Board of Studies of Electrical & Electronics Engineering Dept.

Attendance Sheet

S.NO	NAME	DESIGNATION	DESIGNATION IN BOS	SIGNATURE
1	Dr.K.Rahul Wilson	Professor & Head of the Department EEE, ECET	Chairman	15/11/23
2	Dr.A.Raghu Ram	Professor of EEE, JNTUH UCESTH	Member-JNTUH	15/11/23
3	Dr. T. Anil Kumar	Professor of EEE, Anurag Univeristy, Hyd	Member-other college	
4	Dr.P.Vasudeva Naidu	Professor of EEE, MEC, Hyd.	Member-other college	
5	Mr.G.Veeranna	Asst. Engineer Manager, Electrical Power Transmission & Distribution department, L&T, Hyderabad	Member-Industry	
6	Mr.D.Prasada Rao	Assistant Professor, ECET	Member-college	
7	Mr.B.Jail Singh	Assistant Professor, ECET	Member-college	
8	Mrs. Ch. Yamini Chandana	Assistant Professor, ECET	Member-college	
9	Mr.A.Ravi Kumar	M.Tech	Member-Alumni	
10	Prof. P. John Paul	Principal ECET	Special Invitee	

ECET
ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY
UGC AUTONOMOUS
(Autonomous Institution - UGC, Govt. of India)
(Sponsored by Ellenki Educational Society)
(Approved by AICTE, New Delhi, Affiliated to JNTUH Hyderabad, MSME - HI Govt. of India,
Accredited by NAAC, Recognisation of 2(f) by UGC, ISO 9001:2015 Certified)

Date: 01-11-2023

Board of Studies of Electrical & Electronics Engineering Dept.

On behalf of ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous), Patelguda(V), Ameenpur(M), Sangareddy(D), Telangana-502319. I am pleased to constitute the Board of Studies in the Department of Electrical and Electronics Engineering for B.Tech and M.Tech Courses as per details given below:

S.NO	NAME	DESIGNATION	DESIGNATION IN BOS
1	Dr.K.Rahul Wilson	Professor & Head of the Department EEE, ECET	Chairman
2	Dr.A.Raghu Ram	Professor of EEE, JNTUH UCESTH	Member (JNTUH)
3	Dr. T. Anil Kumar	Professor of EEE, Anurag Univeristy, Hyd	Member (other college)
4	Dr.P.Vasudeva Naidu	Professor of EEE, MEC, Hyd.	Member (other college)
5	Mr.G.Veeranna	Asst. Engineer Manager, Electrical Power Transmission & Distribution department, L&T, Hyderabad	Member (Industry)
6	Mr.D.Prasada Rao	Assistant Professor, ECET	Member
7	Mr.B.Jail Singh	Assistant Professor, ECET	Member
8	Mrs. Ch. Yamini Chandana	Assistant Professor, ECET	Member
9	Mr.A.Ravi Kumar	M.tech, Alumni	Member
10	Prof. P. John Paul	Principal ECET	Special Invitee

- The above staff members of the Board of Studies in Electrical and Electronics Engineering shall hold the office for a period of three years with effect from the date of issue of this order.
- The members attending the meeting of the Board of Studies are eligible for T.A. and D.A as per rules of the Institution in force.
- The members are also requested to intimate this office in case of any changes in their address and designations.
- We request you to kindly consent your willingness to the member of this BOS.

PRINCIPAL

PRINCIPAL
Ellenki College of Engg. & Tech.
Patelguda (V), Ameenpur (M)
Dist. Sangareddy, 502 319. T.S

Department of Electrical and Electronics Engineering

Minutes of Board of Studies Meeting

Date: 15/11/2023

Ellenki College of Engineering & Technology was founded in the year 1999 with a vision to achieve excellence in providing all round education. Established for over two decades, ELLENKI College of Engineering & Technology is one of the premier private engineering colleges in Hyderabad. The College has got Autonomous Status from the A.Y. 2023-24 for 5 years.

The first BOS meeting of the Electrical and Electronics Engineering Department was held on 15th December, 2023 in dual mode. The minutes of meeting are as follows.

The Chairman welcomed all the members to the 1st Board of Studies meeting of the Electrical and Electronics Engineering Department.

1. The Academic course structure for B.Tech-EEE (I, II, III & IV year) has been discussed and drafted for ER23 Regulations.
2. Detailed syllabi for the B.Tech-EEE (I Year) program have been discussed at length. The proposed syllabus has been agreed and no changes were suggested by the BOS members.
3. The proposed syllabus for Basic Electrical Engineering and Basic Electrical Engineering Laboratory offering to CSE, CSE (DS), and CSE (CS) in I B. Tech I Semester has been approved.
4. The proposed syllabus for Basic Electrical Engineering and Basic Electrical Engineering Laboratory offering to ECE and CSE (AI&ML) in I B.Tech II Semester has been approved.
5. Academic course structure for M.Tech (Power Electronics), I & II years have been discussed and drafted for ER23 Regulations.
6. Detailed syllabi for M.Tech (Power Electronics), I Year program have been discussed at length. The proposed syllabus has been agreed upon by the BOS Members.

