



<b>Program</b>	BACHELOR OF TECHNOLOGY (B.Tech)	<b>Semester - 3</b>
<b>Type of Course</b>	Skilling-Based Course/Training	
<b>Prerequisite</b>		
<b>Rationale</b>	-	
<b>Effective From A.Y.</b>	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				SEE TH	IAT	SEE P	CCE	
-	-	-	2	-	-	80	20	100

*SEE - Semester End Examination, IAT - Internal Assessment Test, CCE - Continues & Comprehensive Evaluation*



<b>Program</b>	BACHELOR OF TECHNOLOGY (B.Tech)	<b>Semester - 3</b>
<b>Type of Course</b>	Professional Core Course	
<b>Prerequisite</b>	1EL101 - BASIC ELECTRICAL ENGINEERING	
<b>Rationale</b>	This course provides foundational knowledge of transformers and induction motors, essential components in electrical power systems and industrial applications. It equips students with analytical and practical skills for evaluating machine performance, efficiency, and motion control methods. By integrating theoretical concepts with hands-on analysis, the course prepares students for real-world challenges in power engineering and motion industry.	
<b>Effective From A.Y.</b>	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				SEE TH	IAT	SEE P	CCE	
3	-	2	4	70	30	50	50	200

SEE - Semester End Examination, IAT - Internal Assessment Test, CCE - Continues & Comprehensive Evaluation

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>Single Phase Transformer</b> Review of single phase transformer, Construction, E.M.F. equation, Types of Transformers Equivalent circuit, phasor diagram for different power factor, Losses, separation of no-load losses, efficiency, conditions for maximum efficiency, determination of equivalent circuit parameters, calculation of efficiency and voltage regulation using Direct load test, O.C. and S.C. Test, Sumner's test. Polarity test, Concept of all-day efficiency. Parallel operation of transformers and Load sharing under different operating conditions. Auto transformer, saving of copper and applications. Numerical based on above topics.	12	25
2	<b>Three Phase Transformer</b> Construction, types of connection and their comparative features, Three- winding transformers Vector groups, terminal marking and nomenclature, protective and safety devices fitted on Transformers, Parallel operation of three phase transformers, Magnetizing current, No-load and on-load tap-changing of transformers, Cooling of transformers. Application of transformers in various electrical Systems, Specification and Rating of transformer. Type routine and special test of transformer.	9	20
3	<b>Electromechanical Energy Conversion</b> Principle, Singly Excited and Doubly Excited Magnetic system. Physical concept of force, speed and Electromagnetic torque production; Electromechanical power.	2	5
4	<b>Three Phase Induction Machine</b> Constructional details, classification, production of rotating magnetic field, Principle of operation, Torque equations, Methods of starting and conventional and electronics starters, full load and maximum operating conditions, condition for maximum-output torque, slip, Torque-slip characteristics, Effect of parameter variation on performance characteristics (variation of rotor and stator resistances, stator voltage, unbalance voltage and frequency), Effect of Harmonics, Phasor-diagram, equivalent circuit. Tests on Induction Motor: Direct Load Test, No load and blocked rotor test-determination of equivalent circuit parameters Losses and efficiency, Predetermination of performance under different operating condition using circle diagram. Speed control for induction motors with conventional method and Electronic convertors. Crawling and Cogging of induction motor, Energy Efficient three phase induction motor. Induction generator operation. Self-excitation of induction generator. Numerical based on above topics.	15	30
5	<b>Single Phase Induction Motor</b> Double field revolving theory, Starting & running performance of 1- phase induction Motor, Equivalent circuit of 1- induction motor, Types of single-phase motors, Principle and operation of split phase, Resistance start, Capacitor start and capacitor start & run induction motor, Shaded pole induction motor.	5	15
6	<b>Commutator motors</b>	2	5



**Course Content**

T - Teaching Hours | W - Weightage

Sr.	Topics	T	W
	Construction and working principle of Universal motor and Repulsion motor.		
<b>Total</b>		<b>45</b>	<b>100</b>

**Suggested Distribution Of Theory Marks Using Bloom's Taxonomy**

Level	Remembrance	Understanding	Application	Analyze	Evaluate
<b>Weightage</b>	25	30	10	15	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes**

At the end of this course, students will be able to:

CO1	Describe the fundamental principles of single-phase transformer, including Construction, working, testing methods, Evaluate the performance parameters and parallel operation.
CO2	Comprehend the fundamental principles of three-phase transformers, including construction and Compare different transformer connections, vector groups, and relevant phasor diagrams and testing.
CO3	Describe of electromechanical energy conversion.
CO4	Analysis the construction, working principle, Testing, Evaluate the Performance Parameters and operational feasibility of 3-phase Induction machine.
CO5	Illustrate the construction, working principle and application of single phase induction motor.
CO6	Comprehend the construction, working principle of Commutator motors.

