Bachelor of Technology

(B Tech)

3rd Semester

Course Structure

2024 Batch

Department of

Electrical &Electronics Engineering

NIST University,
Pallur Hills, Berhampur, 761008, Odisha
www.nist.edu

Second - Year Course Structure (III Semester)							
S. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**P**	**T**	**Credits**
1	BS	MTH-204	Numerical Methods and Complex Analysis	3	0	0	3
2	PC	EEE-200	Electronics Devices and Circuits	3	2	0	4
3	PC	EEE-201	Network Analysis	3	2	0	4
4	PC	ELE-200	DC Machine and Transformer	3	2	0	4
5	PC	EEE-202	Signal and Systems	3	2	0	4
6	AEC	ENG-200	Soft skill-I	1	2	0	2
7	VAC	CVL-204	Environmental Science and Engineering	1	0	0	1
	Total Credits						**22**

COURSE DESCRIPTION: Electronics Devices and Circuits

Degree	B. Tech.	
Level	Undergraduate	
Branch	EEE (Electrical and Electronics Engineering)	
Semester	3rd	
Subject Name	Electronics Devices and Circuits	
Course Type	Theory	
Course Code	EEE 200	
Category	Engineering Science	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	Nil
	Practice	Nil
	Total	36 Hours
Recommended Background Knowledge	Basic Electrical and Electronics Engineering	
Subject Description	The content of this course mainly deals with Analog Electronic circuits. This course typically introduces students to the principles and applications of analog electronic circuits, including amplifiers, operational amplifiers, oscillators and other essential circuit building blocks. Analog circuits, unlike their digital counterparts, deal with continuously varying signals (analog signals), meaning the voltage or current changes smoothly over time. They are built using a variety of components like resistors, capacitors, inductors, diodes, and transistors. These circuits are used for a wide range of applications, including signal conditioning, amplification, filtering, and more. This course emphasizes understanding the behavior of circuits from first principles, covering particularly FETs (Field Effect Transistors) based circuits. It balances theory with practical lab exercises, allowing students to	

<table>
<tr><td></td><td colspan="2">build and test circuits to verify their performance.</td></tr>
<tr><td rowspan="2">Objectives

and

Outcomes</td><td colspan="2">Objectives:

The course should enable the students to:

1. Understand the structure, basics principle of operations and applications of transistors in real life
2. Gain knowledge of various biasing techniques and develop the small-signal models to analyze the performance of amplifier circuits operating at low and high frequency
3. Design the application circuits using Operational Amplifiers (OP-AMPs)
4. Analyze the performance parameters of feedback topologies and extend the concept of feedback in design of amplifier and oscillator circuits</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Illustrate working principle of different transistors and choosing proper device depending upon application considering economic and technology up-gradation
2. Analyze various transistor biasing techniques to have excellent stabilization against internal and external parameter variations
3. Analyze the performance parameters of amplifiers operating at low and high frequency using small signal models of transistors
4. Design OP-AMP based circuits for various applications and apply various feedback topologies in design of OP-AMP based amplifier and oscillator circuits</td></tr>
<tr><td rowspan="5">Assessment/
Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test</td><td>5 %</td></tr>
<tr><td>Course Project</td><td>5 %</td></tr>
<tr><td>Attendance</td><td>10 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson India Education Services Pvt. Ltd., 2015.
2. David A. Bell, “Electronic Devices and Circuits”, Oxford Higher Education Press, 5th Edition, 2010.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, “Microelectronic Circuits – Theory and Applications”, 7th Edition, Oxford University Press, 2017.
2. Donald A. Neamen, “Electronic Circuits – Analysis and Design”, 3rd</td></tr>
</table>

	Edition, McGraw Hill Education, 2006. 3. J. Milliman, C. Halkias and Satyabrata Jit, "Electronics Devices and Circuits", 4th Edition, Mc-Graw Hill.

<table>
<tr><td rowspan="6">Digital Learning Resources</td><td>Course Name</td><td>Analog Circuit</td></tr>
<tr><td>Course Link</td><td>https://nptel.ac.in/courses/117/101/117101106/</td></tr>
<tr><td>Course Instructor</td><td>Prof. A. N. Chandorkar, Department of Electrical Engineering, IIT Bombay</td></tr>
<tr><td>Course Name</td><td>Analog Electronic Circuits</td></tr>
<tr><td>Course Link</td><td>https://nptel.ac.in/courses/108/102/108102095/</td></tr>
<tr><td>Course Instructor</td><td>Prof. S. C. Dutta Roy, Department of Electrical Engineering, IIT Delhi</td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Illustrate working principle of different transistors and choosing proper device depending upon application considering economic and technology up-gradation	PO1, PO2, PO3, PO5, PO6, PO8, PEO1, PEO2, PEO3, PEO5.
CO2	Analyze various transistor biasing techniques to have excellent stabilization against internal and external parameter variations	PO1, PO2, PO3, PO4, PO5, PO6 , PO7,,PEO1, PEO2, PEO3, PEO4.
CO3	Analyze the performance parameters of amplifiers operating at low and high frequency using small signal models of transistors	PO1, PO2, PO3, PO4, PO5, PO6,PO8, PO9, PO11, PEO1, PEO2, PEO3, PEO5

