Program	BACHELOR OF TECHNOLOGY (B.Tech)	**Semester - 4**
Type of Course	Humanities, Social Science and Management Course	
Prerequisite		
Rationale	This course equips students with foundational competencies in professional behaviour, teamwork, leadership, and engineering ethics to support responsible practice and workplace readiness. Through practice-based learning, it aims to enhance employability while cultivating ethical and holistic professional identity.	
Effective From A.Y.	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE TH**	**IAT**	**SEE P**	**CCE**	**Total Marks**
2	-	2	2	50	30	50	20	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	**Professional Etiquette, Grooming & Workplace Behaviour** • Professional grooming standards • Workplace etiquette (meetings, emails, hierarchy, decorum) • Time management, punctuality & discipline	5	15
2	**Effective Verbal & Non-Verbal & Digital Communication** • Speaking clarity, tone, technical vocabulary • Kinesics: Posture, Gestures • Active listening, paraphrasing, feedback • Digital communication etiquette: chat, online meetings	6	20
3	**Teamwork, Group Dynamics & Conflict Resolution** • Team roles, responsibilities, coordination • Leadership styles & decision-making • Group discussion (GD) frameworks • Emotional intelligence & empathy in teams • Conflict identification, negotiation & resolution models	6	20
4	**Engineering Ethics & Professional Responsibility** • Ethics, moral reasoning & codes of conduct (IEEE, ASME etc.) • Duty of care, safety, accountability • Case-based ethical dilemma analysis • Digital & Online Ethics • Cyber security & Data Responsibility	7	25
5	**Professional Presentation, Pitching** • Structure of technical presentations • Verbal delivery & stage presence • Designing visual aids (PPT, charts, models) • Elevator pitch & persuasive communication • Introduction to Interview Skills	6	20
	Total	30	100

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	15	35	50	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:	
CO1	Identify and recall professional etiquette and workplace behaviour required in structured engineering tasks.
CO2	Discuss the elements of effective verbal and non-verbal communication in individual and group interactions.
CO3	Collaborate and execute team-based activities, demonstrating leadership and cooperative problem-solving.
CO4	Apply professional responsibility frameworks to address ethical dilemmas in engineering scenarios.
CO5	Deliver structured technical presentations using appropriate content, visuals, and delivery techniques, and demonstrate professional interaction skills through mock interviews and structured Q&A practice.

CO PO Mapping

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

Reference Books

1.	**Robert S. Fredman (2021). Understanding psychology 15th Edition :McGreaw Hill.**
2.	**Technical Communication: Principles and Practice (TextBook)** By Meenakshi Raman and Sangeeta Sharma | Oxford University Press
3.	**Professional Communication** By Aruna Koneru | Mc Graw Hill | Latest Edition

List of Practical

1.	**Grooming & Appearance Audit** UNIT-1, CO1
2.	**Personal SWOT Analysis** UNIT-1, CO1
3.	**Listening Comprehension and Interpretation Exercise** UNIT- 2, CO2
4.	**Impromptu Speaking on Workplace Situations** UNIT-2, CO2
5.	**Extempore / Elocution on Workplace Topics** UNIT -2, CO2
6.	**Structured Group Discussion (GD)** UNIT-3, CO3
7.	**Team-Based Problem-Solving Task** UNIT-3, CO-3
8.	**Conflict Resolution Situational Play Simulation** UNIT-3, CO-3
9.	**Ethical Dilemma Case Study Analysis** UNIT-4, CO-4
10.	**Ethical Culture Interaction Exercise** UNIT-4, CO-4
11.	**Elevator Pitch – 60-Second Idea/Project Pitch** UNIT-5, CO-5
12.	**Technical Presentation with Visual Aids** UNIT-5, CO-5
13.	**Mock Interview** UNIT-5, CO-5

Program	BACHELOR OF TECHNOLOGY (B.Tech)	**Semester - 4**
Type of Course	Humanities, Social Science and Management Course	
Prerequisite		
Rationale	-	
Effective From A.Y.	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	-	-	2	50	30	-	30	110