**CO PO Mapping**

CO	CO - 1	CO - 2	CO - 3	CO - 4	CO - 5	CO - 6
PO - 1	3	3	2	3	3	3
PO - 2	2	2		2	1	1
PO - 3						
PO - 4	1	1		1		
PO - 5	1	1		1	1	1
PO - 6	1	1	1	1	1	1
PO - 7						
PO - 8	1	1		1	1	1
PO - 9	1	1		1	1	1
PO - 10						
PO - 11	1	1	1	1	1	1

**Reference Books**

1.	<b>Theory and Performance of Electrical Machines</b> By J B Gupta   Katson Publication
2.	<b>Electrical Technology – Part I and II</b> By B. L. Theraja   S. Chand and Co.
3.	<b>Electrical Machines</b> By I J Nagrath and D. P. Kothari   Tata McGraw-Hill
4.	<b>Electrical Machinery</b> By P. S. Bhimbra   Khanna Publishers

**List of Practical**

1.	<b>To study construction and working of transformer.</b>
2.	<b>To study construction and working of induction motor.</b>
3.	<b>To carry out direct load test on a single phase transformer and determine its efficiency and voltage regulation at various load condition.</b>
4.	<b>To conduct open circuit and short circuit test on a single phase transformer and determine efficiency and voltage regulation at any load and find the equivalent circuit parameters.</b>
5.	<b>To operate two single phase transformer in parallel and plot the variation of currents shared by each transformer various load current.</b>
6.	<b>To conduct Sumpner test on two identical single-phase transformers and determine their efficiency at various loads.</b>
7.	<b>To study different types of starters used for 3-phase induction motor.</b>
8.	<b>To study the capacitor start capacitor run type single phase induction motor.</b>
9.	<b>To performer direct load test on three phase induction motor and determine efficiency under various load condition.</b>
10.	<b>To perform no load and blocked rotor test of induction motor to draw circle diagram and determine performance characteristics' of three phase induction motor.</b>
11.	<b>To study construction and working of universal motor and repulsion motor.</b>

**Miscellaneous****(A) Open Source Websites for Self Learning:**

<https://nptel.ac.in/course/108102146>

<https://nptel.ac.in/course/108105017>

<https://nptel.ac.in/course/108106071>

<https://nptel.ac.in/course/108105131>

<https://nptel.ac.in/course/108105155>

**(B) Open source software and website:**

1. Scilab (<https://www.scilab.org/>) – An open-source alternative to MATLAB, useful for circuit analysis, transformer calculations, and motor performance analysis.

2. Octave (<https://www.gnu.org/software/octave/>) – Useful for numerical calculations and simulation of electrical machines.

3. PSIM (Free Version) / OpenModelica (<https://openmodelica.org/>) – For modeling and simulating electrical circuits and machines.

4. FEMM (Finite Element Method Magnetics) (<http://www.femm.info/>) – Used for electromagnetic field analysis of transformers and induction motors.

5. KiCad (<https://www.kicad.org/>) – Open-source PCB design tool, useful for designing small transformer circuits.

6. LTspice (<https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html>) – For circuit simulation, including transformer and motor circuits.

**(C) Open Source Websites Simulation:**

1. All About Circuits (<https://www.allaboutcircuits.com/>) – Excellent resource for learning about transformers, motors, and electrical engineering concepts.
2. Electrical4U (<https://www.electrical4u.com/>) – Provides detailed explanations of electrical machines, transformers, and motor operation.
3. MIT Open Courseware (<https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/>) – Free courses on electrical machines and power electronics.
4. Circuit Lab (Free with limited access) (<https://www.circuitlab.com/>) – Web-based circuit simulator for testing transformer and motor circuits.
5. Virtual Labs by IITs (Government of India Initiative) (<https://vlab.co.in/>) – Simulations and experiments related to transformers and induction motors.

**(D) List of Laboratory Resources Required:****1. Transformers and Induction Machines:**

- Single-Phase Transformers (Different KVA Ratings)
- Auto-Transformers (Variable voltage supply)
- Three-Phase Induction Motors (Squirrel Cage & Slip-Ring types, various power ratings)
- Single-Phase Induction Motors (Split-phase, Capacitor start, Capacitor run, Shaded pole)
- Cut section of various machines

**1. Testing and Measurement Instruments:**

- Multimeters (Digital & Analog)
- Wattmeters (Single-phase & Three-phase)
  - AC/DC Voltmeters & Ammeters
  - Frequency Meters
  - Power Factor Meter
  - Open Circuit & Short Circuit Test Setup (for Transformers)
  - No-load & Blocked Rotor Test Setup (for Induction Motors)
  - Tacho Meter (Digital/Analog)
  - Loading Rheostats

**1. Power and Control Systems:**

- Three-Phase & Single-Phase Power Supply Panels
- DOL (Direct-On-Line) Starters
- Star-Delta Starters
- Auto-Transformer Starters
- Soft Starters for Induction Motors
- Variable Frequency Drives (VFDs)
- Capacitor Banks (for Power Factor Improvement)
- Protection Relays (Overload, Overvoltage, under voltage) panel

**4. Accessories & Safety Tools:**

- Connecting Wires (High voltage & Low voltage)
- Clamp Meters & Power meter
- Autotransformer (Variac)
- Breadboards & Soldering Stations
- Safety Equipment (Insulated gloves, Fire extinguisher, First Aid kit)

**Activities suggested under self learning**

**Sl. No. Name of the activity No. of hours Evaluation Criteria** 1. Industry/Research laboratory visit Visit = 5h, Report preparation = 5h