CO4	Design OP-AMP based circuits for various applications and apply various feedback topologies in design of OP-AMP based amplifier and oscillator circuits	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PEO1, PEO2, PEO3, PEO4, PEO5

DETAILED SYLLABUS:

Module No. 1	**Introduction to Transistors**	**8 Hrs**
Bipolar Junction Transistors (BJTs): Introduction, Transistor structure, Transistor Amplifying action, Modes of Operation, Configurations, Current gains of BJT, Common-Emitter characteristic **Field-Effect Transistors (FETs):** JFET - Construction, Operation, Pinch-off voltage, Drain Saturation current, Current-Voltage Characteristics, JFET as an amplifier and switch, MOSFET – Enhancement and Depletion Modes, Device Structure and Physical Operation, Threshold voltage, Regions of Operation, MOSFET Characteristics, MOSFET as amplifier and switch		

Module No. 2	**BJT amplifiers**	**10 Hrs**
DC-biasing of BJTs: Introduction, Operating point, DC load line, Fixed biased configuration, Collector feedback bias configuration, Emitter-bias configuration, Voltage-divider bias configuration, Bias stabilization of transistors **AC (small signal) analysis of BJT amplifiers:** Introduction, Low frequency model - r_e model, Low frequency analysis of Common emitter (CE) amplifier (fixed bias configuration, voltage divider bias configuration) – Input and Output resistance, Voltage and Current gain, Effects of R_{SIG} and R_L on CE Amplifier, Frequency response of single stage CE amplifiers, High frequency model - Hybrid-π model, Effect of		

Coupling and Bypass capacitors, Frequency response of single stage CE amplifiers considering high frequency model of BJT, Gain-Bandwidth product, Cascade amplifier, Cascode amplifier

Module No. 3	**MOSFET Amplifiers**	**10 Hrs**
DC-biasing of MOSFETs: DMOSFET Biasing Techniques - Constant voltage / Fixed bias, Self-bias configuration, Voltage divider biasing, Bias stabilization EMOSFET Biasing Techniques - Voltage divider biasing, Drain feedback biasing, Bias stabilization **AC (small signal) analysis of EMOSFET amplifiers:** Low frequency models, Frequency response of single stage Common Source (CS) amplifiers, Frequency response of single stage CS amplifiers considering High frequency models of EMOSFET, Miller effect capacitance, Limitations of CS amplifiers, Need of buffers, Effects of R_{SIG} and R_L on CS Amplifier, Cascade and Cascode configurations, Darlington Connection, Current Mirror Circuits		

Module No. 4	**Operational Amplifier and Feedback Topologies**	**10 Hrs**
Open-loop and Closed-loop configurations, OP-AMP application as weighted summer and Instrumentation amplifier. Concepts of negative and positive feedback, Advantage of Negative feedback, Four Basic Feedback Topologies, Principle of oscillation, OP-AMP based Sinusoidal Oscillator Circuits: Wien Bridge oscillator and R-C Phase shift oscillator.		

COURSE DESCRIPTION: Laboratory

Degree	B. Tech.	
Level	Undergraduate	
Branch	Electrical And Electronics Engineering (EEE)	
Semester	3^{rd}	
Subject Name	Electronics Devices and Circuits	
Course Type	Laboratory	
Course Code	EEE-200	
Category	Engineering Science (ES)	
Credit Point	1	
Time Commitment	Lecture + Practice	20 Hours
	Tutorial	Nil
	Total	20 Hours
Recommended Background Knowledge/Course Pre-requisites	Familiarization and testing of electronic components and devices, Understanding and usage of Digital Multimeters, CROs and Function Generators	
Subject Description	Analog Electronic Circuit Lab course provides hands-on experience in designing, building, and testing various analog electronic circuits like amplifiers and oscillators using discrete components like resistors, capacitors, diodes, and transistors. Students learn to design, build, test and analyze the analog circuits and use instruments like digital multimeters, oscilloscopes (CROs), function generators, and power supplies to measure input/output waveforms, voltages, currents, and other parameters. They learn to analyze the measured data, compare theoretical predictions with experimental results, and draw conclusions. At the end, they engage in design and implementation of projects that apply learned concepts. In short, this lab course helps the students to apply theoretical knowledge to practical applications. This lab aims to bridge the gap between theory and practice, enhancing understanding of analog signal processing techniques and building confidence in circuit design.	