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

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Foundations of Indian Knowledge Systems & Sanskrit Heritage** • Meaning, scope, and uniqueness of Indian Knowledge Systems (IKS) • Oral traditions & continuity of knowledge • Scientific structure of Sanskrit language • Vedas, Upanishads, Puranas	6	20
2	**Civilizational Development & Cultural Knowledge Traditions** • Evolution of Indian civilization: Indus Valley to Modern India • Social, cultural, economic systems • Education systems: Gurukula, universities (Takshashila, Nalanda, Vallabhi)	6	20
3	**Engineering and Technological Heritage of India** • Indus Valley engineering: town planning, drainage, water systems,Urban planning • Vedic and post-Vedic engineering concepts • Medieval engineering: stepwells, forts, irrigation systems • Case studies: Lothal dockyard, Chola irrigation, Golconda fort	6	20
4	**Modern India's Contributions to Science, Engineering & Technology** • Colonial to modern transition: railways, canals, bridges • Indian engineers in colonial era (Visvesvaraya & others) • Post-independence nation building: IITs, dams, highways • Space technology (ISRO): Chandrayaan, Mangalyaan	6	20
5	**Emerging Technologies, Sustainability & IKS-Based Future** • Renewable energy: solar, wind, hydropower • Smart cities, AI, IoT, robotics • Green engineering & climate change solutions • Sustainable agriculture & water management (IKS-based) • NEP 2020, Atmanirbhar Bharat, future challenges & opportunities	6	20
	Total	**30**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy			
Level	Remembrance	Understanding	Application
Weightage	30	35	35

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	Summarize the key features of Indian Knowledge Systems, oral knowledge transmission, Sanskrit heritage, and major Indian scriptures
CO2	Discuss India's civilizational growth, socio-economic structures, and the contribution of Gurukula and ancient universities such as Takshashila and Nalanda to education.
CO3	Illustrate the application of historical Indian engineering practices through case studies such as Lothal dockyard, Chola irrigation, and Golconda fort.
CO4	Identify major developments in India's science and technology, including railways, dams, engineering institutions, and space missions
CO5	Apply concepts of emerging technologies, sustainability practices, and IKS-based solutions to address real-world challenges in energy, agriculture, water management, and national development initiatives.

CO PO Mapping

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

CO PSO Mapping

CO	CO - 1	CO - 2	CO - 3	CO - 4	CO - 5
PSO - 1	Moderate (2)	Moderate (2)	Moderate (2)	Moderate (2)	Moderate (2)

Reference Books

1.	**Indian Knowledge Systems: Vol I and II (TextBook)** By Kapil Kapoor, A K Singh | D.K. Print World | 2005

Program	BACHELOR OF TECHNOLOGY (B.Tech)	**Semester - 4**
Type of Course	Professional Core Course	
Prerequisite	Physics, Basic electrical engineering	
Rationale	-	
Effective From A.Y.	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	0	2	4	70	-	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	**Basics of vector analysis** Introduction of vector, scalars and vectors, unit vector, vector addition and subtraction, Position vector , Distance vectors, Dot product, Cross product, components of a vector, Cartesian co-ordinate system, Circular cylindrical co-ordinate system, Spherical co-ordinate system, Transformation from one co-ordinate to other coordinate systems	6	10
2	**Static electric fields** Coulomb's law, Electric field intensity, Electric field due to point and line charges, Line, surface and volume charge distributions, Gauss' law and its applications, Divergence theorem, Potential difference, Potential gradient, Calculation of potential difference for different configurations, Electric dipole, Electrostatic energy and energy density, Poison's and Laplace equation, Uniqueness theorem	9	20
3	**Conductors, Dielectrics and Capacitance** Current and current density, Ohm's law in point form, Continuity equation, Conductor dielectric boundary condition, Dielectric-dielectric boundary condition, Polarization in dielectrics, Capacitance, Capacitance of two wire line	8	20
4	**Steady magnetic fields** Biot savart's law, Ampere's law, Curl operation, Stoke's theorem, Magnetic flux and magnetic flux density, Scalar and vector magnetic potentials, Steady magnetic field produced by current carrying conductors	8	20
5	**Magnetic forces, materials and inductance** Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and Permeability, Magnetic circuit, Inductance and mutual inductances, BH curve	8	20
6	**Time varying fields and Maxwell's equations** Faraday's law, Transformer and motional electromotive forces, Displacement current, Maxwell's equations in integral and point form.	6	10
	Total	45	100

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	20	30	20	20	10	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:	
CO1	Apply vector algebra and coordinate systems to solve basic electromagnetic field problems.
CO2	Determine electric field, flux, potential, and use Gauss's law, Poisson's and Laplace equations for static electric field analysis.
CO3	Explain conduction and dielectric behaviour, apply boundary conditions and calculate capacitance and current density.
CO4	Compute magnetic field quantities using Biot–Savart and Ampere's laws and describe magnetic potentials and flux.
CO5	Analyze magnetic forces, classify magnetic materials, and calculate self and mutual inductance.
CO6	Interpret time-varying electromagnetic fields and apply Maxwell 's equations in integral and point forms.