Total = 10h Based on report submitted. Report should contain observations and calculations based on industry/ lab



data. 2. Technical Video based learning related to the subject(NPTEL) Duration of video = 5h  
Report preparation = 5h Total = 10h Report /presentation based on the video learning outcomes. 3. Assignment writing. Numerical based assignment is preferable. 5 assignments of 2h each. Total = 10h Based on the assignment submitted. 4. Self learning on-line course (SWAYAM) Minimum duration of the course should be 10h. Examination based assessment at the end of course. Based on the certificate produced. 5. Complex problem solving Maximum 2 problem. Study of the problem and solution finding, Total = 10h Based on the depth of the solution submitted. 6 Videos on Industrial safety aspects based on subject Duration of video = 5h Report preparation = 5h Total = 10h Based on quiz/report submitted 7. Poster/chart/power point preparation on technical topics Duration = 6 h Based on poster/chart preparation and presentation skills 8 Working/non-working model on technical topics Working = 12 h Non- working = 8 h Based on inter department/external evaluation 9 Industrial exposure for 2-3 days to observe and provide tentative solutions Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h Based on evaluation of critical problems and solutions 10 Group Discussion on emerging/trending technical topics based on subject Duration = 1 h each Based on performance in group discussion, technical depth, knowledge etc 11. Real world case studies based learning Duration of data collection/study = 5h Report preparation = 5h Total = 10h Based on in-depth study, technical depth, data collected, fact finding, etc. 12 Blog or Technical Article Writing 10h (Research – 6h, Writing – 4h) Based on originality, technical content, references cited, and clarity of communication. 13 Annotated Video Explanation of Concept/Problem 10h (Preparation + Recording + Submission) Based on accuracy of explanation, clarity, and presentation style. 14 Online Technical Quizzes/Simulations Multiple quizzes summing up to 10h Based on quiz scores and reflection report after each quiz. 15 Tech Blog/YouTube Channel Curation 10h (Content curation + Analysis) Summary report on curated content and learning outcomes. 16 Patent Search and Innovation Gap Identification 10h (Search + Report) Based on number of relevant patents analyzed and identification of innovation scope. 17 Maintenance or Troubleshooting Logbook 10h (For example: lab instruments, computer hardware) Based on documented cases, approach, and resolution. 18 Involvement in Student Chapter (IEI/SPE /IEEE/ISTE) Organizing student chapter activities/workshops (5h)+ Report /writing articles for the chapter newsletter(5h) Based on short activity report and reflection

Note:

- All the suggested activity should be related to the subject.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.



<b>Program</b>	BACHELOR OF TECHNOLOGY (B.Tech)	<b>Semester - 3</b>
<b>Type of Course</b>	Professional Core Course	
<b>Prerequisite</b>	Fundamental knowledge of Electrical Engineering.	
<b>Rationale</b>	The course is aimed to provide exposure about, various AC supply systems, transmission lines and their parameters, underground cables and their parameters, substation equipment's, neutral grounding and sources of over-voltages and protection against them.	
<b>Effective From A.Y.</b>	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				SEE TH	IAT	SEE P	CCE	
3	-	2	4	70	30	50	50	200

SEE - Semester End Examination, IAT - Internal Assessment Test, CCE - Continues & Comprehensive Evaluation

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>Electrical Supply Systems</b> Electric supply system, line diagram of Power system, Typical ac power supply scheme, Advantages of high transmission voltage, Overhead v/s underground systems, Requirements of a distribution system, Connection schemes of distribution system. AC Distribution – Methods of solving AC distribution problems, Four wires star connected unbalanced load, Examples.	5	8
2	<b>Transmission Line Parameters (Resistance &amp; Inductance)</b> Line resistance, Inductance of single conductor, Inductance of single phase lines, Flux linkages in terms of self and mutual inductances, Inductance of 3-phase transmission lines – Symmetrical spacing, asymmetrical spacing and transposed lines, Inductance of composite conductors, Inductance of 3-phase double circuit lines, Examples.	13	35
3	<b>Transmission Line Parameters(Capacitance)</b> Line capacitance, Capacitance of single phase lines, Capacitance of three phase lines, Effect of bundling, Capacitance of three phase double circuit lines, Effect of earth on the capacitance, Examples.	4	7
4	<b>Underground Cables</b> Underground cables, construction of cables, Insulating materials of cables, Classification of cables, Cables for 3-phase service, Insulation resistance of a single core cable, Capacitance of a single core cable, Dielectric stress in single core cable, Most economical conductor size in cable, Grading of cables, Capacitance grading, Inter sheath grading, Capacitance of 3-core cables, Measurement of core to core and core to earth capacitances, Examples.	8	15
5	<b>Substation Equipment &amp; Neutral Grounding</b> Classification of substations, Transformer substation, Pole mounted substation, Underground substation, Symbols for equipment's in substations, Equipment's in a transformer substation, Bus-bar arrangements in substations, Terminal and through substations, Key diagrams of 66/11 kV substation and 11kV/400V indoor substation, Line Insulator types, String efficiency. System with ungrounded neutral, Neutral grounding, Advantages of neutral grounding, Methods of neutral grounding – Solid grounding, Resistance grounding, Reactance grounding, Resonant grounding, Voltage transformer earthing, Grounding transformer.	10	25
6	<b>Power Factor and Power Factor Improvement</b> Power factor, Power factor triangle, Causes of low power factor, Disadvantages of low power factor, Power factor improvement, Power factor improvement equipment, Calculations of power factor correction, Most economical power factor, Examples.	5	10
<b>Total</b>		<b>45</b>	<b>100</b>



**Suggested Distribution Of Theory Marks Using Bloom's Taxonomy**

Level	Remembrance	Understanding	Application	Analyze	Evaluate
<b>Weightage</b>	15	25	25	20	15

*NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.*

**Course Outcomes**

**At the end of this course, students will be able to:**

CO1	Explain the representation of power system & Supply Systems.
CO2	Calculation of line parameters (resistance, inductance and capacitance).
CO3	Describe underground cables.
CO4	Represent different power system components.
CO5	Learn application of Earthing and Neutral Grounding for Power system.
CO6	Learn Power factor improvement in power system network.