<table>
<tr><td rowspan="2">Objectives

and

Outcomes</td><td colspan="2">Objectives:

The course should enable the students to:

1. Know the design procedure for choosing the most suitable biasing circuits for a given transistor
2. Gain practical idea about the limitations of an amplifier through its frequency response
3. Understand the application of OP-AMP in design of various useful practical circuits
4. Learn to apply theoretical knowledge to practical problems and develop proficiency in handling and troubleshooting analog electronic circuits</td></tr>
<tr><td colspan="2">Outcomes:

Upon completion of this course, the student will be able to:

1. Construct appropriate biasing circuits for a given transistor and understanding practical limitations of an amplifier circuit through frequency response of a given common amplification circuit
2. Develop ability to design and conduct experiments on different analog electronic circuits including amplifiers and oscillators
3. Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis
4. Acquire the relevant skills to use the techniques and modern engineering tools of electronic circuits for engineering practice</td></tr>
<tr><td rowspan="7">Assessment/
Evaluation</td><td>Lab Experiments</td><td>30%</td></tr>
<tr><td>Record Writing</td><td>20%</td></tr>
<tr><td>Behavior/ Attitude</td><td>5%</td></tr>
<tr><td>Quiz</td><td>10%</td></tr>
<tr><td>Attendance</td><td>5%</td></tr>
<tr><td>Final Project Presentation</td><td>20%</td></tr>
<tr><td>Final Viva/ Final Lab Quiz Test</td><td>10%</td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Construct appropriate biasing circuits for a given transistor and understanding practical limitations of an amplifier circuit through frequency response of a given common amplification circuit.	PO1, PO2, PO3, PO5, PO6, PO7, PO8, PEO1, PEO2, PEO3, PEO5.
CO2	Develop ability to design and conduct experiments on different analog electronic circuits including amplifiers and oscillators	PO1, PO2, PO3, PO4, PO5, PO7 , PO8,PO10,PEO1, PEO2, PEO3, PEO4.
CO3	Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO11, PEO1, PEO2, PEO3, PEO5
CO4	Acquire the relevant skills to use the techniques and modern engineering tools of electronic circuits for engineering practice	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9, PO10, PEO1, PEO2, PEO3, PEO4, PEO5

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Durations
1	Construct and compare the performance of BJT bias circuits (namely fixed bias, collector feedback bias and voltage-divider bias circuits) in terms of their stability factors	2 Hours
2	Determine the input & output impedance and gain of a single stage CE amplifier	2 Hours
3	Study the single stage CE amplifier and find the gain-bandwidth product from its frequency response	2 Hours
4	Design, assemble & test and compare the performances of JFET bias circuits (fixed bias and self-bias circuits)	2 Hours
5	Determine the drain and transfer characteristics of a JFET & calculate the drain resistance, amplification factor and the transconduntance of the given JFET	2 Hours
6	Study the frequency response of a single stage CS FET amplifier and find the bandwidth of the amplifier circuit	2 Hours
7	Construct and test Differentiator and Integrator circuit using OP-AMP	2 Hours
8	Design and test a Wein-Bridge oscillator circuit using OP-AMP to produce sinusoidal waveforms of different amplitudes and frequencies	2 Hours
9	Design and test a RC phage shift oscillator circuit using OP-AMP to produce sinusoidal waveforms of different amplitudes and frequencies	2 Hours
10	Design, assemble and test of Darlington connection and a current mirror circuit	2 Hours

Degree	B. Tech.	
Level	Undergraduate	
Branch	EEE (Electrical & Electronics Engineering)	
Semester	3rd	
Subject Name	Network Analysis	
Course Type	Lab integrated Theory	
Course Code	EEE201	
Category	PC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	0 Hours
	Practice	06 Hours
	Total	42 Hours
Recommended Background Knowledge	Electrical System Around us	
Subject Description	The subject gives an overview of network analysis techniques, Transient and steady state sinusoidal response. Network graphs and their applications in network analysis. Two-port networks, combination of two ports, Analysis of common two ports, Resonance, Coupled circuits, Network functions, parts of network functions, obtaining a network function from a given part. Elements of network synthesis techniques.	
Outcomes	**Outcomes:** 1. Understanding the structure of complex circuits using network Topology 2. Obtain the transient and steady-state response of electrical circuits. 3. Understanding and calculating parameters for two-port networks, which are essential for analyzing interconnected systems. 4. Potentially exploring techniques to synthesize one-port networks from given impedance or admittance functions.	
Assessment/ Evaluation	Mid-Term Examination	30 %
	Quiz Test-1	5 %
	Academic Project	5 %
	Attendance	10 %

	End-Term Examination	50 %
Prescribed Text Book(s)	[1] Fundamentals of Electric Circuits – Alexander & Sadiku – Tata McGraw Hill, 5th Edition. [2] Network Analysis and Synthesis– M E Van Valkenburg – Pearson Education, 3rd Edition.	
Reference Book(s)	[1] Theory and problem of electrical circuits, Schaum's Outline Series, TMH – Joseph A. Edminister, Mahmood Maqvi. [2] Network theory, Sudhakar and Shymmohan, TMH Publications. [3] W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013	

