GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

No. _____ Dated _____

Dean (Academics)

Please find below the Study Scheme for further approval from Academic Council:

Program	B.Tech.(Electrical Engineering)	Semester	3
Scheme Code	2024	AICTE/UGC	AICTE
Subject Group		Lateral Entry Status	N
Six Month Training	N	Compulsory Theory Count	7
Compulsory Practical Count	2	Elective Theory Count	0
Elective Practical Count	0	Total Course Count	9

List of Courses

S.No.	Course Category	Module Name	Course Code	Course Title	Theory/ Practical (T/P)	Course Type	Contact hours Per Week			Integrated Course	Credits	Marks Distribution		Min. % of Problems(#)
							L	T	P			CA Marks	ESE Marks	
1	Basic Science Courses	Mathematics	BSEE101	Mathematics-III	T	Compulsory	3	1	0	N	4	40	60	90
2	Professional Core Courses	Circuits and Devices	CEE101	Signals and Systems	T	Compulsory	3	1	0	N	4	40	60	70
3	Professional Core Courses	Circuits and Devices	CEE102	Analog Electronics	T	Compulsory	3	1	2	Y	5	90	60	40
4	Professional Core Courses	Electrical Machines	CEE103	Transformer and DC Machines	T	Compulsory	3	1	2	Y	5	90	60	40
5	Professional Core Courses	Control and Instrumentation	CEE104	Measurements and Instrumentation	T	Compulsory	3	0	0	N	3	40	60	20
6	Humanities, Social Sciences and Management Courses	Business Management	HSMC103	Business Essentials for Engineers	T	Compulsory	2	0	0	N	2	40	60	0

Uploaded by(Sign. with date)	Verified by(Sign. with date)	Recommended by(Sign. with date)
Department Clerk(hkogne)	BoS Convener	HoD cum Chairperson (BoS)

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7	Mandatory Courses (Non-Credit)	Constitutional Studies	MC101	Indian Constitution	T	Compulsory	2	0	0	N	0	50	0	0
8	Project Work, Seminar and Internship	Technical Communication	SMEE101	Seminar and Technical Report Writing for Engineers	P	Compulsory	0	0	2	N	1	50	0	0
9	Project Work, Seminar and Internship	Experiential Learning	TREE101	Training-I	P	Compulsory	0	0	40	N	1	60	40	0
Total							19	4	46		25			

Department Remarks: Approved by BoS - Approved in BOS meeting wide meeting no 16 held on 16/05/2025. For MC101 (Non-Credit Course), the minimum criteria for passing is to secure at least 40% of maximum marks assigned to continuous assessment (CA) and attain satisfactory level (S). Training-I (TREE101) evaluates Institutional Training of 120 hours undertaken by students at the end of second semester with 60 hours at department and other 60hours for self-learning duration of 3 weeks.

ESE- End Semester Examination, **CA-** Continuous Assessment

#-Minimum percentage of Numerical/Design/Programming Problems in ESE (for Theory).

Uploaded by(Sign. with date) Department Clerk(hkcgne)	Verified by(Sign. with date) BoS Convener	Recommended by(Sign. with date) HoD cum Chairperson (BoS)
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Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: BSEE101
Course Title: Mathematics-III

Programme: B.Tech. (Electrical Engineering)	**L:** 3 **T :** 1 **P :** 0	**Credits:** 4
Semester:3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T) = 60 hrs
Total Max. Marks:100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical/Design/Programming Problems in ESE:90%		
Duration of End Semester Examination (ESE): 3hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Compute the Laplace and inverse Laplace transforms of standard and piecewise-defined functions.
2	Use Laplace transforms to solve ordinary differential equations with initial conditions.
3	Determine the Fourier series expansion of periodic functions and analyze their convergence and harmonic structure.
4	Solve first and second-order PDEs using different methods.
5	Apply the Cauchy-Riemann equations to verify the analyticity of complex functions and analyze their behavior in the complex plane.
6	Apply Cauchy's Integral theorem, Cauchy's Integral formula and the residue theorem to evaluate real and complex integrals.

Contents

Part-A

Unit-1 Laplace Transforms **11(L) hrs**

Definition and existence of Laplace Transforms, Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Transform of multiplication and division by t, convolution theorem, Laplace transform of unit step function. Applications to solution of ordinary linear differential equations with constant coefficients.

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Unit-2 Fourier Series **11(L) hrs**

Introduction, even and odd functions, periodic functions, Dirichlet's conditions for Fourier series, Euler's formulae for Fourier series expansion, change of interval, half-range series expansions, Fourier series of different waveforms

Part-B

Unit-3 Partial Differential Equations **11(L) hrs**

Formation of partial differential equations; Equations solvable by direct integration; First order partial differential equations; solution of Lagrange's Linear equations, homogeneous linear partial differential equations with constant coefficients, classification of partial differential equations into elliptic, parabolic and hyperbolic equations, Solution by method of separation of variables.

Unit-4 Functions of Complex Variables **12(L) hrs**

Definition of Limit: continuity, derivative of complex functions and analytic functions. Necessary and sufficient conditions for analytic function (without proof); Cauchy-Riemann equation (Cartesian and polar co-ordinates); harmonic functions; orthogonal system; determination of conjugate functions. Millne's Thomson method: Applications to fluid flow problems. Complex integration: Line integrals in the complex plane; Cauchy's integral theorem (without proof); Cauchy's integral formula (without proof)for analytic functions and their derivatives. Taylor's and Laurent's expansions; singular points; poles; residue; Cauchy's Residue theorem; evaluation of real integrals by contour integration involving a function of sine and cosine.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/ case-studies etc. (as the case may be).

Textbooks

1. R.K. Jain and S.R.K Iyenger, "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 2008.

2. B.S. Grewal, "Higher Engineering Mathematics" 44th edition, Khanna Publishers.

Reference Books

1. R. Babu, "Engineering Mathematics", Pearson Education, 2009.

2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th edition, Wiley India Pvt Ltd

3. R.V. Churchill and J.W. Brown, "Complex Variables and Applications", Tata McGraw-Hill (2008).

4. J.B. Conway, "Functions of One Complex Variable" 2nd edition, Springer-Verlag, New York.

Online Learning Materials

1. https://www.kuk.ac.in/wp-content/uploads/notes/Notes_1454_FourierLaplace.pdf
   Accessed on October 15, 2025
2. https://tutorial.math.lamar.edu/Classes/DE/ConvolutionIntegrals.aspx
   Accessed on October 15, 2025
3. https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring-2018/pages/lecture-notes/
   Accessed on October 15, 2025

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4. https://tutorial.math.lamar.edu/classes/de/intropde.aspx Accessed on October 15, 2025

Supplementary SWAYAM Courses:

S. No	Course Name	Instructure	Host Institute	URL
1.	Mathematical Methods and its Applications	Prof. P.N. Agrawal Prof. S.K. Gupta	IIT Roorkee	https://nptel.ac.in/courses/111107098
2.	Complex Analysis	Prof. Pranav Haridas IIT Madras	Prof. Pranav Haridas IIT Madras	https://nptel.ac.in/courses/111106141
3.	Introduction to Fourier Analysis	Prof. Parasar Mohanty	IIT Kanpur	https://nptel.ac.in/courses/111104519

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: CEE101
Course Title: Signals and Systems

Programme: B.Tech. (Electrical Engineering)	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 70%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the concepts of continuous-time systems.
2	Apprehend concepts of discrete-time systems.
3	Understand the behavior of continuous and discrete-time LTI.
4	Apply the concept of Fourier Transforms.
5	Understand the concept of Laplace and z-Transforms.
6	Analyze Sampling and Reconstruction of the control system.