**CO PO Mapping**

CO	CO - 1	CO - 2	CO - 3	CO - 4	CO - 5	CO - 6
PO - 1	3	3	2	3	2	3
PO - 2	2	3	2	2	2	3
PO - 3	1	1	1	2	1	2
PO - 4	1	2	1	1	2	1
PO - 5	2	3	2	3	2	3
PO - 6	1	1	2	1	2	1
PO - 7	1	1	1	1	1	1
PO - 8	1	1	1	1	2	1
PO - 9	2	1	1	1	1	1
PO - 10	1			1	1	1
PO - 11	1	1	1	1	2	2



#### Reference Books

1.	<b>Principles of Power System</b> By V. K. Mehta, Rohit Mehta   S. Chand Publications
2.	<b>Electrical Power Systems</b> By Rao S. S and Uppal S. L   Khanna Publications
3.	<b>A Course in Power Systems</b> By J.B. Gupta   S.K. Kataria & Sons
4.	<b>Electrical Power systems</b> By C. L .Wadhwa   New Age International Publishers
5.	<b>Modern Power system Analysis</b> By I J Nagrath, D P Kothari   McGraw Hill
6.	<b>Elements of Power Systems Analysis</b> By W. D. Stevenson   McGraw Hill

#### List of Practical

1.	Develop single line diagram of power system in Simulink software.
2.	Simulation of three phase system with three phase balanced load with neutral grounded.
3.	Simulation of three phase system with three phase load, effect of unbalanced load on the voltages of phases with and without neutral grounded.
4.	Write a program for calculating line inductance for different conductor configurations and dimensions.
5.	Write a program for calculating line capacitance for different configurations and design of line.
6.	Write a program to calculate string efficiency of string of insulating discs for voltage levels.
7.	Prepare layout of substation for 66/11 kV with all necessary equipment's.
8.	Prepare layout for Pole mounted substation with all necessary equipment's.
9.	To study different types of underground cable use in Power system.
10.	Simulation on power factor improvement for different Load.
11.	To study different types of earthing and its application.

**Miscellaneous****(a) Suggested Self-Learning Points (Total 45 Hours)**

1. Industry / research laboratory visit. (Visit (5Hr) + Report Preparation (5Hr) = Total 10 Hours)
2. Technical video learning related to subject. (Video (5Hr) + Report Preparation (5Hr) = Total 10 Hours)
3. Assignment writing. (Assignment of 2Hr each = Total 10 Hours)
4. Self-learning online courses. (Minimum duration of course 10Hr = Total 10 Hours)
5. Videos on Industrial safety aspects based on subject. (Video (5Hr) + Report Preparation (5Hr) = Total 10 Hours)
6. Poster/chart/power point preparation on technical topics. (Poster Preparation (5Hr) = Total 6 Hours)
7. Working/non-working model on technical topics. (Working model 12Hr and Non-working model 8Hr)
8. Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue. (Industrial exposure duration (15Hr) + problem identification and tentative solutions (10Hr) = Total 25 Hours)
9. Group Discussion on emerging/trending technical topics based on subject. (Duration 1Hr each)
10. Real world case studies-based learning. (Duration of data collection (5Hr) + Report Preparation (5Hr) = Total 10 Hours)

**(a) Books:**

1. Principles of Power System: V. K. Mehta, Rohit Mehta, S. Chand Publications
2. Electrical Power Systems: Dr. S. L. Uppal, Prof. S. Rao, Khanna Publications
3. A Course in Power Systems: J. B. Gupta, Katson Books
4. Electrical Power systems: C. L. Wadhwa, New Age International Publishers
5. Modern Power system Analysis by I J Nagrath, D P Kothari, McGraw Hill Education
6. Elements of Power Systems Analysis: W. D. Stevenson Jr., 4th Edition, McGraw Hill Education.

**(b) Open source software and website:**

1. MATLAB/Scilab
2. PSCAD
3. Power World Simulator



<b>Program</b>	BACHELOR OF TECHNOLOGY (B.Tech)	<b>Semester - 3</b>
<b>Type of Course</b>	Professional Core Course	
<b>Prerequisite</b>	Basic understanding of solving simultaneous linear equations, knowledge of linear constant coefficient differential equations, and foundational concepts of Laplace transforms are essential for learning advanced circuit analysis techniques.	
<b>Rationale</b>	This course provides essential analytical tools to understand and solve electrical circuits. It covers key topics such as network theorems, transient and steady-state analysis, phasor techniques, Laplace transforms, and two-port networks. These concepts build problem-solving skills and form a foundation for advanced areas like power systems, electronics, and control systems, preparing students for real-world engineering challenges.	
<b>Effective From A.Y.</b>	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				Total Marks
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		
				SEE TH	IAT	SEE P	CCE	
3	-	2	4	70	30	50	50	200

SEE - Semester End Examination, IAT - Internal Assessment Test, CCE - Continues & Comprehensive Evaluation