Digital Learning Resources			
	1.	Circuit Theory by Prof. S.C.Dutta Roy, Professor, IIT Delhi https://archive.nptel.ac.in/courses/108/102/108102042/	**NPTEL**
	2.	Network Analysis by Prof. Tapas Kumar Bhattacharya, Professor, IIT Kharagpur https://archive.nptel.ac.in/courses/108/105/108105159/	**NPTEL**
	3.	Basic Electric Circuits by Dr. Ankush Sharma https://archive.nptel.ac.in/courses/108/104/108104139/	**NPTEL**

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Understanding the structure of complex circuits using network Topology.	PO1,PO2
CO2	Obtain the transient and steady-state response of electrical circuits.	PO1
CO3	Understanding and calculating parameters for two-port networks, which are essential for analyzing interconnected systems	PO1,PO2,PO3
CO4	Potentially exploring techniques to synthesize one-port networks from given impedance or admittance functions	PO1,PO2

DETAILED SYLLABUS:

<table>
<tr><th>Module – 1</th><th>Network Topology and Coupled Circuits</th><th>08 Hours</th></tr>
<tr><td colspan="3">Definitions of branch, node, tree, planar, non-planar graph, incidence matrix, basic tie set schedule, basic cut set schedule.
Analysis of dc and AC circuits with independent and dependent sources: Reciprocity theorem, Compensation theorem, Milliman’s theorem
Coupled Circuits: Self-inductance and Mutual inductance, Coefficient of coupling, dot convention, Ideal Transformer, Analysis of multi-winding coupled circuits, Analysis of single tuned and double tuned coupled circuits.</td></tr>
</table>

<table>
<tr><th>Module No. 2</th><th>Laplace transform and its Application Electrical circuits</th><th>10 Hours</th></tr>
<tr><td colspan="3">. Electrical Circuit Analysis Using Laplace Transforms:
Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions.
Transient analysis of electrical circuits using Laplace Transforms:
First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, Evaluating initial conditions procedure, second order differential equations, homogeneous, non- homogenous, problem solving using R-L-C elements with DC excitation and AC excitation,</td></tr>
</table>

Module No. 3	Two Port Network and Network Functions:	9 Hours
Two Port Networks: Relationship of two port networks, Z-parameters, Y- parameters, Transmission line parameters, h-parameters, Inverse h- parameters, Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, Cascading of two port networks, series connection of two port networks, problem solving including dependent sources also. **Network functions:** Significance of Poles and Zeros, Restriction on location of Poles and Zeros, Time domain behavior from Pole-Zero plots.		

Module No. 4	Fourier series & its Application, and Network Synthesis:	9 Hours
Fourier series & its Application: Fourier series, Fourier analysis and evaluation of coefficients, Steady state response of network to periodic signals, Fourier transform and convergence, Fourier transform of some functions, Parsvel's theorem. **Network Synthesis:** Realizability concept, Hurwitz property, positive realness, and properties of positive real functions. Synthesis of R-L, R-C and L-C driving point functions in Foster and Cauer forms		

Network Theory Laboratory

Degree	B. Tech.	
Level	Undergraduate	
Branch	EE (Electrical Engineering)	
Semester	3rd	
Subject Name	Network Theory	
Course Type	Laboratory	
Category	PC(Professional Core)	
Credit Point	1	
Time Commitment	Lecture + Practice	20 Hours
	Tutorial	Nil
	Total	20 Hours
Recommended Background Knowledge/Course Pre-requisites	Knowledge of basics Circuits	
Subject Description	Network Theory Lab is a practical course where students learn to analyze and design electrical circuits using fundamental concepts and theorems. It involves hands-on experience with circuit construction, measurement, and verification of theoretical principles. The lab focuses on understanding network behavior in both steady-state and transient conditions	
Outcomes	**Outcomes:** 1. Apply Network theorems for the analysis of electrical circuits. 2. Obtain the Steady state and transient response of electrical circuits 3. Obtain frequency repose of the electrical circuits. 4. Analyze two port circuit behavior, Filter circuits.	
Assessment/ Evaluation	Lab Experiments	30%
	Record Writing	20%

	Behavior/ Attitude	5%
	Quiz	10%
	Attendance	5%
	Final Lab Test	20%
	Final Viva/ Final Lab Quiz Test	10%
Prescribed Text Book(s)	[1] S. Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013. [2] G. Rizzoni, "Principles and Applications of Electrical Engineering", McGrawHill, 2017	
Digital Learning Resources		