Contents

Part-A

Unit-1 Signal definition and classifications **11 (L) hrs**

Signals as seen in everyday life and in various branches of engineering and science. Definition, Different operations on signals: time shifting, time scaling, time reversal, differentiation, Integration and convolution. Classification of signals: even and odd signals, conjugate symmetric and asymmetric signals, periodic and non-periodic signals, area and average of signals, energy and power signals. Basic types of signals: unit impulse, unit step, unit ramp signal, parabolic signal, signum signal, complex exponential, Rect signal, sampling function, sync function. Mathematical representation of signals.

Unit-2 Systems and their properties **06 (L) hrs**

System definition. Properties of system: static and dynamic systems, causal and non-causal systems, linear and non-linear systems, time variant and time invariant systems, stable and unstable systems. Linear time invariant (LTI) system, impulse response, transfer function. Various conditions for LTI systems, differential equations for LTI systems.

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Part-B

Unit-3 Fourier transform for Signals and Systems **10 (L) hrs**

Fourier series representation of periodic signals, Waveform Symmetries, Fourier Transform, Various properties: linearity, time reversal, time shifting, frequency shifting, time scaling, differentiation in time domain, integration in time domain, differentiation frequency domain, area under time and frequency domain, convolution/multiplication and their effect in the frequency domain, Fourier domain duality, Parseval's Theorem.

Unit-4 Laplace Transform for Signals and Systems **10 (L) hrs**

Review of the Laplace transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. Properties of Laplace transform: frequency shifting, conjugation, differentiation and integration in the frequency domain, initial and final value theorem, Region of convergence (ROC) and its properties, Inverse Laplace transform.

Unit-5 Discrete time system and Z transform **08 (L) hrs**

Discrete time signals: representation, types and operations, tabular method to perform convolution. z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis. Conversions: z transform to discrete-time Fourier transform. Properties and ROC, sampling theorem.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", 2nd edition, Prentice Hall of India, 2015.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw-Hill Education, 2010.
4. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

References Books

1. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
2. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
3. M. J. Robert, "Fundamentals of Signals and Systems", McGraw-Hill Education, 2007.

Online learning material

1. http://www.eng.ucy.ac.cy/cpitris/courses/ece623/notes/SignalsAndSystems.pdf Accessed on October 15, 2025
2. https://web.itu.edu.tr/hulyayalcin/Signal_Processing_Books/Oppenheim_Signals_and_Systems.pdf Accessed on October 15, 2025

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B.Tech. 2nd Year (Electrical Engineering)

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Signal and Systems	Prof. K.S. Venkatesh	IIT Kanpur	https://nptel.ac.in/courses/117104074
2	Signals and Systems	Prof. Hitesh Shrimali, Prof. Kushal K. Shah	IIT Mandi, IISER Bhopal	https://onlinecourses.nptel.ac.in/noc25_ee78/preview

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B.Tech. 2nd Year (Electrical Engineering)

Subject Code: CEE102
Subject Name: Analog Electronics

Programme: B.Tech. (Electrical Engineering)	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Design and analyze basic diode circuits.
2	Understand the characteristics of transistor.
3	Understand the characteristics of MOSFET.
4	Design and analyze various amplifier circuits.
5	Design OP-AMP-based circuits.
6	Construct and analyze linear and non-linear applications of OP-AMP

Contents

Part-A

Unit-1 Diode Circuits **7(L) hrs**

Ideal and practical model of diode, Half-wave and full-wave rectifier, Performance measures: ripple factor, efficiency, PIV, regulation, Filters: Capacitor, Inductor, LC and π filters, Zener diode: voltage regulation, clipping and clamping circuits.

Unit-2 Bipolar Junction Transistors **9(L) hrs**

Construction, operation and characteristics of BJT (CB, CE, CC), Load line analysis, Q-point, and biasing methods, Transistor as a switch and amplifier, Thermal stability and stability factors, small signal analysis: r_e model and h-parameter model, CE amplifier with and without emitter resistance.

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Unit-3 Metal Oxide Semiconductor Field Effect Transistors **9(L) hrs**

MOSFET: Construction, working, and characteristics, Biasing techniques: Self-bias, Voltage-divider bias, Common-source, Common-drain, Common-gate configurations, MOSFET as switch and amplifier, small signal equivalent circuits and high frequency equivalent circuit.

Part-B

Unit-4 Differential, Multistage and Power Amplifiers **7(L) hrs**

Differential amplifier and its types, Direct-coupled multistage amplifier, Power amplifier and its Classification, Amplifier Distortion, Heat Sinks.

Unit-5 Operational Amplifiers and Applications **13 (L) hrs**

Overview of OP-AMP basics, Ideal vs Practical OP-AMP, parameters (CMRR, Slew rate, Offset, etc.), Open loop and closed configuration of OP-AMP, Applications: Summing amplifier, Integrator, Differentiator, Voltage buffer, Active filters, Oscillators: Phase shift, Wien bridge, Schmitt Trigger, voltage regulator, Analog to Digital Conversion, Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular- wave generators, Precision rectifier, peak detector.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case- studies etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	To design and implement half-wave and full-wave rectifier circuits, and to observe and analyze their output waveforms with and without RC filters.
2	To design a voltage regulator circuit employing a Zener diode and to study the effects of line and load variations on voltage regulation performance.
3	To design and analyze various clipper and clamper circuits using diodes, and to observe their corresponding waveform modifications.
4	To experimentally determine the input and output characteristics of a transistor in the common-emitter configuration.
5	To study the series regulator.
6	To analyze operational amplifier-based inverting and non-inverting amplifier circuits.
7	To plot and analyze the drain and transfer characteristics of a Field Effect Transistor (FET) and determine its key parameters.
8	To design and implement a voltage follower circuit using an operational amplifier and study its unity gain and high input impedance characteristics.
9	To analyze an operational amplifier circuit functioning as a zero-crossing detector.
10	To implement a Schmitt trigger circuit using an operational amplifier.
11	To study operational amplifier circuits functioning as integrators and differentiators.
12	To analyze the output of direct coupled amplifier.
13	To study the common collector (Emitter Follower) transistor amplifier.
14	To analyze the output of two stage capacitor coupled amplifier.
15	To construct and study the operation of operational amplifier-based summing and

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	difference amplifiers.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. A.S. Sedra and K. C. Smith," Microelectronic Circuits", New York, Oxford University Press,1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw-Hill U. S., 1992.
3. J. Millman and A. Grabel," Micro-electronics", McGraw-Hill Education,1988.