Finally, the Chairman thanked all the members for their presence and also for their valuable suggestions towards the importance of the Curriculum and Syllabus of Electrical and Electronics Engineering.

15/11/23
Chairman
Board of Studies

15/11/23

15/11/2023

15/11/23

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD

B.Tech in ELECTRICAL AND ELECTRONICS ENGINEERING
PROPOSED COURSE STRUCTURE (ER23 Regulations)

I Year I Semester

S. No.	Course Code	Course Title	L	T	P	Credits
1		Matrices and Calculus	3	1	0	4
2		Engineering Chemistry	3	1	0	4
3		C Programming and Data Structures	3	0	0	3
4		Electrical Circuit Analysis – I	3	0	0	3
5		Computer Aided Engineering Graphics	1	0	4	3
6		Elements of Electrical and Electronics Engineering	0	0	2	1
7		Engineering Chemistry Laboratory	0	0	2	1
8		C Programming and Data Structures Laboratory	0	0	2	1
		Induction Program				
		Total Credits	**13**	**2**	**10**	**20**

I Year II Semester

S. No.	Course Code	Course Title	L	T	P	Credits
1		Ordinary Differential Equations and Vector Calculus	3	1	0	4
2		Applied Physics	3	1	0	4
3		Engineering Workshop	0	1	3	2.5
4		English for Skill Enhancement	2	0	0	2
5		Electrical Circuit Analysis - II	2	0	0	2
6		Applied Python Programming Laboratory	0	1	2	2
7		Applied Physics Laboratory	0	0	3	1.5
8		English Language and Communication Skills Laboratory	0	0	2	1
9		Electrical Circuit Analysis Laboratory	0	0	2	1
10		Environmental Science	3	0	0	0
		Total Credits	**13**	**2**	**14**	**20**

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Numerical Methods and Complex variables	3	1	0	4
2		Electrical Machines-I	3	1	0	4
3		Analog Electronic Circuits	3	0	0	3
4		Power System-I	3	0	0	3
5		Electro Magnetic Fields	3	0	0	3
6		Electrical Machines Laboratory-I	0	0	2	1
7		Analog Electronic Circuits Laboratory	0	0	2	1
8		Electrical Simulation tools Laboratory	0	0	2	1
9		Gender Sensitization Laboratory	0	0	2	0
		Total Credits	**15**	**2**	**08**	**20**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Solid Mechanics & Hydraulic Machines	3	1	0	4
2		Measurements and Instrumentation	3	0	0	3
3		Electrical Machines–II	3	0	0	3
4		Digital Electronics	2	0	0	2
5		Power System-II	3	0	0	3
6		Digital Electronics Laboratory	0	0	2	1
7		Measurements and Instrumentation Laboratory	0	0	2	1
8		Electrical Machines Laboratory-II	0	0	2	1
9		Real-time Research Project/ Field Based Project	0	0	4	2
10		Constitution of India	3	0	0	0
		Total Credits	**17**	**1**	**10**	**20**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Power Electronics	3	1	0	4
2		Control Systems	3	1	0	4
3		Microprocessors & Microcontrollers	3	0	0	3
4		Professional Elective-I	3	0	0	3
5		Business Economics and Financial Analysis	3	0	0	3
6		Microprocessors & Microcontrollers Laboratory	0	0	2	1
7		Power Electronics Laboratory	0	0	2	1
8		Advanced English Communication Skills Laboratory	0	0	2	1
9		Intellectual Property Rights	3	0	0	0
		Total Credits	**18**	**2**	**6**	**20**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1		Open Elective-I	3	0	0	3
2		Professional Elective-II	3	0	0	3
3		Signals and Systems	3	0	0	3
4		Power System Protection	3	0	0	3
5		Power System Operation and Control	3	0	0	3
6		Power System Laboratory	0	0	2	1
7		Control Systems Laboratory	0	0	2	1
8		Digital Signal Processing Lab	0	0	2	1
9		Industry Oriented Mini Project/ Internship	0	0	4	2
10		Environmental Science	3	0	0	0
		Total Credits	**18**	**0**	**10**	**20**

Environmental Science in III Yr II Sem Should be Registered by Lateral Entry Students Only.