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

Reference Books

1.	**Engineering Electromagnetics** By W.H. Hayt and J A Buck | Tata McGraw Hill Publications
2.	**Elements of Electromagnetics** By Matthew N.O. Sadiku | Oxford University Press
3.	**Principles of Electromagnetics** By M.N.O. Sadiku, S.V. Kulkarni | Oxford University Press.
4.	**"Electromagnetism- Theory and Applications"** By A Pramanik | PHI Learning Pvt. Ltd. , New Delhi.
5.	**"Elements of Electromagnetic fields"** By S.P. Seth | Dhanpat Rai & Co.
6.	**Electromagnetic Waves** By R.K. Shevgaonkar | Tata McGraw Hill India.
7.	**Electromagnetic Fields and Waves** By Simon Ramo, John Whinnery | Wiley India Edition. 8. Narayana Rao, N: Engineering Electromagnetics, Prentice Hall. | Third Edition

List of Practical

1.	**To write a program on basic concepts of vector analysis.**
2.	**To write a program on electric field intensity for line charge and surface charge.**
3.	**To write a program on problems on electric flux density.**
4.	**Simulate electric field distribution using FEM for given charge configurations.**
5.	**To write a program based on potential and potential gradient.**
6.	**To write a program based on current and current density.**
7.	**Write the program for the unit vector calculation and vector multiplication.**
8.	**To write a program on alteration between Cartesian, cylindrical and spherical co-ordinate systems.**
9.	**To write a program on computes Biot-savart law.**
10.	**To study and understand the nature of a field using divergence.**
11.	**To write a program on coulomb's law.**
12.	**To write a program to computes force between two parallel conductor.**
13.	**To simulate a program computes the potential difference between two points due to a point charge.**
14.	**To write a program computes the capacitance of co-axial cable of the conductor.**

Miscellaneous

Suggested self-learning Points (Total 45 Hours)

1. **Industry / Research Laboratory Visit** – Visit (5 hours) + Report preparation (5 hours); Total: 10 hours; Evaluation based on the report submitted.
2. **Technical Video Learning Related to the Subject** – Video learning (5 hours) + Report/Presentation preparation (5 hours); Total: 10 hours; Evaluation based on report or presentation outcomes.
3. **Assignment Writing** – Assignments of 2 hours each; Total: 10 hours; Evaluation based on assignments submitted.

4. **Self-Learning Through Online Courses** – Minimum course duration of 10 hours; Total: 10 hours; Evaluation based on understanding.
5. **Videos on Industrial Safety Aspects Related to the Subject** – Video learning (5 hours) + Report preparation (5 hours); Total: 10 hours; Evaluation based on understanding.
6. **Poster / Chart / PowerPoint Preparation on Technical Topics** – Poster/Presentation preparation (5 hours); Total: 6 hours; Evaluation based on poster/chart quality and presentation skills.
7. **Working / Non-Working Model on Technical Topics** – Working model (12 hours) or Non-working model (8 hours); Evaluation based on understanding, implementation, and results.
8. **Industrial Exposure (2–3 Days)** – Industrial exposure (15 hours) + Problem identification and tentative solutions (10 hours); Total: 20 hours; Evaluation based on problem analysis and solutions.
9. **Group Discussion on Emerging / Trending Technical Topics Based on Subject** – Duration 1 hour each; Total: 2 hours; Evaluation based on performance, technical depth, and knowledge.
10. **Real-World Case Study–Based Learning** – Data collection (5 hours) + Report preparation (5 hours); Total: 10 hours; Evaluation based on in-depth study, technical depth, and data analysis.
11. **Problem Solving / Coding Using SCILAB, MATLAB, MS-EXCEL, or Other Relevant Software** – Five small coding problems (2 hours each); Total: 10 hours; Evaluation based on understanding, implementation, and results.
12. **Technical Quiz Related to Topics** – Total duration: 6 hours; Evaluation based on quiz performance.
13. **Online Certification Courses (NPTEL / SWAYAM / Coursera / edX)** – Completion of one MOOC; Total: 20 hours; Evaluation based on certificate submission, one-page summary/review, and presentation.