References Books

1. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
2. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

Online learning material

1. http://www.introni.it/pdf/Millman%20Halkias%2020Integrated%20Electronics.pdf
   Accessed on October 15, 2025
2. https://pages.uoregon.edu/rayfrey/AnalogNotes.pdf
   Accessed on October 15, 2025
3. https://neurophysics.ucsd.edu/courses/physics_120/Agarwal%20and%20Lang%20(2005)%252
   Accessed on October 15, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Analog Electronic Circuits	Prof. S.C. Dutta Roy	IIT Delhi	https://nptel.ac.in/courses/108102095

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: CEE103
Course Title: Transformer and DC Machines

Programme: B.Tech. (Electrical Engineering)	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the concepts of magnetic circuits.
2	Understand the operation of DC generators.
3	Analyze the performance characteristics of DC Motors for different operating conditions.
4	Understand the concept of torque in rotating machines.
5	Testing of a single-phase transformer and evaluating efficiency and voltage regulation.
6	Understand the concept of three-phase, auto transformers and special transformers.

Contents

Part-A

Unit-1 Magnetic Fields and Magnetic Circuits **6 (L) hrs**

Review of magnetic circuits - MMF, flux, effect of saturation; harmonics in magnetization current, influence of highly permeable materials on the magnetic flux.

Unit-2 DC Generator **8 (L) hrs**

Working principle, construction of DC machines, armature windings, E.M.F. and torque equations, armature reaction: effect of brush shift and compensating winding. Commutation: causes of bad commutation, methods of improving commutation.

Unit-3 DC Mot0or **9 (L) hrs**

Working principle, back emf, torque, characteristics of shunt and series motors, starters (3-point, 4-point), speed control methods (field and armature control). Braking: plugging, dynamic and regenerative braking. Estimation of losses and efficiency by Swinburne's test and Hopkinson test. Introduction to brushless direct current (BLDC) motor.

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PART-B

Unit-4 Single Phase Transformers **11 (L) hrs**

Working principle of transformer ,constructional features and E.M.F equation, Phasor diagram on no- load and loaded conditions, Referred parameters equivalent circuit, in rush phenomenon, Voltage regulation and efficiency, All day efficiency, Open circuit test, short circuit test and back-to-back test..

Unit-5 Three Phase Transformers and Auto-Transformer **11 (L) hrs**

Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, No-load and on-load tap-changing of transformers, Different diagnostic techniques of transformers, dry type transformer and amorphous transformer (definition, advantages, applications).

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	To perform open circuit and short circuit tests on a single-phase transformer and hence find equivalent circuit parameters, voltage regulation and efficiency.
2	To find the efficiency and voltage regulation of single-phase transformer under different loading conditions.
3	To perform back-to-back test (Sumpner's Test) two single-phase transformers.
4	To perform polarity test and parallel operation of two single-phase transformers.
5	To make Scott connections on three-phase transformer to get two phase supply.
6	To verify the outputs of various connections in three-phase transformer.
7	To start the dc motor and study in detail the three-point and four-point starters.
8	To measure armature and field resistance of direct current (DC) shunt generator and to obtain its open circuit characteristics.
9	To perform speed control on dc shunt motor by field current and armature voltage.
10	To draw speed-torque characteristics of dc shunt/series /compound motor.
11	To perform Swinburne's test (no load test) to determine losses of dc shunt motor.
12	Application of MATLAB for solution of problems regarding transformers and dc machines.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1 A. E. Fitzgerald and C. Kingsley, *"Electric Machinery"*, New York, McGraw-Hill Education, 2013.

2 M. G. Say, *"Performance and design of AC machines"*, CBS Publishers, 2002.

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3 P.S.Bimbhra, *"Electrical Machinery"* ,Khanna Publishers, 2011.
4 I. J. Nagrath and D. P. Kothari, *"Electric Machines"*, McGraw-Hill Education,2010.

Reference Books

1 A. E. Clayton and N. N. Hancock, *"Performance and design of DC machines"*, CBS Publishers, 2004.
2 Smarajit Ghosh, "*Electrical Machines*", Pearson, 2005.

Online Learning Materials

1. https://nptel.ac.in/courses/108102146 Accessed on October 22, 2025

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Electrical Machines I	Prof G Sridharo Rao, Prof P Sasidharo Rao, Dr Krishna Vasudevan	IIT Madras	https://nptel.ac.in/courses/108106071
2	Electrical Machines I	Prof D Khastha, Prof Suman Maiti	IIT Kharagpur	https://nptel.ac.in/courses/108105017
3	Electrical Machines I	Prof Tapas Kumar	IIT Kharagpur	https://nptel.ac.in/courses/108105155

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: CEE104
Course Title: Measurements and Instrumentation

Programme: B.Tech. (Electrical Engineering)	**L:** 3 **T:** 0 **P:** 0	**Credits:**3
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)=45 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Non- Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Compare different types of instruments-their working principles, advantages, and disadvantages.
2	Understand the working of the wattmeter and energy meters.
3	Comprehend different flux and permeability measurement methods.
4	Acquire knowledge of AC potentiometers and bridges.
5	Understand the working and applications of the cathode ray oscilloscope.
6	Acquire knowledge about the use of transducers for physical variables.

Contents

PART-A

Unit-1 Basic Concepts of Measurements **12(L) hrs**

Concepts relating to Measurements, True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity, Errors in Measurements, Measurement standards, characteristics, errors in measurement calibration of meters, significance of IS standards of Instruments, Classification of meters, operating forces, essentials of indicating instruments, deflecting, damping, controlling torques. Ammeters and voltmeters, moving coil, moving iron, constructional details and operating, principles shunts and multipliers, extension of range, Measurement of power and energy, Dynamometer type wattmeter for single-phase and three-phase power measurement, induction type energy meters for single phase and three-phase energy measurement.

Unit-2 Measurement of High Range Quantities **8(L) hrs**

Measurement of high DC voltages, measurement of high AC voltages, electrostatic voltmeters, DC Hall effect sensors, high current measurements, Current transformers and potential transformer: principle working.

PART-B

Unit-3 Magnetic Measurements **9(L) hrs**

Measurement of flux and permeability, flux meter, Hall effect Gaussmeter for BH curve and permeability measurement, hysteresis measurement, principle of ballistic galvanometer, determination of BH curve, hysteresis

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loop, Lloyd Fisher square for measurement of iron losses.

Unit 4 Bridges and DSO **7(L) hrs**

AC Bridges, Maxwell's bridge, Schering bridge, and Wien's bridge, Overview of CRO, Advantages of DSO over CRO, Block diagram and principle of operation of general-purpose DSO, Time base and vertical controls, applications of DSO.

Unit-5 Transducers and their Applications **9(L) hrs**

Definition and classification, overview of transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain, and temperature, basic principles and working of LVDT, electromagnetic and ultrasonic flow meters, piezo electric force transducer, load cell, RTD, Thermistors, thermocouple, Need for data acquisition system.