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IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Power Electronic Applications to Renewable Energy Systems	3	1	0	4
2		Open Elective-II	3	0	0	3
3		Professional Elective-III	3	0	0	3
4		Professional Elective-IV	3	0	0	3
5		Fundamentals of Management for Engineers	2	0	0	2
6		Simulation of Renewable Energy Systems Laboratory	0	0	4	2
7		Project Stage - I	0	0	6	3
		Total Credits	**14**	**1**	**10**	**20**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective-III	3	0	0	3
2		Professional Elective-V	3	0	0	3
3		Professional Elective-VI	3	0	0	3
4		Project Stage – II including Seminar	0	0	22	11
		Total Credits	**9**	**0**	**22**	**20**

***MC – Satisfactory/Unsatisfactory**

Professional Elective - I

1	IoT Applications in Electrical Engineering
2	High Voltage Engineering
3	Computer Aided Electrical Machine Design

Professional Elective - II

1	Cyber-Physical Systems
2	Power Semiconductor Drives
3	Wind and Solar Energy systems

Professional Elective-III

1	Mobile Application Development
2	Digital Signal Processing
3	Electric and Hybrid Vehicles

Professional Elective-IV

1	HVDC Transmission
2	Power System Reliability
3	Embedded Systems Applications

Professional Elective-V

1	Power Quality & FACTS
2	Solar Power Batteries
3	AI Techniques in Electrical Engineering

Professional Elective-VI

1	Smart Grid Technologies
2	Electrical Distribution Systems
3	Machine Learning Applications to Electrical Engineering

OPEN ELECTIVES

Open Elective-I:

1	Renewable Energy Sources
2	Fundamental of Electric Vehicles

Open Elective-II:

1	Utilization of Electric Energy
2	Energy Storage Systems

Open Elective-III:

1	Charging Infrastructure for Electric Vehicles
2	Reliability Engineering

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD

PROPOSED SYLLABUS

ELECTRICAL CIRCUIT ANALYSIS –I

B.Tech. I Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Mathematics

Course Objectives:

- To gain knowledge in circuits and to understand the fundamentals of derived circuit laws.
- To learn steady state and transient analysis of single phase and 3-phase circuits.
- To understand Theorems and concepts of coupled circuits.

Course Outcomes: After learning the contents of this paper the student must be able to

- Understand network analysis, techniques using mesh and node analysis.
- Evaluate steady state and transient behavior of circuits for DC and AC excitations.
- Analyze electric circuits using network theorems and concepts of coupled circuits.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To gain knowledge in circuits and to understand the fundamentals of derived circuit laws.	3	3	3	3	3	3	1	1	2	2	1	3
To learn steady state and transient analysis of single and three phase circuits.	3	2	3	2	3	3	2	2	2	3	2	3
To understand Theorems and concepts of coupled circuits.	3	2	3	1	3	3	1	1	2	2	2	3

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand network analysis, techniques using mesh and node analysis.	3	3	3	3	3	3	3	1	2	1	1	2
Evaluate steady state and transient behaviour of circuits for DC and AC excitations.	3	3	3	3	3	3	3	3	3	3	2	3
Analyse electric circuits using network theorems and concepts of coupled circuits.	3	2	2	2	3	3	3	2	1	3	3	2

UNIT-I:

Network Elements & Laws: Active elements, Independent and dependent sources. Passive elements — R, L and C, Energy stored in inductance and capacitance, Kirchhoff's laws, Source transformations, Star-delta transformations, Node voltage method, Mesh current method including super node and super mesh analysis.

UNIT-II:

Single-Phase Circuits: RMS and average values of periodic sinusoidal and non- sinusoidal waveforms, Phasor representation, Steady-state response of series, parallel and series-parallel circuits. Impedance, Admittance, Current locus diagrams of RL and RC series and parallel circuits with variation of various parameters. Resonance: Series and parallel circuits, Bandwidth and Q-factor.

UNIT-III:

Network theorems: Superposition theorem, Thevinin's theorem, Norton's theorems, Maximum power transfer theorem, Tellegen's theorem, Compensation theorem, Milliman's theorem and Reciprocity theorem. (AC & DC).

UNIT-IV:

Poly-phase Circuits: Analysis of balanced and unbalanced 3-phase circuits, Star and delta connections, Measurement of three-phase power for balanced and unbalanced loads.

UNIT-V:

Coupled circuits: Concept of self and mutual inductance, Dot convention, Coefficient of coupling, Analysis of circuits with mutual inductance.

Topological Description of Networks: Graph, tree, chord, cut-set, incident matrix, circuit matrix and cut-set matrix.

TEXTBOOKS:

1. Van Valkenburg M.E, "Network Analysis", Prentice Hall of India, 3rd Edition, 2000.
2. Ravish R Singh, "Network Analysis and Synthesis", McGrawHill, 2nd Edition, 2019.