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Apply Network theorems for the analysis of electrical circuits	PO1, PO2, PO3, PO4, PO5
CO2	Obtain the Steady state and transient response of electrical circuits	PO1, PO2, PO3, PO5
CO3	Obtain frequency repose of the electrical circuits.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analyze two port circuit behavior, Filter circuits	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Duration in Hrs
1	Verification of Network Theorems in DC circuits. (Reciprocity theorem, , Milliman's theorem & Compensation Theorem).	2
2	Verification of Network Theorems in AC circuits. (Superposition theorem, Reciprocity theorem, Maximum Power transfer theorem).	2
3	Study of DC and AC Transients for R-L, R-C & R-L-C circuits using storage oscilloscope.	2
4	Determination of two port network parameters.	2
5	Frequency response of Low pass and High Pass Filters.	2
6	Frequency response of Band pass and Band Elimination Filters	2
7	Determination of self inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit	2
8	Study of resonance in R-L-C series and R-L-C Parallel circuit using oscilloscope	2
9	Determine the frequency response of Series RLC and Parallel RLC circuit Using MATLAB Simulink	2
10	Determination of Response of different DC circuits using MATLB	2

Degree	B. Tech.	
Level	Undergraduate	
Branch	EE (Electrical Engineering)	
Semester	3rd	
Subject Name	DC Machine and Transformer	
Course Type	Lab integrated Theory	
Course Code	ELE200	
Category	PC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	0 Hours
	Practice	06 Hours
	Total	42 Hours
Recommended Background Knowledge	Electrical System Around us	
Subject Description	The subject "DC Machines and Transformers" focuses on the principles, construction, operation, and applications of both DC machines (motors and generators) and transformers, which are essential components in electrical power systems and various industries. The course provides students with a strong foundation in these electromechanical energy conversion devices.	
Outcomes	**Outcomes:** 1. . Understand electrical principle, laws, and working of DC generator and motor and losses and also conduct various tests on the DC generator. 2. Understand electrical principle, laws, and working of DC motor, losses and also conduct various tests on the DC Motor. 3. Understand electrical principle, laws, and working of 1 phase transformer and losses and also conduct various tests on the transformer. 4. Understand electrical principle, laws, and working of 3 phase transformer and convert 3 phase transformer to multi phase transformer.	
Assessment/ Evaluation	Mid-Term Examination	30 %
	Quiz Test-1	5 %

<table>
<tr><td rowspan="3"></td><td>Academic Project</td><td>5 %</td></tr>
<tr><td>Attendance</td><td>10 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">[1] P S Bimbhra – Electrical Machinery –Khanna Publishers.
[2] B.S.Guru & H.R.Hiziroglu-‘Electric Machinery & Transformers’-3rd Ed-Oxford Press, 2014</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">[1] P.C.Sen-‘Principles of Electric Machines and Power Electronics’-2nd Edition, John Wiley and Sons, Wiley India Reprint, 2014.
[2] A.E.Fitgerland, Charles Kingslay Jr. & Stephen D. Umans -Electric machinery – 6th Edition Mc Graw Hill – Reprint 2015.
[3] D.P. Kothari & I.J. Nagrath - Electric Machines – 4th Edition Mc Graw Hill – Reprint 2015.
[4] Stephen J. Chapman-‘Electric Machinery and Fundamentals’- Mc Graw Hill International Edition, (Fourth Edition), 2015.
[5] M.G.Say-‘Alternating Current Machines’, English Language Book Society (ELBS)/Longman , 5th Edition, Reprinted 1990.</td></tr>
<tr><td>Digital Learning Resources</td><td colspan="2">
<table>
<tr><th>Subject Name</th><th>Link</th><th>Name of the Instructor</th></tr>
<tr><td>Electrical Machine-I</td><td>https://nptel.ac.in/courses/108105017</td><td>Dr. D.Kastha, Professor, IIT Kharagpur</td></tr>
<tr><td>Electrical Machine-I</td><td>https://archive.nptel.ac.in/courses/108/102/108102146/</td><td>Dr. G. Bhubaneswari, Professor, IIT Delhi</td></tr>
</table>
</td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	To understand basic principle of operation, characteristics and performance of DC Generator.	PO1, PO2, PO3, PO4
CO2	To Explore the characteristics of DC motor and Analyze different testing methods to predetermine the efficiency of DC machines.	PO1, PO2, PO3, PO4, PO5, PO6, PO7
CO3	To Explain the basic principle of operation, characteristics and performance of single phase transformer.	PO3, PO4, PO5, PO10
CO4	To demonstrate the constructional features and perform circuit connection of three-phase transformer.	PO3, PO4, PO5, PO10

DETAILED SYLLABUS:

Module – 1	DC Generator:	08 Hours
General principles of DC machines: Armature Windings (Simplex Lap and Simplex Wave), Expression for EMF Induced and Torque developed in the Armature counter Torque and Counter or Back EMF, Methods of Excitation, Armature Reaction, Methods of Reduction of Armature reaction, Commutation. DC Machine Characteristics: Conditions for Self Excitation, Critical Resistance and Critical Speed. Internal, External and load Characteristics for self and Separately Excited DC Generator		

Module No. 2	DC Motor:	10 Hours
DC Motor principle of operation, Characteristic for Speed~ Armature Current, Torque~Armature Current and Speed~ Torque of a DC Shunt, Series and Compound Motor and Comparison. Necessity of a Starter, Starting of DC Shunt, Series and Compound Motors, Speed Control of DC Shunt and Series motor, Losses, efficiency and power flow diagram. **DC Machines Testing:** Direct test, Swinburnes's Test and Hopkinson's Test. Applications of DC Motor.		