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>Circuit Theorems</b> Principle of Superposition, Thevenin's Equivalent Circuit, Norton's Equivalent Circuit, Maximum Power Transfer Condition, Reciprocal Network Principle, Compensation Method, Analysis Using Controlled Sources, Node Voltage Method, Mesh Current Method, Duality Principle, Dual Networks Concept.	12	25
2	<b>Time domain Analysis of first order circuit</b> Initial and final conditions in elements, Concept of steady state and transient response, forced and free response of RL and RC Circuit, time constant, Solution of first order differential equations for Series and parallel R-L, R-C circuits.	6	15
3	<b>Time domain Analysis of second order circuit</b> Generalized solution of second order differential equation, nature of roots, Time domain response of 2nd order linear circuit, discharging of capacitor through an inductor.	4	10
4	<b>Sinusoidal steady state analysis</b> Rotating Phasor Representation of a Sine Wave, Phasor Illustrations, Impedance and Admittance, AC Circuit Examination, Root Mean Square (RMS) Values, Average Power and Complex Power, Three-Phase Systems, Mutual Inductance in Coupled Circuits, Dot Convention for Coupled Circuits, Ideal Transformer Model.	6	15
5	<b>Laplace Transform Technique in Circuit Analysis</b> Laplace Transform Overview, Laplace transform of standard input signals, Initial value and final value theorem, Inverse Laplace transform, Solution of 1st and 2nd order R-L, R-C, RLC circuits equations using Laplace transform, Introduction of transfer function, Concept of Poles and Zeros, Transfer function representation of electrical circuits.	9	20
6	<b>Two Port Network and Network function</b> Introduction to Two Port Networks, relationship of two port variables, Short circuit admittance parameter, Open-circuit impedance parameter, Transmission Parameter, Hybrid Parameter, Relationships between parameters.	8	15
<b>Total</b>		<b>45</b>	<b>100</b>



**Suggested Distribution Of Theory Marks Using Bloom's Taxonomy**

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
<b>Weightage</b>	15	20	20	25	25	0

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes**

**At the end of this course, students will be able to:**

C01	Interpret and evaluate electrical circuits using node voltage and mesh current methods, and apply various circuit theorems and duality principles for circuit simplification and analysis.
C02	Determine initial and final conditions in RL, RC circuits, and solve first order differential equations to analyze transient and steady-state behavior in time domain.
C03	Solve 2nd order differential equations to analyze transient and steady-state behavior in time domain.
C04	Transform sinusoidal circuits into phasor domain and analyze single-phase and three-phase AC circuits for impedance, power, and mutual inductance using phasor and RMS techniques.
C05	Apply Laplace transform techniques for solving circuit equations, and develop s-domain models of electrical networks for system analysis and transfer function representation.
C06	Examine two-port network behavior using different parameter representations and analyze interrelationships between network functions and system variables.

**CO PO Mapping**

CO	CO - 1	CO - 2	CO - 3	CO - 4	CO - 5	CO - 6
PO - 1	3	3	3	3	3	3
PO - 2	3	3	3	3	3	3
PO - 3	1	1	1	1	1	1
PO - 4	3	3	3	3	3	3
PO - 5						
PO - 6						
PO - 7	1	1	1	1	1	1
PO - 8	1	1	1	1	1	1
PO - 9	2	2	2	2	2	2
PO - 10	1	1	1	1	1	1
PO - 11	1	1	1	1	1	1

**Reference Books**

1.	<b>Electric Circuit Analysis</b> By K.S.Suresh Kumar   Pearson Publications
2.	<b>Network Analysis</b> By M E Van Valkenburg   PHI Publication
3.	<b>Electrical Circuit Analysis and synthesis</b> By A. A. Nimje and D. P. Kothari   New Age International Publications
4.	<b>Networks and Systems</b> By D. Roy Choudhury   New Age International Publications, Pub. Year 1998
5.	<b>Engineering Circuit Analysis</b> By W. H. Hayt, J.E. Kemmerly, and Durbin S. M.   Tata McGraw Hill
6.	<b>Electric Circuits</b> By C. K. Alexander and M. N. O. Sadiku   McGraw Hill Education, Pub. Year 2004
7.	<b>Basic Circuit Analysis</b> By K. V. V. Murthy and M. S. Kamath   Jaico Publishers, Pub. Year 1999

**List of Practical**

1.	To verify the Superposition Theorem by comparing analytical and experimental results.
2.	To verify the Thevenin and Norton's theorems by comparing analytical and experimental results.
3.	To verify the maximum power transfer theorem by comparing analytical and experimental results.
4.	To verify the Superposition Theorem by comparing analytical and simulated results with dependent sources.
5.	To verify the Thevenin and Norton's theorems by comparing analytical and simulated results with dependent sources.
6.	To simulate and analyze the steady-state and transient time-response of series R-L circuit.
7.	To simulate and analyze the steady-state and transient time-response of series R-C circuit.
8.	To simulate and analyze the steady-state and transient time-response of series R-L-C circuit.
9.	To verify the analytical steady state solution of AC circuits using phasors with experimental results
10.	To verify experimental results of open-circuit impedance parameter of a tow-port network with analytical Results
11.	To verify experimental results of short-circuit parameter of a tow-port network with analytical results.
12.	To verify experimental results of hybrid parameter of a tow-port network with analytical results.
13.	To verify experimental results of transmission parameter of a tow-port network with analytical results.