Text Books

1. H. Frick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice-Hall of India, Reprint, 1988.
2. K. Sawhney, "A course in Electrical and Electronics Measurements and Instruments" Dhanpat Rai & Co. (Pvt.) Ltd, 2017.
3. E. Jones, "Instrumentation Measurement and Feedback", Tata McGraw-Hill, 1986.

Reference Books

1. E. O Doebeling, "Measurement Systems Application and Design" McGraw Hill Publishing Company, 1990.
2. A. S. Mooris, "Principle of Measurement and Instrumentation", Prentice Hall of India,1999.
3. J. B. Gupta, "A course in Electrical & Electronic Measurement & Instrumentation.", S K Kataria & Sons, 2016.
4. H. S Kalsi, "Electronic Instrumentation" Tata McGraw Hill, New Delhi, 2012.
5. W. D. Cooper, "Modern Electronics Instrumentation" Prentice Hall of India, 2001.

Online learning material

1. https://mrce.in/ebooks/Instrumentation%20&%20Measurements%20Introduction%203rd%20Ed.pdf Accessed on October 16, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Electrical Measurement and Electronic Instruments	Prof. Avishek Chatterjee	IIT Kharagpur	https://nptel.ac.in/courses/108105153

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: SMEE101

Course Title: Seminar and Technical Report Writing for Engineers

Programme: B.Tech (Electrical Engineering)	**L: 0 T: 0 P:** 2	**Credits:** 1
Semester: 3	**Theory/Practical:** Practical	**Teaching Hours:** 30(P) = 30hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** 0
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Not Applicable		
Duration of End Semester Examination (ESE): Not Applicable		
Course Type: Seminar		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Define and agree the purpose of the report and needs of the readers/audience
2	Design a document structure to effectively get the message across
3	Identify the necessary content and have an appropriate layout
4	Use readily available tools to assist with report writing (LaTex)
5	Reference and quote correctly, and not infringe. Know about Intellectual Property Rights
6	Speak and defend technical reports publicly.

Contents

Instructions

Each single B.tech student of 3rd semester has to present a seminar on a topic of science and Technology which is relevant to the Branch of Study. They have to conduct a Power Point Slide Presentation and a Prescribed format Reports should be submitted to the department, The credit of the seminar will be distributed among the presentation, report, topic content, power point slide preparation, the abstract, skill of presentation, response to the questions, answering methods, report and to the overall efforts of the student, that are put in towards the successful execution of the seminar .

Selection of Seminar Topic:

Seminar Topic should normally be very closely related to the subsequent project work. An idea or subject tips can be filtered out from various sources like scientific magazines, newspapers etc. The material collections process will lay foundation and directions, for the initiation, budding, growth and for the topic development of seminar. The materials can include information's about similar and co-existing fields. If the seminar is an analysis or comparison or an addition to the existing products, methods, process, techniques or application then literature survey includes the detailed study, analysis, explanations, limitation, various other methods used & practiced, the merits & demerits , advantages & disadvantages and comparison of the existing or present with the proposed or new ones. Generally for a totally new idea or inventions or principles the literature surveys will focus to reveal and establish that there are so many other systems existing but not this idea or method.

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Material preparation for seminar report
A typical sample of a front page / cover page and certificate are given on college website. The way students have to arrange (lay out) the various chapters, figures, tables, charts, nomenclature, annexes and references are given.

Material preparation for Power Point Presentation in the Class Room
Each student has to give a lecture with the help of PPT for nearly 15 minutes and should clarify the doubts asked by the audience and should answer to the questions raised by the seminar reviewing/evaluation faculties. The way of presentation, method of delivery, approach to the questions are important. The PPT slide lay out should be free flowing type and the slides should positively help the smooth flow of lecture. The main subject topic should be focused and should be arranged in the order as they come in lecture. The slide should generally simple aesthetic in design, pleasing back ground with natural light colours and designs with no animations. Do not use dark colours like red, violet and black etc. The headings and typing words, symbols should be well clear and distinguishable from the background. The minimum size of letters is 18 to 24, the headings can be up to 34 size. Use normal Times New Roman type letters of suitable sizes. The slides should not be over crowded with sentences or formula. Each single slide can contain a maximum of 10 to 12 lines. Do not cut and paste a whole paragraph or a definition as such rather make small bulleted sentences.

Text Books

1. J.V. Emden and J. Easteal, "Technical Writing and Speaking, an Introduction", McGraw-Hill 1996.
2. W.S. Pfeiffer, "Pocket Guide to Technical Writing", Prentice Hall 1998.
3. A. Eisenberg, "Effective Technical Communication", McGraw-Hill 1992.
4. A.H. Basson and T.W. V. Backström, "Guide for Writing Technical Reports", 3rd Edition, Stellenbosch University",2007.
5. R. P. Merges, P. S. Menell, M. A. Lemley, Intellectual Property in New Technological Age 1997

Reference Books

1. J.V. Emden, "Effective communication for Science and Technology", Palgrave 2001.
2. J.V. Emden, "A Handbook of Writing for Engineers",2nd ed. Macmillan 1998.
3. F.Mittelbach , M.Goossens, J. Braams, D. Carlisle and C.Rowley, "The LaTeX Companion (Tools and Techniques for Computer Typesetting)", 2nd Edition,Addison Wesley,2005
4. S. Kottwitz, "LaTeX Beginner's Guide",1st Edition PACKT, 2011.
5. J.W. Davies, "Communication for Engineering Students", Longman, 1996.
6. T. Ramappa, Intellectual Property Rights Under WTO, S. Chand Publishers, 2008

Online Learning Materials:

1 "Introduction to LaTex", http://home.iitk.ac.in/~kalpant/docs/intro_latex.pdf
Accessed on November 13, 2025
2 LaTeX, Wikibook , http://en.wikibooks.org/wiki/LaTeX,en.wikibooks.org, 2016.
Accessed on November 13, 2025

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B.Tech. 2nd Year (Electrical Engineering)

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Academic & Research Report Writing	Dr. Samir Roy	NITTTR, Kolkata	https://onlinecourses.swayam2.ac.in/ntr20_ed30/preview

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GURU NANAK DEV ENGINEERING COLLEGE, LUDHIANA

No. _____ Dated _____

Dean (Academics)

Please find below the Study Scheme for further approval from Academic Council:

Program	B.Tech.(Electrical Engineering)	Semester	4
Scheme Code	2024	AICTE/UGC	AICTE
Subject Group		Lateral Entry Status	N
Six Month Training	N	Compulsory Theory Count	7
Compulsory Practical Count	1	Elective Theory Count	0
Elective Practical Count	0	Total Course Count	8