Module No. 3	Single-phase Transformer:	9 Hours
Principle of operation, EMF Equation, Phasor Diagrams at No -Load and Load Conditions of an Ideal transformer and practical transformer, Equivalent Circuit, Determination of Parameters from Tests (Polarity Test, Open Circuit Test and Short Circuit Test, Back to Back test), Per Unit Calculation and its importance, Voltage Regulation, Losses, Efficiency and all day efficiency		

Module No. 4	Auto Transformer and Three phase Transformer	9 Hours
Auto-Transformer and Parallel Operation of Transformers: Auto Transformer: Basic constructional features; VA conducted magnetically and electrically. Comparative study with two winding transformer, Conversion of a two winding transformer into a single winding transformer. Parallel operation of transformers and load sharing.		

Three-phase Transformer: Constructional features, as a single unit and as a bank of three single phase transformers. Three-Phase Transformer connections, Transformer Ratings and Related problems, Two Single-Phase Transformers connected in Open Delta (V-Connection) and their rating. T-Connection (Scott Connection) of Two Single-Phase Transformers. Transformer Three phase Connections: Various Phase Displacements (0^o, 180^o, $+30^o$ and -30^o), Connection Diagrams and Phasor Diagrams of various Vector Groups. Indian standards for manufacturing transformers

DC Machine and Transformer Laboratory

Degree	B. Tech.	
Level	Undergraduate	
Branch	EE (Electrical Engineering)	
Semester	3rd	
Subject Name	DC Machine And Transformer	
Course Type	Laboratory	
Category	PC(Professional Core)	
Credit Point	1	
Time Commitment	Lecture	Nil
	Tutorial	Nil
	Practice	20 Hours
	Total	20 Hours
Recommended Background Knowledge/Course Pre-requisites	Knowledge of basics Circuits	
Subject Description	The "DC Machines and Transformer Lab" is a course focused on the practical application and testing of DC machines (motors and generators) and transformers. Students gain hands-on experience with the construction, operation, and performance analysis of these essential electrical components used in power systems and various industries	

<table>
<tr><td rowspan="1">Outcomes</td><td colspan="2">Outcomes:
1. Acquire hands on experience of conducting various tests on dc generator and obtaining their performance indices using standard analytical method.
2. Acquire hands on experience of conducting various tests on dc motor and obtaining their performance indices using standard analytical method.
3. Acquire hands on experience of conducting various tests on 1-phase transformer.
4. Acquire hands on experience of conducting various tests on 3-phase transformer.</td></tr>
<tr><td rowspan="7">Assessment/ Evaluation</td><td>Lab Experiments</td><td>30%</td></tr>
<tr><td>Record Writing</td><td>20%</td></tr>
<tr><td>Behavior/ Attitude</td><td>5%</td></tr>
<tr><td>Quiz</td><td>10%</td></tr>
<tr><td>Attendance</td><td>5%</td></tr>
<tr><td>Final Lab Test</td><td>20%</td></tr>
<tr><td>Final Viva/ Final Lab Quiz Test</td><td>10%</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">[1] P S Bimbhra – Electrical Machinery –Khanna Publishers.
[2] B.S.Guru & H.R.Hiziroglu-‘Electric Machinery & Transformers’-3rd Ed-Oxford Press, 2014</td></tr>
<tr><td>Digital Learning Resources</td><td colspan="2"></td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Acquire hands on experience of conducting various tests on dc generator and obtaining their performance indices using standard analytical method.	PO1, PO2, PO3, PO4, PO5
CO2	Acquire hands on experience of conducting various tests on dc motor and obtaining their performance indices using standard analytical method	PO1, PO2, PO3, PO5
CO3	Acquire hands on experience of conducting various tests on 1-phase transformer	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Acquire hands on experience of conducting various tests on 3-phase transformer	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Duration in Hrs
1	Determination of critical resistance and critical speed from no load test of a DC shunt generator.	2
2	Plotting of external and internal characteristics of a DC shunt generator	2
3	Speed control of DC shunt motor by armature voltage control and flux control method	2
4	Determination of efficiency and losses of a DC shunt motor using Swinburne's method	2
5	Determination of efficiency and losses of a DC machines using regenerative or Hopkinson's method	2
6	Determination of Efficiency and Voltage Regulation by Open Circuit and Short Circuit test on single phase transformer	2
7	Parallel operation of two single phase transformers	2
8	Back-to Back test or Sumpner's test on two single phase transformers	2
9	Study of open delta and Scott connection of two single phase transformers	2
10	Separation of hysteresis and eddy current losses in a transformer	2

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	EE (Electrical Engineering)	
Semester	3^{rd}	
Subject Name	Signal and Systems	
Course Type	Theory	
Course Code	EEE 202	
Category	PC (Professional Core)	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	Nil
	Practice	Nil
	Total	36 Hours
Recommended Background Knowledge	Basics of Fourier Series, Fourier Transform	
Subject Description	This course introduces fundamental concepts of signals and systems with a focus on both continuous-time (CT) and discrete-time (DT) domains. It covers signal classifications, system properties, convolution and correlation operations, and essential analytical tools such as Fourier Series, Fourier Transform, and Laplace Transform. Emphasis is placed on mathematical modeling, signal analysis, and system behavior understanding for applications in communication, control, and signal processing.	
Objectives and	**Objectives:** The course should enable the students to: 1. Impart a foundational understanding of various types of signals and their mathematical operations.	

