Population pressure, water scarcity, industrialization, remedial measures;
Climate change-Reasons, effects (global warming, ozone layer depletion, acid rain) with one case study;
Legal Issues-Environmental legislation (Acts and issues involved), Environmentalethics.

Total Lecture hours — **30 hours**

Text Book(s)

1	S.C. Santra: Environmental Science, New Central Book Agency
2	S.E. Manahan: Environmental Chemistry
3	K.V. Krishnamurthy: Textbook of Biodiversity

Reference Book(s)

1	Agarwal, K.C., Environmental Biology, Nidi Publication Ltd., Bikaner, 2001.
2	Bharucha Erach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmadabad, 2002
3	Dr R J Ranjit Daniels and Dr Jagadish Krishnaswamy, Environmental studies-2010-Willey India

Course name: Analog Electronics Lab

Course Code: BEL24202P **L:T:P::0:0:2**

Course Objectives:

To be able to design, construct, and analyze fundamental analog electronic circuits

Course Outcomes:

1. To demonstrate the basic concept of electronic devices, circuits and their applications.
2. To analyze the different characteristics of the electronic devices and their circuits.

LIST OF EXPERIMENTS:

1. Construction of Half wave and full wave rectifier circuits and study their characteristics.
2. Common Base configuration of BJT and Evaluation of H-parameter.
3. Common Emitter configuration of BJT and Evaluation of H-parameter.
4. Study of JFET/MOSFET characteristics.
5. Study of OPAMP inverting and Non-inverting Amplifiers.
6. Study of OPAMP Summing and Difference Amplifier.
7. Study of Instrumentation Amplifier using OPAMP.
8. Study of Wein Bridge Oscillator using OPAMP.
9. Study of active filters using OPAMP.
10. Study of non-linear OPAMP applications

Learning Resources:

1. Analog Electronics Laboratory Manual

Course name: Electrical Machines-I Lab

Course Code: BEL24203P **L:T:P::0:0:2**

Course Objectives:

1. To analyze, test, and evaluate the performance characteristics and control methods of DC machines and transformers, enabling them to apply theoretical knowledge to practical applications in electrical engineering.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. conduct and interpret open circuit characteristics and load tests on DC shunt generators, as well as perform load tests on DC series and compound motors to evaluate their performance.
2. implement and analyzing various speed control methods for DC shunt motors, enhancing their ability to manage and optimize motor performance in practical scenarios.
3. perform open circuit, short circuit, load, and Sumpner's tests on single-phase transformers, and understand the connections and operational principles of three-phase transformers, thereby gaining a comprehensive understanding of transformer performance and efficiency.

LIST OF EXPERIMENTS:

1. Open circuit characteristics of a DC shunt Generator.
2. Load Test on a DC shunt generator.
3. Speed Control of a D.C. Shunt Motor.
4. Open circuit and short circuit tests on a single-phase transformer.
5. Load Test on a single-phase transformer.
6. Sumpner's test on two similar single-phase transformers.
7. Study on Three-phase Transformer Connections.
8. Hopkinson's Test on two similar DC machines.
9. Load test on a D.C Series Motor.
10. Load test on a D.C Compound Motor.

Learning Resources:

1. Electrical Machines-I Laboratory Manual

Course name: Electrical Instruments and Measurements Lab

Course Code: BEL24204P **L:T:P::0:0:2**

Course Objectives:

1. To apply knowledge to design and implement measurement setups using electronic instruments for practical electrical engineering applications.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. compare different measurement techniques, critically analyzing their suitability for specific electrical parameters and conditions.
2. design and implement measurement setups using electronic instruments to accurately measure electrical quantities, demonstrating practical application skills.
3. analyze information obtained from measurements, draw conclusions, and make recommendations based on the analysis of electronic instrument data.

LIST OF EXPERIMENTS:

1. Measurement of very low resistance using Kelvin's double bridge.
2. Measurement of frequency using Wien bridge oscillator
3. Measurement of capacitance using Schering Bridge.
4. Calibration of Single-phase energy meter with resistive load.
5. Measurement of power in a 3- phase balanced circuit by two
6. Wattmeter method.
7. Temperature measurement using RTD.
8. Temperature measurement using Thermistor Temperature measurement using Thermocuple

Learning Resources:

1. Laboratory Manual of Electrical Instruments and Measurements Laboratory

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