List of Courses

S.No.	Course Category	Module Name	Course Code	Course Title	Theory/ Practical (T/P)	Course Type	Contact hours Per Week			Integrated Course	Credits	Marks Distribution		Min. % of Problems(#)
							L	T	P			CA Marks	ESE Marks	
1	Professional Core Courses	Circuits and Devices	CEE105	Digital Electronics	T	Compulsory	3	1	2	Y	5	90	60	40
2	Professional Core Courses	Electrical Machines	CEE106	Asynchronous Machines	T	Compulsory	3	1	0	N	4	40	60	40
3	Professional Core Courses	Circuits and Devices	CEE107	Power Electronics	T	Compulsory	3	1	2	Y	5	90	60	25
4	Professional Core Courses	Circuits and Devices	CEE108	Electrical Circuit Analysis	T	Compulsory	3	1	0	N	4	40	60	60
5	Professional Core Courses	Power and Energy Systems	CEE109	Power System Apparatus and Protection	T	Compulsory	3	1	2	Y	5	90	60	30
6	Humanities, Social Sciences and Management Courses	Human Values	HSMC104	Universal Human Values: Understanding Harmony	T	Compulsory	2	0	0	N	2	40	60	0

Uploaded by(Sign. with date) Department Clerk(hkcgne)	Verified by(Sign. with date) BoS Convener	Recommended by(Sign. with date) Hon'ble Chairperson (BoS)
E-Printed on:31-10-2025 09:57:57		

H.O.D. 31-Oct-2025
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7	Mandatory Courses (Non-Credit)	Environmental Studies	MCEE101	Environmental Sciences and Sustainability	T	Compulsory	2	0	0	N	0	50	0	0
8	Mentoring and Professional Development	Life Skills	MPD102	Mentoring and Professional Development	P	Compulsory	0	0	1	N	1	100	0	0
Total							19	5	7		26			

Department Remarks: Approved by BoS - Approved in BOS wide meeting no.16 dated 16/05/2025. For MCEE101 (Non-Credit Course), the minimum criteria for passing is to secure at least 40% of maximum marks assigned to Continuous Assessment (CA) and attain satisfactory level (S). For MPD102, there is one period per week in both semesters of 2nd year; final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

ESE- End Semester Examination, **CA-** Continuous Assessment

#-Minimum percentage of Numerical/Design/Programming Problems in ESE (for Theory).

Uploaded by(Sign. with date) Department Clerk(hkcgne)	**Verified by(Sign. with date)** BoS Convener	**Recommended by(Sign. with date)** HoD cum Chairperson (BoS)
E-Printed on:31-10-2025 09:57:58		Page 2 of 2

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: CEE105
Course Title: Digital Electronics

Programme: B.Tech. EE	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 4	**Theory/Practical:** Integrated	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Analyze the number system and logic gates to achieve various designs in digital circuits.
2	Apply the knowledge of binary codes, minimization techniques like Boolean Algebra and K-Map
3	Apply appropriate techniques to design digital circuits with minimum hardware components to meet the desired application within realistic constraints.
4	Design and implement Combinational logic circuits
5	Design and implement Sequential logic circuits
6	Identify and use the appropriate type of analog to digital converters and digital to analog converters for the specified design problems.

Contents

Part-A

Unit-1 Number System and Logic Function Minimization **9(L) hrs**

Introduction. Number System: Binary, Octal & Hexadecimal Number Systems. Digital signals. Basic Logic Gates. Universal Gates. Binary codes: BCD Code, Gray Code. Boolean algebra. De-Morgan's Theorem. Minimization of logic function using Boolean Algebra. Standard representation for logic functions (SOP &POS). K-map representation, Minimization of logic functions using K-map. Don't care conditions.

Unit-2 Combinational Circuits **10(L) hrs**

Introduction of combinational circuits. Adder: Half-Adder, Full-Adder. Subtractor: Half-Subtractor, Full-Subtractor. Multiplexer. De-Multiplexer. Encoder: Decimal to BCD Encoder, Octal to Binary Encoder, Hexadecimal to Binary Encoder. Decoder: BCD to 7-segment decoder, BCD to Decimal Decoder. Code Converter. Digital Comparator. Parity Checker/generator.

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Part-B

Unit-3 Sequential Circuits **11(L)hrs**

Introduction of Sequential circuits. Latch. Flip-flops: S-R flip flop & clocked S-R flip flop, J-K flip-flop, T- flip-flop and D- flip-flop, Applications of flip-flops. Registers: Shift Register, Applications of shift registers. Counters: types of counters, Asynchronous (ripple) counter, synchronous counter, Ring Counter, Twisted-ring counter, Up/Down Counter, Applications of counters.

Unit-4 A/D AND D/A Converters **10(L)hrs**

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, Specifications for D/A converters, 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.

Unit-5 Semiconductor Memories And Programmable Logic Devices **5(L)hrs**

Memory organization and operation. Classification and Characteristics of memories. Sequential memory. Read only memory (ROM), Read and write memory (RAM), Content addressable memory (CAM), Charge de coupled device memory (CCD), Commonly used memory chips.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	Verification of the truth tables of TTL gates viz: 7400, 7402, 7404, 7408, 7432, 7486.
2	Design and realization of all gates using NAND/NOR gates.
3	Verification of theorems and laws using gates.
4	Design and verification of the truth tables of Half-Adder using different gates and Full Adder circuit using 7483 IC.
5	Design and verification of the truth table of four bit subtractor using 7483 IC.
6	Verification of truth table of Multiplexer (74150).
7	Verification of truth table of Demultiplexer (74154). .
8	Design and test S-R flip-flop using NOR/NAND gates.
9	Verify the truth table of a JK flip flop using IC 7476.
10	Verify the truth table of a D flip flop using IC 7474 and study its operation in the toggle and asynchronous mode.
11	Verify the truth table of decoder driver7447/7448 and operate a 7 segment LED display through a counter using a low frequency clock. BCD to Decimal decoder 7442.
12	To realize SIPO, SISO, PIPO, and PISO shift register circuits using D flip-flops.
13	Operate the counters 7490, 7493 and 74193(Up/Down counting mode). Verify the frequency division at each stage. Using a frequency clock (say 1 Hz) display the count of LEDs.

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14	To design MOD-10 synchronous up-counter using D flip-flops.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. R. P. Jain, *"Modern Digital Electronics"*, McGraw Hill Education, 2009.
2. M. M. Mano, *"Digital logic and Computer design"*, Pearson Education India, 2016.
3. A. Kumar, *"Fundamentals of Digital Circuits"*, Prentice Hall India, 2016.
4. Laboratory Manuals.

Reference Books

1. Donald P. Leach and Albert Paul Malvino, "*Digital Principles and Applications*", 5 ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, Digital System-Principles and Applications, Pearson Education.
3. Morris Mano, Digital Design, Prentice Hall of India Pvt. Ltd
4. J Thomas L. Floyd, Digital Fundamentals, Pearson Education, New Delhi, 2003.

Online Learning Materials

1. Digital electronics by D. K. Kaushik
   https://www.researchgate.net/publication/264005171_Digital_Electronics
   Accessed on November 13, 2025.