Useful Links

1. Scilab (https://www.scilab.org/) – An open-source alternative to MATLAB, useful for circuit analysis,
2. Octave (https://www.gnu.org/software/octave/) – Useful for numerical calculations and simulation of electrical circuits.
3. PSIM (Free Version) / OpenModelica (https://openmodelica.org/) – For modeling and simulating circuits
electrical
4. FEMM (Finite Element Method Magnetics) (http://www.femm.info/) – Used for electromagnetic field analysis
5.
LTspice (https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html) – For circuit simulation.
6. Virtual Labs by IITs (Government of India Initiative) (https://vlab.co.in/) – Simulations and experiments related electrical concepts
7. All About Circuits (https://www.allaboutcircuits.com/) – Excellent resource for learning about electrical engineering concepts.
8. Electrical4U (https://www.electrical4u.com/) – Provides detailed explanations of electrical ma

Program	BACHELOR OF TECHNOLOGY (B.Tech)	**Semester - 4**
Type of Course	Professional Core Course	
Prerequisite	Basic electrical engineering, circuit analysis, elementary differential equations, and Laplace transforms.	
Rationale	-	
Effective From A.Y.	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE TH**	**IAT**	**SEE P**	**CCE**	**Total Marks**
3	0	2	4	70	-	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	**Introduction to Control system** Block diagram of basic control system, application areas with examples. Feedback control: Open-loop and closed-loop systems, Benefits of Feedback.	4	10
2	**Mathematical modelling of systems** Introduction to translational and rotational mechanical, electrical, thermal, Force voltage and force current analogy, Position servo mechanism, Block diagram reduction technique and signal flow graph representation of physical systems, comparison and limitation, Mason's gain formula	9	20
3	**Time response Analysis** Introduction, Typical test signal, Steady state error and error constant, Time response of first and second order systems for standard test inputs, Time response specification	9	20
4	**Concepts of stability** Concept of stability, Routh-Hurwitz criteria, Relative stability analysis, Root-locus technique, Construction of Root-loci	8	20
5	**Frequency-response analysis** Relationship between time and frequency response, Polar plots, Bode plots, Nyquist stability criterion, Relative stability using Nyquist criterion	9	20
6	**Design of control systems** Introduction to phase lag, phase lead and phase lag-lead networks and their applications. P, PI, PID Controllers, Introduction of state space model & solution of LTI system.	6	10
	Total	**45**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	25	25	30	10	10	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:	
CO1	Describe the basic structure, classifications, applications, and benefits of feedback in control systems.
CO2	Apply and develop mathematical models of mechanical, electrical, thermal, hydraulic, and pneumatic systems, and construct block diagrams and signal-flow graphs using Mason's Gain Formula.
CO3	Analyze and compute time response parameters, steady-state errors, and performance indices for first- and second-order control systems under standard test inputs.
CO4	Examine and evaluate system stability using Routh–Hurwitz criteria and construct and interpret root-locus plots for determining relative stability.
CO5	Evaluate and interpret frequency-response characteristics using Bode, Polar, and Nyquist plots and assess stability margins through frequency-domain methods.
CO6	Apply phase-lead, phase-lag, and lag–lead compensation techniques, and use P, PI, and PID controllers to meet basic performance requirements.

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						
PO - 8						
PO - 9						
PO - 10						
PO - 11						

Reference Books

1.	**Automatic Control Systems** By Benjamin C. Kuo | John Wiley & Sons
2.	**Modern Control Engineering** By K. Ogata | Prentice Hall Inc.
3.	**Control Systems Engineering** By U. A. Patel | Mahajan Publishing House
4.	**Control System Engineering** By U.A.Bakshi, U.V.Bakshi | Technical publication,2020
5.	**Control Systems: Principles and Design** By M. Gopal | McGraw Hill Education, 1997.
6.	**Control Systems Engineering** By I. J. Nagrath and M. Gopal | New Age International, 2009

List of Practical

1.	**Introduction to the simulink software for control systems.**
2.	**To perform the simulink / programing practical on open loop & close loop phenomena.**
3.	**Find transfer function and it's pole and zero by using simulation tool.**
4.	**To simulate graphical representation of time response of 1st order control system subjected to step, ramp, parabolic, impulse input function for different time period.**
5.	**Find out overall transfer function using block diagram reduction technique using simulation.**
6.	**Using simulation tool obtain the poles and zeros of a system, given the transfer function, and plot them on real & imaginary axis.**
7.	**To plot the Root locus for the given set of systems using simulation tool.**
8.	**To obtain the Bode-plots for the given systems by using simulation tool.**
9.	**To plot the Nyquist plot for the given set of systems using simulation tool.**
10.	**To find stability using R-H criteria using simulation tool.**

Miscellaneous

Suggested Self-Learning Points: (Total 45 Hours)