**Miscellaneous****Open source software and website:**

- Bhattacharya, T. K. *Network Analysis* [MOOC]. NPTEL-NOC. <https://archive.nptel.ac.in/courses/108/105/108105159/>
- De, N. K., et. Al. . *Basic Electrical Technology* [Handout]. NPTEL Online Course. <https://nptel.ac.in/courses/108105053>

**Activities Suggested under Self-learning (A total of 30 hours)**

**Sr. No. Name of the Activity Activity Description and No. of Hours Suggested Evaluation Criteria Targeted CO**

**1** NPTEL Video Lectures Watch core lecture videos from NPTEL – *Network Analysis* to build fundamental understanding (20 hrs.) Submit assignment of the modules that student learned CO1 – CO6

**2** DIY (Do It Yourself) Circuit Construction Construct and test circuits on a breadboard/PCB to verify Superposition, Thevenin, Norton, and Maximum Power Transfer theorems (At least one circuit) (6 hrs.) Submit the circuit observation sheet; instructor validation or peer review CO1

**3** MATLAB Programming for Circuit Analysis Write code for mesh/nodal analysis, Laplace solutions, and response plots (At least five problems) (20 hrs.) Summary report on curated content and learning outcomes CO1 – CO4

**4** Simulation Practice (LTspice/ngSpice/MATLAB) Simulate RL, RC, RLC for transient response analysis (10 hrs.) Submit circuit files (screenshots), results (graphs/waveforms), and a comparison table with theoretical values CO2

**5** DIY (Do It Yourself) Circuit Construction Construct and test circuits on a breadboard/PCB to analyse the transient response of RL, RC, RLC (At least one circuit) (6 hrs.) Submit the circuit observation sheet; instructor validation or peer review CO2

**6** Problem Solving Practice One assignment per module should be given with minimum 10 questions per module. The difficulty level should be medium to hard. (20 hrs.) Submit scanned solutions (on LMS) or of written work; assess accuracy, clarity of steps, and coverage of problem types CO1 – CO6

**7** Mini Case Studies (Real-World Applications) Document at least 2 real-world examples where network theorems are used in systems like power supply, filters, audio electronics (4 hrs.) Submit a 2–3-page report with circuit diagram, theorem used, and explanation of functionality CO1 – CO3

**8** MATLAB Programming for Transfer Function Analysis Write MATLAB code for transfer function, pole-zero plots, and frequency response (At least two problems) (8 hrs.) Submit .m files with plotted outputs, explain poles/zeros, and relate to system behaviour; evaluated for correctness and insightfulness CO3 – CO4



<b>Program</b>	BACHELOR OF TECHNOLOGY (B.Tech)	<b>Semester - 3</b>
<b>Type of Course</b>	Professional Core Course	
<b>Prerequisite</b>		
<b>Rationale</b>	Analog and Digital Electronics is a fundamental subject that shall give engineering students essential knowledge and skills related to designing, analyzing, and implementing electronic circuits. It bridges theoretical concepts with practical applications, crucial for careers related to electronics, automation, telecommunications, and embedded systems. Analog and Digital Electronics underpins modern technological advancements.	
<b>Effective From A.Y.</b>	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				SEE TH	IAT	SEE P	CCE	
3	-	2	4	70	30	50	50	200

SEE - Semester End Examination, IAT - Internal Assessment Test, CCE - Continues & Comprehensive Evaluation

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>Differential, multi-stage and operational amplifiers</b> Power amplifier, Differential 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 band width product)	6	10
2	<b>Linear applications of op-amp</b> Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator and differentiator, active filter, voltage regulator, oscillators (Wein bridge and phase shift).	8	20
3	<b>Non linear applications of op-amp</b> Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, Peak detector.	5	10
4	<b>Combinational Digital Circuits</b> Standard representation for logic functions, simplification of logic functions using K-map and Boolean algebra, Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, digital comparator, parity checker/generator, code converters, priority encoders, decoders/ drivers for display devices.	9	20
5	<b>Sequential circuits and systems</b> A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J- K, T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip-flops, special counter IC's, asynchronous sequential counters, applications of counters.	9	20
6	<b>A/D and D/A Converters Digital to analog converters</b> weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	8	20
<b>Total</b>		<b>45</b>	<b>100</b>



**Suggested Distribution Of Theory Marks Using Bloom's Taxonomy**

Level	Remembrance	Understanding	Application	Analyze	Evaluate
<b>Weightage</b>	20	30	20	10	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes**

**At the end of this course, students will be able to:**

CO1	Describe the functioning & Characteristics of OPAMP.
CO2	Design and implement OP-AMP circuits for linear application.
CO3	Design and implement OP-AMP circuits for Non-linear application.
CO4	Comprehension & design of combinational logic circuits.
CO5	Comprehension & design of sequential logic circuits.
CO6	Describe the process of Analog to Digital conversion and Digital to Analog Conversion.

**CO PO Mapping**

CO	CO - 1	CO - 2	CO - 3	CO - 4	CO - 5	CO - 6
PO - 1	3	2	2	3	3	2
PO - 2	2	3	3	2	2	2
PO - 3	1	2	2	2	2	2
PO - 4		2	2	2	2	2
PO - 5		2	2	2	2	1
PO - 6	1	2	2	2	2	2
PO - 7		1	1	1	1	1
PO - 8	1	1	1	1	1	1
PO - 9	2	1	1	1	1	2
PO - 10		1	1	1	1	
PO - 11	1	2	2	2	2	2

**Reference Books**

1.	<b>Op-Amps and Linear Integrated Circuits</b> By Ramakant A. Gayakwad   Pearson Education India
2.	<b>Modern Digital Electronics</b> By R.P. Jain   McGraw Hill Education, Pub. Year2009
3.	<b>Digital Logic and Computer Design</b> By Mano M. Morris   Pearson publication
4.	<b>Fundamentals of Digital Circuits</b> By A. Kumar   Prentice Hall India

**List of Practical**

1.	To verify the working of Op-amp as an Inverting and a Non-inverting amplifier.
2.	To study & verify summing amplifier using Op-Amp.
3.	To verify the working of Op-amp as an Integrator.
4.	To verify the working of Op-amp as a Differentiator.
5.	To Study Waveform generation-Square, triangular wave form generation using OPAMPs.
6.	To form half-adder, full-adder & half subtractor & full subtractor using logic gates and verify truth table.
7.	To perform 8:1 MUX & 1:8 DEMUX.
8.	To study different types of flip-flops.
9.	To design and test 4-bit asynchronous binary counters.
10.	To study digital to analog and analog to digital converter.