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Digital Electronics	Dr. P. Sivasankar	NITTTR, Chennai	https://onlinecourses.swayam2.ac.in/ntr25_ed125/preview
2	Digital Circuit Design - A Practical Approach (Hindi Language)	Dr. Kanika Sharma	NITTTR, Chandigarh	https://onlinecourses.swayam2.ac.in/ntr25_ed75/preview
3	Digital Electronics: Theory and Practice (In Punjabi)	Dr. Balwinder Singh Dhaliwal	NITTTR Chandigarh	https://onlinecourses.swayam2.ac.in/ntr25_ed76/preview
4	Digital Circuits	Prof. Santanu Chattopadhyay	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_ee125/preview

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: CEE106
Course Title: Asynchronous Machines

Programme: B.Tech. (Electrical Engineering)	**L:** 3 **T:** 1 **P:** 0	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T) = 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 40%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the principle, construction, operation and characteristics of three phase induction motor.
2	Design and analysis of equivalent circuit for construction of phasor diagram and evaluation of various circuit parameters of induction machine.
3	Interpret the different techniques for the speed control and starting of an induction motor.
4	Analyze performance characteristics of Induction Generator.
5	Apprehend performance characteristics of Single Phase Induction Motors.
6	Understand some special type of motors.

Contents

Part-A

Unit-1 Three Phase Induction Motors **12 (L)hrs**

Analogy between induction motor and transformer, constructional features, production of rotating field, distributed three-phase winding, concept of slip, rotor frequency, current, power and torque. Torque-slip characteristics, effect of rotor circuit resistance. Circuit model, phasor diagram and equivalent circuit of three-phase induction motor. Crawling and cogging, High torque cage motors: double cage and deep bar motor.

Unit-2 Starting Methods and Speed Control **10 (L) hrs**

Starting methods, Speed control methods, Motor tests for estimation of equivalent circuit parameters, Introduction to variable frequency drives (VFD).

Part-B

Unit-3 Induction Generator **6 (L) hrs**

Operation: Isolated and Grid mode, methods of excitation, application of induction generator in wind mills

Unit-4 Single –Phase Motors **10 (L) hrs**

Double revolving field theory, characteristics, working principle and applications of - split phase motors, capacitor start motors, capacitor start-capacitor run motors, permanent split capacitor, shaded pole motor.

Unit-5 Special Purpose Motors **07 (L) hrs**

Construction, principle of operation and applications of -Stepper Motors, Linear Induction Motor and Universal Motor. Advanced materials and noise reduction techniques in induction motors. Use of induction motors in electric vehicles.

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Scheme Code- 2024

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1 A.E. Fitzgerald and C. Kingsley, *"Electric Machinery"*, New York, McGraw Hill Education, 2013.
2 M.G. Say, *"Performance and design of AC machines"*, CBS Publishers, 2002.
3 P.S. Bimbhra, *"Electrical Machinery"*, Khanna Publishers, 2011.
4 I.J. Nagrath and D.P. Kothari, *"Electric Machines"*, McGraw HillEducation,2010.

Reference Books

1 A. E. Clayton and N. N. Hancock, *"Performance and design of DC machines"*, CBS Publishers, 2004.
2 Smarajit Ghosh, "*Electrical Machines*", Pearson, 2005.

Online learning material

1. https://referenceglobe.com/CollegeLibrary/library_books/20200125041045198204Electrical%20Machines%20by%20Mr.%20S.%20K.%20Sahdev.pdf

Accessed on November 13, 2025

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Electrical Machines II	Prof Tapas Kumar	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc23_ee55/preview
2	Induction, Synchronous and Special Electrical Machines	Dr. A. Venkadesan	NIT, Puducherry	https://onlinecourses.swayam2.ac.in/ntr25_ed135/preview
3	Electrical Machines	Prof. G. Bhuvaneswari	IIT Delhi	https://nptel.ac.in/courses/108102146

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: CEE107
Course Title: Power Electronics

Programme: B.Tech. (Electrical Engineering)	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 25%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): CEE102
Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Analyze various thyristor family and its commutation techniques.
2	Comprehend different single phase power converter circuits.
3	Apprehend three phase power converter circuits.
4	Understand categorization of chopper as per necessity of industrial electronics application.
5	Develop skills to propose cycloconverter circuits for various applications.
6	Understand the use of inverters in commercial and industrial applications.

Contents

Part-A

Unit-1 Power Electronics Devices and its Characteristics **10(L) hrs**

Introduction to Thyristor Family, V-I Characteristics of SCR, SUS, GTO, LASCR, DIAC, TRIAC, Principle of Operation of SCR, Turn-on Methods of a Thyristor, Switching Characteristics of Thyristors during Turn-on and Turn-off, Gate Characteristics, Firing of Thyristors, Series and Parallel Operation of SCR, Protection of SCR from Over Voltage and Over Current.

Unit-2 Thyristor Commutation Techniques **5 (L) hrs**

Load Commutation (Class A), Resonant-Pulse Commutation (Class B), Complementary Commutation (Class C), Impulse Commutation (Class D), External Pulse Commutation (Class E), Line Commutation (Class F).

Unit-3 Phase Controlled Techniques **8 (L) hrs**

Introduction to Phase angle Control, Single Phase Half Wave Phase Controlled Rectifiers with R and RL Load, Single Phase Full Wave Phase Controlled Rectifiers with R and RL Load (including continuous and discontinuous current mode) having mid-point (M-2) and bridge (B-2) Configuration, Three Phase Full Controlled Bridge Rectifiers with R and RL Load having M-3 and B-3 Configuration. Basic Circuit and Principle of Operation of Dual Converter with Circulating and Non-Circulating Current mode of operation.

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Part-B

Unit-4 Choppers **8 (L) hrs**

Introduction and Principle of Chopper Operations, Control strategies, Chopper Configurations, Regenerative Chopper, Voltage Commutated Chopper, Current Commutated Chopper, Load Commutated Chopper.

Unit-5 Cycloconverters **7 (L) hrs**

Basic Circuit and Operation of Single Phase Cycloconverter, Single Phase to Single Phase Cycloconverter, Three Phase to Single Phase Cycloconverter, Advantages and Disadvantages of Cycloconverter.

Unit-6 Inverters **7 (L) hrs**

Introduction, Operating Principle of Single-Phase Inverter, Three Phase Bridge Inverter, VSI, CSI, Voltage Control (PWM Control) and Reduction of Harmonics in the Inverter Output Voltage.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case- studies etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	Determine the V–I characteristics of an SCR.
2	Investigate the effect of a free-wheeling diode on an R–L load.
3	Analyze the output voltage and current waveforms of a single-phase half-wave rectifier using an SCR.
4	Analyze the output voltage and current waveforms of a three-phase full-wave rectifier using an SCR.
5	Examine various firing techniques of an SCR using a UJT, opto-coupler, or pulse transformer.
6	Evaluate the performance of a three-phase fully controlled bridge converter for different firing angles.
7	Perform thyristorzed speed control of a DC motor.
8	Conduct speed control of an induction motor using thyristors.
9	Measure the V–I characteristics of a UJT and use it as a relaxation oscillator.
10	Examine the V–I characteristics of a TRIAC.
11	Analyze the V–I characteristics of a MOSFET.
12	Analyze the V–I characteristics of an IGBT.
13	Perform speed control of a BLDC motor using thyristors, MOSFETs, or IGBTs.
14	Carry out speed control of a PMDC motor using thyristors, MOSFETs, or IGBTs.
15	Execute speed control of a stepper motor using thyristors, MOSFETs, or IGBTs.
16	Design and evaluate a single-phase inverter using thyristors, MOSFETs, or IGBTs.
17	Investigate the characteristics of a Metal Oxide Varistor (MOV).
18	Examine the operation and performance of a Switched-Mode Power Supply (SMPS).
19	Explore the working principle of a single-phase cycloconverter.
20	Demonstrate the operation of different commutation circuits.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit

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a project report and give a presentation of the same.