<table>
<tr><td rowspan="2">Outcomes</td><td colspan="2">2. Introduce the analysis and classification of linear time-invariant (LTI) systems in both CT and DT domains.
3. Develop the ability to analyze signals and systems using Fourier Series and Fourier Transform.
4. Provide knowledge of Laplace Transform techniques for solving and analyzing differential equations in system modeling.</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Classify and analyze various types of continuous-time and discrete-time signals.
2. Determine and evaluate properties of systems including linearity, time-invariance, causality, and stability.
3. Apply Fourier Series and Fourier Transform to analyze and interpret signal behaviors in the frequency domain.
4. Utilize Laplace Transform for solving differential equations and analyzing system dynamics in the s-domain.</td></tr>
<tr><td rowspan="5">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test</td><td>5 %</td></tr>
<tr><td>Course Project</td><td>5 %</td></tr>
<tr><td>Attendance</td><td>10 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">[1] Tarun Kumar Rawat, Signals and Systems, 1st edition, Oxford University Press, 2010, India.
[2] A. Nagoor kani, Signals and Systems, 2nd edition, Tata McGraw Hill Education Private Limited, 2010, New Delhi.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">[1]. I.J. Nagrath, S. N. Sharan, and R. Ranjan, S. Kumar, Signals and Systems, 2nd Edition, Tata McGraw Hill Education Private Limited, 2001, New Delhi.
[2]. Ramesh Babu , Signals and Systems, 4th edition, Scitech Publication, 2010, India.</td></tr>
<tr><td rowspan="2">Digital Learning Resources</td><td>Course Name</td><td>Signals and Systems</td></tr>
<tr><td>Course Link</td><td>https://onlinecourses.nptel.ac.in/noc21_ee28/preview</td></tr>
</table>

	Course Instructor	*Prof. Kushal K. Shah, IISER Bhopal*
	Course Name	*Principles of Signals and Systems*
	Course Link	*https://archive.nptel.ac.in/courses/108/104/108104100/*
	Course Instructor	*Prof. Aditya K. Jagannatham, IIT Kanpur*

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Classify and analyze various types of continuous-time and discrete-time signals.	PO1, PO2, PO3, PO5, PO9,PEO1, PEO2, PEO4
CO2	Determine and evaluate properties of systems including linearity, time-invariance, causality, and stability.	PO1, PO2, PO3, PO4,PO5, PO9 ,PEO1, PEO2, PEO5
CO3	Apply Fourier Series and Fourier Transform to analyze and interpret signal behaviors in the frequency domain.	PO1, PO2, PO3, PO4,PO5, PO6,PO7, PEO1, PEO2, PEO4
CO4	Utilize Laplace Transform for solving differential equations and analyzing system dynamics in the s-domain.	PO1, PO2, PO3, PO4, PO5, PO6, PEO1, PEO2, PEO4, PEO5

DETAILED SYLLABUS:

Module No. 1	Introduction to Signals: Continuous and Discrete Time Signals	9 Hrs
Basics of continuous-time (CT) and discrete-time (DT) signals. Classification of signals: energy, power, periodic, aperiodic, even, odd, causal, anti-causal, and standard signals. Basic operations on signals: amplitude and time scaling, time shifting, folding, addition, and multiplication.		

Module No. 2	Introduction to Systems: Continuous and Discrete Time Systems	9 Hrs
Classification of continuous-time and discrete-time systems: linear, non-linear, time-invariant, time-varying, causal, non-causal, stable, unstable, static, and dynamic systems. Convolution sum and integral for LTI systems. Properties of LTI systems. Basics of correlation and difference with convolution.		

Module No. 3	Continuous Time Fourier Series and Fourier Transform	9 Hrs
Introduction to Fourier Series: trigonometric and exponential forms, properties. Fourier Transform for CT signals: FT of aperiodic and periodic signals, convergence, properties, and system analysis using FT. Concepts of energy and power spectral density.		

Module No. 4	Laplace Transform	9 Hrs
Introduction to complex frequency (S-domain). Definition and conditions for existence of Laplace and inverse Laplace transforms. Key theorems, differentiation and integration in Laplace domain. Transforms of standard functions. Initial and final value theorems.		