**Miscellaneous****Open source software and website:**

1. Tinkercad software
2. NPTEL website and IITs virtual laboratory

**List of Laboratory/Learning Resources Required:**

1. Kits of different practicals

**Suggested Project List:**

1. Design of Non-inverting amplifier.
2. Design of Inverting amplifier.
3. Design of Zero Crossing Detector

**Suggested Self-Learning Activities for Students:**

Sr.

**No. Name of the activity No. of hours Evaluation Criteria**  
1 Interpretation of Datasheet of IC741 and Analyze datasheets Preparing report Based on the understanding  
2 Making of charts of various Analog and digital Ics. Preparing of Chart Based on understanding  
3 Differential Amplifier, Multistage Amplifier and Power stage Amplifier circuit

simulation using MATLAB Use of MATLAB for circuit simulation Based on the understanding and applying of MATLAB  
4 Simulation of all Linear application of op-amp Use of MATLAB for circuit simulation Based on the type of application and explanation  
5 Simulation of all Non-linear application of op-amp Use of MATLAB for circuit simulation Based on the type of application and explanation  
6 Build circuits on a breadboard: all linear and non linear application of Op-amp Any two linear and non linear applications of Op- amp. Based on the circuit explanation and results.  
7 Practice debugging of circuits, identifying faults in circuits using multimeters and oscilloscopes One circuit for each debugging and fault identifying exercise Based on the Skill.  
8 Mini project: Design and implementation of any application of op-amp Undertake a small home-based or simulation-based project (10 h) Based on the understanding, implementation and results.  
9 Study and simulate logic gates: AND,OR,NOT,NAND,NOR, XOR using Matlab. Duration of task = 2h Preparation of Report=2h Based on the understanding and applying of MATLAB for realisation.  
10 Learn and realise Boolean algebra basics and laws Duration of task = 2h Preparation of Report=2h Based on report submitted.

Report should contain observations and truth table.  
11 Mini Task: Design and realize a logic circuit using Matlab Any two Based on the understanding, implementation and results/truth table.  
12 Study combinational circuits: simplification of multiplexers, decoders circuits using Karnaugh maps.

Mini Project: Create and simulate multiplexer and decoder circuit using Matlab. One circuit for each decoder and multiplexer = 5h/each



Based on the understanding, implementation and results/ truth table. 13 Study of sequential circuits: simplification of flip-flops/latch, shift register, counters One circuit for each flip- flop, shift register and counter= 5h/each Based on the understanding, implementation and results/ truth table. 14 Implement a logic-based application using Arduino (e.g., traffic light controller, seven segment display) Any one Arduino based digital application = 20h Based on the understanding, implementation and results. 15 Technical Video based learning related to the analog and Digital electronics Duration of video = 5h Report preparation=5h Total= 10h Report/presentation based on the video learning outcomes. 16 Assignment writing on number system, memory basics, IC logic families. 1 assignment of 2h each. Total = 6h Based on the assignment submitted. 17 Online Certification Courses (NPTEL /SWAYAM/Coursera / edX) In analog and Digital electronics Complete one MOOC (Massive Open Online Course) from NPTEL/SWAYAM relevant to ADE-Electrical Engineering. Certificate +a1-page summary or review Presentation of the course. Certificate of the course 18 Real world case studies based learning in ADE Duration of data collection/study = 5h Report preparation=5h Total = 10h Based on in-depth study, technical depth, data collected, fact finding, etc. 19 Discussion on research paper based on ADE 5researchpaper =20 h Summarize research paper and evaluation critical parameters 20 Poster/chart/power point preparation on ADE Duration=6h Based on poster/chart preparation and presentation skills 21 Working/non-working model on technical topics of ADE Working = 12 h Non-working=8h Based on inter department/external evaluation 22 Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue Duration =15h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h Based on evaluation of critical problems and solutions 23 Group Discussion on emerging/trending technical Topics based on ADE Duration=1h each Based on performance in group discussion, technical depth, knowledge etc. 24 Involvement in Student Chapter Activities (IEEE/ISTE/IEI) Organizing student chapter activities/ workshops (5h)+Report/ writing articles for The chapter newsletter(5h) Based on short activity report and reflection 25 Industry Visit and Report Preparation Attend an industry visit (e.g., to a substation, manufacturing unit, renewable energy plant) and prepare a detailed report. Based on the report

Note:

- All the suggested activity should be related to the subject.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective recordkeeping and to ensure transparency in the evaluation and assessment of self-learning activities.