- **Industry/Research Laboratory Visit:**5 hours visit + 5 hours report preparation (Total 10 hours), evaluated based on report quality.
- **Technical Video Learning:** 5 hours video watching + 5 hours report/presentation (Total 10 hours), evaluated on learning outcomes.
- **Assignment Writing:** Five assignments of 2 hours each (Total 10 hours), evaluated based on submitted work.
- **Self-Learning Online Course:** Minimum 10-hour course, evaluated based on understanding of content.
- **Industrial Safety Videos:** 5 hours video learning + 5 hours report preparation (Total 10 hours), evaluated on understanding.
- **Poster/Chart/PowerPoint Preparation:** 6 hours preparation, evaluated on presentation skills and content quality.
- **Technical Model (Working/Non-Working):** 12 hours for working or 8 hours for non-working model, evaluated on implementation and results.
- **Industrial Exposure (2–3 Days):** 15 hours exposure + 10 hours problem analysis (Total 20 hours), evaluated on solutions and critical thinking.
- **Group Discussion on Technical Topics:** 2 hours total, evaluated on technical depth and participation.
- **Real-World Case Study Learning:** 5 hours data collection + 5 hours report preparation (Total 10 hours), evaluated on depth of study and findings.

Useful Links

1. NPTEL (https://nptel.ac.in/) – Free online courses on Control System by IIT professors.
2. ALL ABOUT CIRCUITS (https://www.allaboutcircuits.com/)– Tutorials and interactive contents
3. Electrical4U (https://www.electrical4u.com/) – Conceptual explanations of control system.
4. Scilab – MATLAB alternative for numerical computations and control simulations.

Program	BACHELOR OF TECHNOLOGY (B.Tech)	**Semester - 4**
Type of Course	Professional Core Course	
Prerequisite	Fundamental knowledge of Electrical Engineering.	
Rationale	-	
Effective From A.Y.	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE TH**	**IAT**	**SEE P**	**CCE**	
3	0	2	4	70	-	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	**Representation of Power System Components:** One line and impedance diagram, Per unit system, Per unit representation of transformer, Per unit impedance diagram of power system, Examples – per unit system and impedance diagram, Synchronous machine, Power factor and power control, Salient pole synchronous generator, Operating chart of a synchronous generator, Representation of loads.	5	10
2	**Transmission Line Modelling and Performance:** Introduction, Short transmission line, Medium transmission line, Long transmission line – Rigorous solution, Evaluation of ABCD constants, Interpretation of long line equations, Ferranti effect, Complex power through a transmission line, Methods of voltage control, Examples.	9	20
3	**Symmetrical Fault Analysis:** Introduction, Transient on a transmission line, Short circuit of a synchronous machine on no load, short circuit of a loaded synchronous machine, Selection of circuit breakers,Examples, ZBUS formulation – by inverting YBUS, current injection technique, ZBUS building algorithm (Type – 1, 2, 3, 4 modifications).	9	20
4	**Symmetrical Components:** Symmetrical component transformation, Phase shift in star-delta transformers, Sequence impedances of transmission lines, Sequence - impedances and networks of synchronous machines, Sequence impedances and networks of transformers, Construction of sequence networks of a power system, Examples.	8	20
5	**Unsymmetrical Fault Analysis:** Introduction, Symmetrical component analysis of unsymmetrical faults, Single line to ground fault, Line to line fault, Double line to ground fault, Open conductor faults.	6	10
6	**Corona**	8	20

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	Critical Disruptive Voltage, Visual Critical Voltage, Corona Loss, Line Design based on Corona, Disadvantages of Corona, Radio Interference, Inductive interference between Power and Communication lines, Examples. **Over-voltages in Power Systems:** Causes of over-voltages, Internal causes of over-voltages, Mechanism of lightning discharge, Types of lightning strokes, Harmful effects of lightning, Protection against lightning, Earthing screen, Overhead ground wires, Lightning arresters, Surge absorber.		
		Total	**45**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	20	25	25	15	15	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:	
CO1	Apply per-unit concepts and impedance diagrams to represent power system components.
CO2	Analyse short, medium and long transmission line models to calculate voltage regulation and overall line performance.
CO3	Apply symmetrical fault analysis and Zbus formulation to determine fault currents.
CO4	Apply symmetrical component transformation to determine sequence impedances and construct sequence networks.
CO5	Apply sequence network combinations to determine system conditions during unsymmetrical faults.
CO6	Understand corona, overvoltage and lightning protection in power systems.