COURSE DESCRIPTION: Laboratory

<table>
<tr><td>Degree</td><td colspan="2">B. Tech.</td></tr>
<tr><td>Level</td><td colspan="2">Undergraduate</td></tr>
<tr><td>Branch</td><td colspan="2">EE(Electrical Engineering)</td></tr>
<tr><td>Semester</td><td colspan="2">3^{rd}</td></tr>
<tr><td>Subject Name</td><td colspan="2">Signal and Systems</td></tr>
<tr><td>Course Type</td><td colspan="2">Laboratory</td></tr>
<tr><td>Course Code</td><td colspan="2">EEE 202</td></tr>
<tr><td>Category</td><td colspan="2">PC (Professional Core)</td></tr>
<tr><td>Credit Point</td><td colspan="2">1</td></tr>
<tr><td rowspan="3">Time Commitment</td><td>Practice</td><td>20 Hours</td></tr>
<tr><td>Tutorial</td><td>Nil</td></tr>
<tr><td>Total</td><td>20 Hours</td></tr>
<tr><td>Recommended Background Knowledge/Course Pre-requisites</td><td colspan="2">Knowledge in Matlab</td></tr>
<tr><td>Subject Description</td><td colspan="2">This laboratory course aims to provide practical exposure to fundamental concepts in Signals and Systems using MATLAB as a simulation tool. Students will learn to generate and analyze continuous-time (CT) and discrete-time (DT) signals, apply convolution and correlation techniques, and explore transformations like Fourier Series and Laplace Transforms. The course emphasizes algorithmic thinking and the use of MATLAB programming for solving signal processing problems.</td></tr>
<tr><td>Objectives and Outcomes</td><td colspan="2">Objectives:
The course should enable the students to:
1. Familiarize with MATLAB-based signal representation and manipulation.
2. Enable to generate and visualize CT and DT signals and perform basic signal operations.</td></tr>
</table>

	3. Impart hands-on experience in implementing linear convolution and correlation for system analysis. 4. Provide computational techniques for solving signals using Fourier Series and Laplace Transforms.
	Outcomes: Upon completion of this course, the student will be able to: 1. Implement signal generation and perform matrix manipulations using MATLAB. 2. Analyze the behavior of CT and DT signals through convolution and correlation techniques. 3. Apply computational methods to evaluate Fourier Series and Laplace transforms of signals. 4. Develop MATLAB programs for simulation and visualization of signal processing concepts.

Assessment/ Evaluation	Lab Experiments	30%
	Record Writing	20%
	Behavior/ Attitude	5%
	Quiz	10%
	Attendance	5%
	Final Project Presentation	20%
	Final Viva/ Final Lab Quiz Test	10%

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Implement signal generation and perform matrix manipulations using MATLAB.	PO1, PO2, PO3, PO4, PO5, PO7, PO9, PEO1, PEO2,

		PEO4, PEO5
CO2	Analyze the behavior of CT and DT signals through convolution and correlation techniques.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9 ,PEO1, PEO2, PEO5
CO3	Apply computational methods to evaluate Fourier Series and Laplace transforms of signals.	PO1, PO2, PO3, PO4,PO5, PO6, PO7, PO8, PO9, PEO1, PEO2, PEO4
CO4	Develop MATLAB programs for simulation and visualization of signal processing concepts.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10, PEO1, PEO2, PEO4, PEO5

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Durations
1	Creation of arrays and matrices in simulator and their manipulation	2 Hours
2	Use of control structures and writing of programs and function	2 Hours
3	Generation and plotting of various continuous time signals	2 Hours
4	Generation and plotting of various discrete time signals	2 Hours
5	Linear Convolution of CT signals	2 Hours
6	Linear Convolution of DT signals	2 Hours
7	Linear Correlation of CT signals.	2 Hours
8	Linear Correlation of DT signals.	2 Hours
9	Computation of trigonometric Fourier Series of CT periodic signals	2 Hours
10	Computation of Laplace transform and Inverse Laplace Transform of signals	2 Hours

Bachelor of Technology

(B Tech)

4th Semester

Course Structure

2024 Batch

Department of

Electrical &Electronics Engineering

NIST University,
Pallur Hills, Berhampur, 761008, Odisha
www.nist.edu

Second - Year Course Structure (IV Semester)							
S. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**P**	**T**	**Credits**
1	BS	PHY-200	Fuel Cell Technology	3	0	1	4
2	PC	ELE-201	Electrical Power Transmission and Distribution	3	2	0	4
3	PC	ELE-202	Rotating AC Machine	3	2	0	4
4	PC	EEE-204	Electromagnetic Theory	3	2	0	4
5	HS	MGT-200/MGT-201	Engineering Economics /Organization Behavior	3	0	0	3
6	SEC	CSE-201	Introduction to Python Programming	0	2	0	1
7	SEC	MGT-203	Aptitude and Reasoning—I	0	2	0	1
8	VAC	MGT-202	Constitution of India	1	0	0	1
	Total Credits						**22**