<b>Program</b>	BACHELOR OF TECHNOLOGY (B.Tech)	<b>Semester - 3</b>
<b>Type of Course</b>	Basic Science Course	
<b>Prerequisite</b>		
<b>Rationale</b>	-	
<b>Effective From A.Y.</b>	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				SEE TH	IAT	SEE P	CCE	
3	1	-	4	70	30	-	50	150

SEE - Semester End Examination, IAT - Internal Assessment Test, CCE - Continues & Comprehensive Evaluation

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS:</b> Roots of Algebraic and Transcendental Equations: Bisection, false position, Secant and Newton-Raphson methods, Fixed Point Iteration, Rate of convergence	8	15
2	<b>NUMERICAL INTEGRATION</b> Newton-Cotes formula, Trapezoidal and Simpson's formulae, error formulae, Gaussian quadrature formulae.	6	15
3	<b>NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS</b> Picard Method, Taylor Method, Euler and Modified Euler Methods and Runge-Kutta Second order and Fourth order methods, Milne's Predictor-Corrector Methods.	10	20
4	<b>LAPLACE TRANSFORMS</b> Laplace Transform and inverse Laplace transform, Linearity, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals, Unit Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting), Laplace transform of periodic functions, Short Impulses, Dirac's Delta Function, Convolution, Integral Equations, Differentiation and Integration of Transforms, Application of Laplace transform to ODE.	10	25
5	<b>FOURIER SERIES</b> Fourier Series of 2n periodic functions, Dirichlet's conditions for representation by a Fourier series, Orthogonality of the trigonometric system, Fourier Series of a function of period 2n, Fourier Series of even and odd functions, Half range Fourier series.	7	15
6	<b>FOURIER INTEGRAL AND FOURIER TRANSFORM</b> Fourier Integral, Fourier Cosine Integral and Fourier Sine Integral, Fourier Transform, Fourier Cosine Transform, Fourier Sine Transform	4	10
<b>Total</b>		<b>45</b>	<b>100</b>

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy						
Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
<b>Weightage</b>	10	25	35	0	0	0

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.



**Course Outcomes**

At the end of this course, students will be able to:

C01	Solve algebraic equation by using numerical methods and understand convergent of it
C02	Able to solve numerical integration problems.
C03	Able to solve problems in ordinary differential equations.
C04	To grasp the concept of Laplace transform and to solve initial value problems.
C05	Expand the functions in Fourier series
C06	Expand the functions in Fourier integral and Fourier Transform.

**CO PO Mapping**

CO	CO - 1	CO - 2	CO - 3	CO - 4	CO - 5	CO - 6
PO - 1	1	1	1	1	1	1
PO - 2	1	1	1	1	1	1
PO - 3						
PO - 4	1	1	1	1	1	1
PO - 5	1	1	1	1	1	1
PO - 6	1	1	1	1	1	1
PO - 7						
PO - 8						
PO - 9	1	1	1	1	1	1
PO - 10						
PO - 11	1	1	1	1	1	1



<b>Program</b>	BACHELOR OF TECHNOLOGY (B.Tech)	<b>Semester - 3</b>
<b>Type of Course</b>	Mandatory Non-Credit Course-Audit Course	
<b>Prerequisite</b>		
<b>Rationale</b>	-	
<b>Effective From A.Y.</b>	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
Lecture	Tutorial	Lab	Credit	Theory Marks		Practical Marks		Total Marks
				SEE TH	IAT	SEE P	CCE	
2	-	-	0	50	-	-	-	50

*SEE - Semester End Examination, IAT - Internal Assessment Test, CCE - Continues & Comprehensive Evaluation*

Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
1	<b>History of Making of the Indian Constitution</b> History Drafting committee, ( Composition & Working)	6	20
2	<b>Philosophy of the Indian Constitution</b> Preamble Salient features	4	10
3	<b>Contours of Constitutional Rights &amp; Duties</b> Fundamental rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties	6	20
4	<b>Women Empowerment</b>  Introduction to Women Empowerment Dimensions of Empowerment Barriers to Women Empowerment Role of Education in Empowerment  Government and Legal Initiatives Role of Civil Society and Media Case Studies and Role Models	6	20
5	<b>IT Act 2000</b> Objectives Features Amendments Sections Offences and Penalties	4	15
6	<b>Election Commission</b>	4	15



Course Content		T - Teaching Hours   W - Weightage	
Sr.	Topics	T	W
	Chief election commissioner Election Commission: role and functioning. State election commission: role and functioning. Institute and bodies for the welfare of SC/ST/OBC and women		
<b>Total</b>		<b>30</b>	<b>100</b>

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy						
Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
<b>Weightage</b>	35	35	30	0	0	0

*NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.*

Course Outcomes	
<b>At the end of this course, students will be able to:</b>	
CO1	The historical development and drafting of the Indian Constitution, including the role of the Constituent Assembly and Drafting Committee, and its relevance today..
CO2	Grasp the ideals in the Preamble and key features of the Indian Constitution.
CO3	Acknowledge the key constitutional rights and duties and their role in ensuring justice and equality.
CO4	Know the women empowerment, its challenges, and the roles of education, policy, society, and role models in promoting gender equality.
CO5	Aware of the IT Act 2000, including its objectives, features, key amendments, major sections, and cyber offences with penalties.
CO6	Will gain knowledge about the structure, role, and functioning of the Election Commission at both central and state levels. They will understand the responsibilities of the Chief Election Commissioner and other commissioners in ensuring free and fair elections.



**CO PO Mapping**

CO	CO - 1	CO - 2	CO - 3	CO - 4	CO - 5	CO - 6
PO - 1						
PO - 2						
PO - 3						
PO - 4						
PO - 5						
PO - 6						
PO - 7	1	1	1	1	1	1
PO - 8						
PO - 9	1	1	1	1	1	1
PO - 10	1	1	1	1	1	1
PO - 11	1	1	1	1	1	1