Text Books

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. P. S. Bimbhra, Power Electronics, Khanna Publishers, 2010.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

References Books

1. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
2. Joseph Vithayathil, Power Electronics: Principles and Applications, Tata McGraw-Hill, 2011.
3. P. C. Sen, *Power Electronics*, Tata McGraw-Hill Education, 1987.
4. Bimal K. Bose, *Modern Power Electronics and AC Drives*, Prentice Hall of India, 2002.

E-books and online learning material:

1. http://site.iugaza.edu.ps/malramlawi/files/RASHID_Power_Electronics_Handbook.pdf Accessed on October 16, 2025.
2. https://books.google.co.in/books?id=LX5GKpQz2CgC&printsec=frontcover&source=gbs_ge_summary_r&cad=0 Accessed on October 16, 2025

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Power Electronics	Prof. D.Prasad, Prof. N.K. De, Dr. D.Kastha, Prof. Sabyasachi Sengupta	IIT Kharagpur	https://nptel.ac.in/courses/108105066
2	Industrial Drives - Power Electronics	Prof. K. Gopakumar	IISc Bangalore	https://nptel.ac.in/courses/108108077
3	Power Electronics	Prof. B.G. Fernandes, Prof. Kishore Chatterjee	IIT Bombay	https://nptel.ac.in/courses/108101038

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: CEE108

Course Title: Electrical Circuit Analysis

Programme:B.Tech (Electrical Engineering)	**L:** 3 **T:** 1 **P:** 0	**Credits:**4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)= 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 60%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): CEE101

Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Apply network theorems for the analysis of electrical circuits
2.	Obtain the steady-state and transient response of electrical circuits
3.	Analyze circuits in the sinusoidal steady-state (single-phase and three-phase)
4.	Analyze electrical circuits using Laplace Transform
5.	Analyze various types of two port networks and their inter connection
6.	Synthesize two port networks

Contents

PART-A

Unit -1 Basics of Circuits **10 (L) hrs**

Circuit Elements – Sources (Dependent and Independent) and Sinks, Mesh and Nodal Analysis, Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources, Node and Mesh Analysis, Concept of duality and dual networks.

Unit-2 Solution of First and Second Order Networks **9 (L) hrs**

Solution of first and second order differential equations for Series and parallel R-L-C circuits, Transients – Natural and Forced Response, Time constants, Source free R-L and R_C circuits, R-L and R-C circuits with source, AC Transients.

PART-B

Unit-3 Sinusoidal Steady State Analysis **8 (L) hrs**

Representation of sine function as rotating phasor, Phasor Operations, Series and parallel R-L, R-C, R-L-C circuits, RMS values, Average Power and Complex Power, Resonance Magnetic Circuits - Mutual coupled circuits and Dot Polarity,

Unit-4 Electrical Circuit Analysis using Laplace Transforms **9 (L) hrs**

Laplace Transform of circuit elements, Analysis of electrical circuits using Laplace Transform for standard inputs, Inverse Laplace Transform, Transformed network with initial conditions.

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Unit-5 Two Port Network and Network Functions **9 (L) hrs**

Two Port Networks, Concept of Symmetry and Reciprocity, Impedance Parameters, Admittance Parameters, Transmission parameters and hybrid parameters, Interconnections of Two Port Networks, Synthesis of network using Foster and Cauer Forms.

Text Books

1. M. E. V. Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. R. Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, *"Engineering Circuit Analysis"*, McGraw-Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, *"Electric Circuits"*, McGraw-Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, *"Basic Circuit Analysis"*, Jaico Publishers, 1999.

Reference Books

1 J. Bird, "Electrical Circuit Theory and Technology", 7th edition, Routledge, 2021.

2 S. Ghosh and A. Chakraborty, "Network Analysis and Synthesis", McGraw-Hill Education, 2009.

3 C. K. Alexander and M. N. O. Sadiku, "Fundamentals of Electric Circuits", 7th edition, McGraw-Hill, 2022.

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Circuit Theory	Prof. S.C. Dutta Roy	IIT Delhi	https://nptel.ac.in/courses/108102042
2	Basic Electrical Circuits	Prof. Gajendranath Chowdary	IIT Hyderabad	https://onlinecourses.nptel.ac.in/noc21_ee99/preview

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: CEE109
Course Title: Power System Apparatus and Protection

Programme:B.Tech (Electrical Engineering)	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 4	**Theory/Practical:** Integrated	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Interpret the structure and components of electric power systems.
2	Apply transmission line modeling techniques to evaluate its parameters and performance.
3	Understand the operation of relays, circuit breakers, and protection systems under various fault conditions.
4	Evaluate the suitability of protection schemes for transformers, generators, motors, and feeders.
5	Outline the basic protection schemes for microgrids.
6	Demonstrate the operation and characteristics of protection devices through practical experiments.

Contents

Part-A

Unit-1Power System Structure and Line Parameters **8(L) hrs**

Structure of electric power system, single line diagram, types of power plants, layout of thermal and hydro power stations, comparison of AC and DC transmission systems, voltage levels and standardization; types of loads, economic selection of conductor size using Kelvin's Law, types of distribution networks: radial, ring, interconnected, types of conductors: bundled and stranded, conductor transposition, skin effect and proximity effect, symmetrical and unsymmetrical spacing, concepts of GMD and GMR, calculation of resistance, inductance, and capacitance of single-phase and three-phase lines, effect of earth on capacitance.

Unit-2 Transmission Line Performance and Compensation **7(L) hrs**

Short, medium, and long transmission line models, ABCD parameters, voltage regulation and efficiency, Ferranti effect, surge impedance loading, real and reactive power flow, line loadability, introduction to shunt and series compensation, overview of FACTS devices.

Unit-3 Underground Cables **7(L) hrs**

Types of underground cables, construction, insulation materials and grading, dielectric stress and capacitance calculations, charging current, thermal characteristics and current rating, cable faults and fault location methods, comparison with overhead transmission systems.

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Part-B

Unit-4 Substations and Switching Devices **7(L) hrs**

Types of substations, bus-bar arrangements, isolators, circuit breakers: air blast, oil, SF_6, vacuum, arc formation and quenching, re-striking and recovery voltage, rating and testing of circuit breakers, types of fuses and characteristics, lightning and surge protection devices, surge arresters, insulation coordination, grounding methods: solid, resistance and reactance earthing.

Unit-5 Equipment Protection and Protective Relays **8(L) hrs**

Need for protection, protection zones, types of relays: electromagnetic, static, numerical, overcurrent, earth fault, differential, directional and distance relays, relay characteristics and basic coordination principles, transformer protection: differential and Buchholz relay, generator protection: stator fault and loss of excitation, motor protection: overload and phase failure, feeder and busbar protection.