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						
PO - 8						
PO - 9						
PO - 10						
PO - 11						

Reference Books

1.	**Modern Power system Analysis** By I J Nagrath, D P Kothari | McGraw Hill
2.	**Power System Analysis** By Hadi Saadat | McGraw Hill
3.	**Electrical Power systems** By C. L .Wadhwa | New Age International Publishers
4.	**Principles of Power System** By V. K. Mehta, Rohit Mehta | S. Chand Publications
5.	**Power System Analysis and Design** By J. Duncan Glover, Thomas J. Overbye, Mulukutla S. Sarma | Cengage Learning India Pvt. Ltd.
6.	**Elements of Power Systems Analysis** By W. D. Stevenson | McGraw Hill
7.	**Power System Analysis** By John J. Grainger, William D. Stevenson | McGraw Hill

List of Practical

1.	**To write computer program for plotting instantaneous voltage, current and power in a single phase ac circuit.**
2.	**Find voltage regulation and efficiency of short transmission line for different specified set of sending end quantities (sending end leading, unity and lagging power factor) and receiving end quantities (different load at leading, unity and lagging power factor) using simulation package.**
3.	**Find voltage regulation and efficiency of a Medium transmission line (using π model & T model) for different specified set of sending end quantities (sending end leading, unity and lagging power factor) and receiving end quantities (different load at leading, unity and lagging power factor) using simulation package.**
4.	**Calculate voltage regulation and efficiency of a Long transmission line using distributed capacitance model for different specified set of sending end quantities (sending end leading, unity and lagging power factor) and receiving end quantities (different load at leading, unity and lagging power factor) using simulation package.**
5.	**To obtain voltage profile and loadability curve for a transmission line.**
6.	**To compute shunt reactor compensation and performance of open circuited line.**
7.	**To compute shunt capacitor compensation and performance of loaded line.**
8.	**To compute series capacitor compensation and performance of loaded line.**
9.	**To develop program for formulation of ZBUS matrix through ZBUS building algorithm.**
10.	**To simulate transient in series R-L circuit with special attention to change in DC offset current for application of excitation at different instant.**
11.	**To develop program to transform three phase unbalanced phasor into its symmetrical components.**
12.	**To develop program to transform symmetrical components into its original phasors.**

Miscellaneous

(a) Suggested Self-Learning Points (Total 45 Hours):

1. **Industry / Research Laboratory Visit** – Visit (5 hours) + Report preparation (5 hours); Total: 10 hours; Evaluation based on the report submitted.
2. **Technical Video Learning Related to the Subject** – Video learning (5 hours) + Report/Presentation preparation (5 hours); Total: 10 hours; Evaluation based on report or presentation outcomes.
3. **Assignment Writing** – Assignments of 2 hours each; Total: 10 hours; Evaluation based on assignments submitted.
4. **Self-Learning Through Online Courses** – Minimum course duration of 10 hours; Total: 10 hours; Evaluation based on understanding.
5. **Videos on Industrial Safety Aspects Related to the Subject** – Video learning (5 hours) + Report preparation (5 hours); Total: 10 hours; Evaluation based on understanding.
6. **Poster / Chart / PowerPoint Preparation on Technical Topics** – Poster/Presentation preparation (5 hours); Total: 6 hours; Evaluation based on poster/chart quality and presentation skills.
7. **Working / Non-Working Model on Technical Topics** – Working model (12 hours) or Non-working model (8 hours); Evaluation based on understanding, implementation, and results.
8. **Industrial Exposure (2–3 Days)** – Industrial exposure (15 hours) + Problem identification and tentative solutions (10 hours); Total: 20 hours; Evaluation based on problem analysis and solutions.
9. **Group Discussion on Emerging / Trending Technical Topics Based on Subject** – Duration 1 hour each; Total: 2 hours; Evaluation based on performance, technical depth, and knowledge.
10. **Real-World Case Study–Based Learning** – Data collection (5 hours) + Report preparation (5 hours); Total: 10 hours; Evaluation based on in-depth study, technical depth, and data analysis.
11. **Problem Solving / Coding Using SCILAB, MATLAB, MS-EXCEL, or Other Relevant Software** – Five small coding problems (2 hours each); Total: 10 hours; Evaluation based on understanding, implementation, and results.
12. **Technical Quiz Related to Topics** – Total duration: 6 hours; Evaluation based on quiz performance.
13. **Online Certification Courses (NPTEL / SWAYAM / Coursera / edX)** – Completion of one MOOC; Total: 20 hours; Evaluation based on certificate submission, one-page summary/review, and presentation.

Useful Links

1. Scilab
2. Octave
3. Power World Simulator

Program	BACHELOR OF TECHNOLOGY (B.Tech)	**Semester - 4**
Type of Course	Professional Core Course	
Prerequisite	Basics of Electrical Engineering	
Rationale	-	
Effective From A.Y.	2025-26	

Teaching Scheme (Contact Hours)				Examination Scheme				
				Theory Marks		Practical Marks		
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE TH**	**IAT**	**SEE P**	**CCE**	**Total Marks**
3	0	2	4	70	-	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	**DC Machines:** Construction and Working: Basic construction and operating principles. DC Generator: Induced EMF equation, field excitation types (separately excited, shunt, series), and voltage build-up in a shunt generator. Application DC Motor: Back EMF and torque equations, armature circuit equation, field excitation types, performance characteristics, and speed control methods and starter. Losses and Efficiency, Swinburne's test on D.C... shunt machine. Application.	9	20
2	**PMDC and BLDC Motor** Construction, working, and applications of Permanent Magnet DC Motor (PMDC), Construction, working, and applications. Of Permanent Magnet Brushless DC Motor (PMBLDC): control techniques. Application	4	10
3	**PMSM, Stepper, Servo Motor** Permanent Magnet Synchronous Machine (PMSM): Types (SPMSM, IPMSM), operation, and applications. Stepper Motor: Types (Variable reluctance, Permanent Magnet, Hybrid), working principle, and applications. Switched Reluctance Motor (SRM): Construction, working, and applications. Servo Motor: AC & DC servo motors, working, and industrial applications.	9	20
4	**Synchronous machines:** Constructional Details, Types of rotor (cylindrical and salient pole), Rotating Magnetic Field, EMF equation, Armature winding (Effect of distribution factor, pitch factor). Armature Reaction, its effects and remedies.	4	10
5	**Synchronous Generator (Alternator):** Working, Equivalent circuit & Phasor diagram of synchronous machine, Armature reaction and its compensation, Power output equation. SCR and its effects, Voltage Regulation, Methods to find voltage regulation: Direct load method Synchronous impedance method, Operating characteristics of synchronous machines, Effects of harmonics on induced emf, Salient pole machine – two reaction theory, power angle characteristics, Sudden short circuit and unbalance conditions, Hunting, Losses and efficiency, Parallel Operation and Synchronization, Load angle and Power flow equations, Operation on load & infinite bus, Synchronous Generator capability characteristics	10	20

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
6	**Synchronous motors:** Working, Magnetic locking, Expression for Different torques, Phasor diagram of Synchronous motor, Starting methods of synchronous motor, Speed regulation, Effect of excitation, Losses and efficiency of motor, Application of synchronous motor as phase modifier and synchronous condensers. V-curves and Inverted V-curves, Power developed by Synchronous motor and stability, Power stages. Hunting of synchronous machines and its prevention.	9	20
	Total	**45**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	20	25	15	20	20	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:	
CO1	Comprehend the construction, operating principles, basic characteristics and application of DC generators and motors.
CO2	Explain the construction, working principles, and applications of PMDC and BLDC motors.
CO3	Describe the operating principles and applications of PMSM, stepper motors, SRM, and servo motors.
CO4	Comprehend the construction, EMF equation, armature reaction, and winding factors of synchronous machines.
CO5	Comprehend the equivalent circuit, phasor diagrams, voltage regulation methods, and performance characteristics of synchronous generators.
CO6	Comprehend the torque production, excitation effects, performance characteristics, and applications of synchronous motors.

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						
PO - 8						
PO - 9						
PO - 10						
PO - 11						

Reference Books

1.	**Theory and Performance of Electrical Machines** By J B Gupta | Katson Publication
2.	**Electrical Technology – Part I and II** By B. L. Theraja | S. Chand and Co.
3.	**Electrical Machinery** By P. S. Bhimbra | Khanna Publishers
4.	**"Electric Machines"** By I J Nagrath and D. P. Kothari | McGraw Hill Education,2010.