Unit-6 Micro-Grid Protection **8(L) hrs**

Introduction to microgrids, comparison between bulk grid and microgrids, components and structure of AC, DC and hybrid microgrids, operating modes of microgrids: islanded and grid-connected, protection challenges due to bi-directional power flow and inverter-based sources, types of faults in microgrids and basic protection requirements, overview of protection schemes for microgrids: conventional and adaptive methods, principles of relay coordination in microgrids.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies, etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	To draw the key diagram of a power system using a single line representation.
2	To obtain the characteristics of the overcurrent and earth fault protection relays.
3	To obtain the characteristics of an overcurrent static relay.
4	To obtain and analyze the operating characteristics of a distance relay.
5	To obtain the operating characteristics of a fuse (HRC or open type).
6	To simulate the different types of faults on the transmission line using software tools.
7	To obtain the characteristics of the undervoltage and overvoltage numeric relay.
8	To obtain the characteristics of a high-speed impedance relay.
9	To perform the differential protection of a three-phase delta-delta connected transformer.
10	To find the breakdown strength of transformer oil using a breakdown voltage tester.
11	To find the breakdown strength of transformer oil using a breakdown voltage tester.
12	To demonstrate the operation of a circuit breaker (air, SF_6, or vacuum type).
13	To test and compare the characteristics of fuses, MCBs, and MCCBs.
14	To find the earth resistance using the three-electrode method.
15	To demonstrate the demand side management for smart grids.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

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Text Books

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis," McGraw-Hill Education, 2011.
2. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear," McGraw-Hill Education, 2018.
3. Y. G. Paithankar and S. R. Bhide, "Fundamentals of Power System Protection", PHI Learning, 2010.
4. C. L. Wadhwa, "Electrical Power Systems," New Age International Publishers, 2023.
5. R. Singh, "Switchgear and Protection," McGraw-Hill Education, 2008.
6. B. R. Gupta, "Power System Analysis and Design," S. Chand & Company, 2005.
7. S.M. Muyeen and S. Rahman (Eds.). "Microgrids: Architecture, Control and Protection", Springer, 2020.

Reference Books

1. H. Saadat, "Power System Analysis," McGraw-Hill Education, 1999.
2. B. M. Weedy and B. J. Cory, "Electric Power Systems", Wiley, 2012.
3. C. R. Mason, "The Art and Science of Protective Relaying," GE Publications, 1956.
4. R. Bansal, "Power System Protection in Smart Grid Environment, "CRC Press, 2019.
5. J.C. Das, "Microgrid Protection," CRC Press, 2020.
6. S. Chowdhury, and P. Crossley, "Smart Microgrids: Design and Control," CRC Press, 2016.

Online Learning Materials

1) https://www.electrical4u.com/electrical-engineering-articles/protection/
Accessed on October 27, 2025
2) https://www.researchgate.net/publication/339460318_Introduction_to_Power_System_Protections3)
Accessed on October 27, 2025
3) https://cemkolaghat.in/study_mat/PC-EE601_Power%20System%20Protection.pdf
Accessed on October 27, 2025
4) https://mrcet.com/downloads/digital_notes/EEE/09022024/1.%20R22%20III%20-%20%20%20%20%20%20%20%20%20%20II%20EEE%20PSP%20DIGITAL%20NOTES.pdf
Accessed on October 27, 2025

Supplementary SWAYAM Courses

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Power System Protection	Prof. Ashok Kumar Pradhan	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc20_ee73/preview
2	Power System Analysis	Prof. Debapriya Das	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc19_ee62/preview

Experiments to be performed through Virtual Labs

Sr. No.	Experiment Name	Experiment Link(s)
1	To study the differential protection of a three-phase delta-delta connected transformer.	https://vp-dei.vlabs.ac.in/Dreamweaver/exp10.html
2	To study the protection of a three phase Induction Motor using Numerical Relay.	https://vp-dei.vlabs.ac.in/Dreamweaver/exp11.html

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B.Tech. 2nd Year (Electrical Engineering)

Course Code: MCEE101
Course Title: Environmental Sciences and Sustainability

Programme: B.Tech. (Electrical Engineering)	**L:** 2 **T:** 0 **P:** 0	**Credits:** 0
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 30(L) = 30 hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** NIL
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 0%		
Duration of End Semester Examination (ESE): NA		
Course Type: Mandatory Course (Non-Credit)		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand basic environmental concepts, ecosystems, and biodiversity with an emphasis on Indian biodiversity and its conservation.
2	Understand pollution sources, effects, and preventive measures, including disaster management.
3	Gain knowledge of energy resources, their exploitation, and sustainable management.
4	Understand the global and Indian frameworks for sustainability and climate change mitigation.
5	Develop awareness of sustainable practices, materials, urbanization, and energy cycles.
6	Develop solutions for environmental issues based on green buildings, energy efficiency, transportation and renewable energy sources.

Contents

Part-A

Unit-1 Environment and Biodiversity **7(L) hrs**

Definition, scope, and importance of environment, Need for public awareness, Ecosystems, energy flow, and ecological succession, Biodiversity: Genetic, species, and ecosystem diversity, Biodiversity values, India as a mega-diversity nation, Biodiversity hotspots, threats, and conservation methods.

Unit-2 Environmental Pollution **6(L) hrs**

Causes, effects, and control measures of: Water pollution, Soil pollution, Air pollution, Noise pollution, Waste Management: Solid, hazardous, and e-waste, Case studies, Environmental protection laws and acts.

Part-B

Unit-3 Sustainability and Management **9(L)hrs**

Development, GDP, Sustainability: concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate Change: Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint.

Unit-4 Sustainability Practices **8(L) hrs**

Global sustainability goals, Circular economy, ISO-14000 Series, Material Life cycle assessment, Environmental impact assessment. Sustainable habitat: green buildings, green materials, Energy efficiency, Sustainable transport. Sustainable energy: Non-conventional Sources, Energy Cycles: carbon cycle, emission and sequestration, Green Engineering: Sustainable Urbanization, Socio-economic and technological change.

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Text Books

1. A. Kaushik and C. P. Kaushik, "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
2. B. Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2016.
3. G. M. Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.
4. D. T. Allen, D. R. Shonnard, "Sustainability Engineering: Concepts, Design and Case Studies", Prentice Hall, 2011.
5. A. S. Bradley, A. O. Adebayo, P. Maria, "Engineering applications in sustainable design and development, Cengage learning, 2015.

Reference Books

1. R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, 38th edition, Enviro Media, 2010.
2. Cunningham, W.P. Cooper, T. H. Gorhani, "Environmental Encyclopedia", Jaico Publications, House, Mumbai, 2001.
3. D. S. Sengar, "Environmental law", Prentice Hall of India PVT. LTD, New Delhi, 2007.
4. R. Rajagopalan, "Environmental Studies-From Crisis to Cur", Oxford University Press, 3rd edition, 2015.
5. K. M. Mackenthun, "Basic Concepts in Environmental Management", Lewis Publishers, London, 1998.

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