List of Practical

1.	**To obtain magnetizing internal & external characteristic of self-excited dc compound generator.**
2.	**Speed control of dc shunt motor using (a) armature control and (b) field control methods.**
3.	**To perform Swinburne's test on DC shunt machine & determine the efficiency of machine as motor & as generator.**
4.	**To perform brake test on a DC shunt motor to determine the efficiency and plot variation of (a) input current (b) speed(c) torque (d) efficiency versus output power.**
5.	**To perform direct load test on alternator and find out voltage regulation.**
6.	**To find out voltage regulation of a 3-ø alternator by synchronous impedance method.**
7.	**To perform the parallel operation of 3-ø alternator with infinite bus.**
8.	**To perform the V- curve and inverted V-curve of a synchronous motor.**
9.	**To study construction, operation and working of PMBLDC Motor.**
10.	**To study construction, operation and working of following Motor. (1) Servo motor (2) Stepper motor.**

Miscellaneous

Activities suggested under self-learning:

1. **Industry / Research Laboratory Visit** – Visit: 5 hours, Report preparation: 5 hours; Total: 10 hours; Evaluation based on report submitted containing observations and calculations based on industry/lab data.
2. **Technical Video–Based Learning Related to the Subject (NPTEL)** – Video duration: 5 hours, Report preparation: 5 hours; Total: 10 hours; Evaluation based on report/presentation derived from video learning outcomes.
3. **Assignment Writing (Numerical Based Preferred)** – Five assignments of 2 hours each; Total: 10 hours; Evaluation based on assignments submitted.
4. **Self-Learning Online Course (SWAYAM)** – Minimum course duration: 10 hours; Evaluation through examination at end of course and based on certificate produced.
5. **Complex Problem Solving** – Maximum two problems; Study and solution finding; Total: 10 hours; Evaluation based on depth of solution submitted.
6. **Videos on Industrial Safety Aspects Based on Subject** – Video duration: 5 hours, Report preparation: 5 hours; Total: 10 hours; Evaluation based on quiz/report submitted.
7. **Poster / Chart / PowerPoint Preparation on Technical Topics** – Duration: 6 hours; Evaluation based on poster/chart preparation quality and presentation skills.
8. **Working / Non-Working Model on Technical Topics** – Working model: 12 hours, Non-working model: 8 hours; Evaluation based on

inter-department/external evaluation.

9. **Industrial Exposure for 2–3 Days to Observe and Provide Tentative Solutions** – Industrial exposure: 15 hours, Problem identification and tentative solution: 10 hours; Total: 20 hours; Evaluation based on critical problem analysis and solutions.
10. **Group Discussion on Emerging / Trending Technical Topics Based on Subject** – Duration: 1 hour each; Evaluation based on performance in group discussion, technical depth, and knowledge.
11. **Real-World Case Study–Based Learning** – Data collection/study: 5 hours, Report preparation: 5 hours; Total: 10 hours; Evaluation based on in-depth study, technical depth, data collected, and fact finding.
12. **Blog or Technical Article Writing** – Total: 10 hours (Research: 6 hours, Writing: 4 hours); Evaluation based on originality, technical content, references cited, and clarity of communication.
13. **Annotated Video Explanation of Concept / Problem** – Total: 10 hours (Preparation + Recording + Submission); Evaluation based on accuracy of explanation, clarity, and presentation style.
14. **Online Technical Quizzes / Simulations** – Multiple quizzes summing up to 10 hours; Evaluation based on quiz scores and reflection report after each quiz.
15. **Tech Blog / YouTube Channel Curation** – Content curation and analysis: 10 hours; Evaluation based on summary report of curated content and learning outcomes.
16. **Patent Search and Innovation Gap Identification** – Patent search and report preparation: 10 hours; Evaluation based on number of relevant patents analyzed and identification of innovation scope.
17. **Maintenance or Troubleshooting Logbook** – Duration: 10 hours (e.g., lab instruments, computer hardware); Evaluation based on documented cases, approach, and resolution.
18. **Involvement in Student Chapter (IEI / SPE / IEEE / ISTE)** – Organizing student chapter activities/workshops: 5 hours, Report writing/articles for chapter newsletter: 5 hours; Evaluation based on short activity report and reflection.

Useful Links

1. NPTEL (https://nptel.ac.in/) – Free online courses on Electrical Machines by IIT professors.
2. MIT Open Courseware (https://ocw.mit.edu/)– Courses related to electrical machines and power electronics.
3. ALL ABOUT CIRCUITS (https://www.allaboutcircuits.com/)– Tutorials and interactive content on motors and power electronics.
4. Electrical4U (https://www.electrical4u.com/) – Conceptual explanations of electrical machines.
5. Scilab (https://www.scilab.org/)– An open-source alternative to MATLAB, useful for circuit analysis, transformer calculations, and motor performance analysis.
6. Octave (https://www.gnu.org/software/octave/)– Useful for numerical calculations and simulation of electrical machines.
7. 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