REFERENCE BOOKS:

1. B. Subramanyam, "Electric Circuit Analysis", Dreamtech Press & Wiley, 2021.
2. James W.Nilsson, Susan A.Riedel, "Electric Circuits", Pearson, 11th Edition, 2020.
3. A Sudhakar, Shyammohan S Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 5th Edition, 2017.
4. Jagan N.C, Lakshrninarayana C., "Network Analysis", B.S. Publications, 3rd Edition, 2014.
5. William Hayt H, Kimmerly Jack E. and Steven Durbin M, "Engineering Circuit Analysis", McGraw Hill, 6th Edition, 2002.
6. Chakravarthy A., "Circuit Theory", Dhanpat Rai & Co., First Edition, 1999.

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ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD
PROPOSED SYLLABUS
ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

Prerequisites: Elements of Electrical Engineering

Course Objectives:

- To measure the electrical parameters for different types of DC and AC circuits using conventional and theorems approach.
- To study the transient response of various R, L and C circuits using different excitations.
- To determine the performance of different types of DC machines and Transformers.

Course Outcomes: After learning the contents of this paper the student must be able to

- Verify the basic Electrical circuits through different experiments.
- Evaluate the performance calculations of Electrical Machines and Transformers through various testing methods.
- Analyze the transient responses of R, L and C circuits for different input conditions.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To measure the electrical parameters for different types of DC and AC circuits using conventional and theorems approach	3	2	1		2	0	0	1	2	0	1	2
To study the transient response of various R, L and C circuits using different excitations	3	2	1	1	3	0	0	0	2	0	1	1
To determine the performance of different types of DC machines and Transformers	3	2	0		3	0	0	0	1	2	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Verify the basic Electrical circuits through different experiments	3	2	1	0	1	0	0	0	2	0	2	2
Evaluate the performance calculations of Electrical Machines and Transformers through various testing methods	3	2	1	0	3	1	0	1	1	2	1	2
Analyse the transient responses of R, L and C circuits for different input conditions	3	2	1	1	3	2	0	0	1	0	2	2

List of experiments/demonstrations:

PART-A (compulsory)

1. Verification Ohm's Law
2. Verification of KVL and KCL
3. Verification of Thevenin's and Norton's theorem

4. Verification of Superposition theorem
5. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits
6. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
7. Performance Characteristics of a DC Shunt Motor
8. Open Circuit and Short Circuit Tests on 1-phase Transformer

PART-B (any two experiments from the given list)

1. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation)
2. Verification of Reciprocity and Milliman's Theorem.
3. Verification of Maximum Power Transfer Theorem.
4. Determination of form factor for non-sinusoidal waveform
5. Transient Response of Series RL and RC circuits for DC excitation

TEXTBOOKS:

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019.
2. MS Naidu and S Kamakshaiah, "Basic Electrical Engineering", Tata McGraw Hill, 2nd Edition, 2008.

REFERENCE BOOKS:

1. P.Ramana, M.Suryakalavathi, G.T.Chandrasheker,"Basic Electrical Engineering", S.Chand, 2nd Edition, 2019.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009
3. M.S.Sukhija, T.K.Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford, 1st Edition, 2012.
4. Abhijit Chakrabarthi, Sudipta Debnath, Chandan Kumar Chanda, "Basic Electrical Engineering", 2nd Edition, McGraw Hill, 2021.
5. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
6. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
7. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD
PROPOSED SYLLABUS
ELECTRICAL CIRCUIT ANALYSIS – II

B.Tech. I Year II Sem.

L	T	P	C
2	0	0	2

Prerequisites: Mathematics

Course Objectives:
- To study the transient analysis of various R, L and C circuits for different inputs
- To understand the Fourier series and Laplace transformation.
- To learn about two-port networks and concept of filters.

Course Outcomes: After learning the contents of this paper the student must be able to
- Observe the response of various R, L and C circuits for different excitations.
- Examine the behavior of circuits using Fourier, Laplace transforms and transfer function of single port network.
- Obtain two port network parameters and applications and design of various filters.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study the transient analysis of various R, L and C circuits for different inputs	3	3	3	3	3	3	1	1	2	2	1	3
To understand the Fourier series and Laplace transformation.	3	2	3	2	3	3	2	2	2	3	2	3
To learn about two-port networks and concept of filters.	3	2	3	1	3	3	1	1	2	2	2	3

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Observe the response of various R, L and C circuits for different excitations	3	3	3	3	3	3	3	1	2	1	1	2
Examine the behavior of circuits using Fourier, Laplace transforms and transfer function of single port network.	3	3	3	3	3	3	3	3	3	3	2	3
Obtain two port network parameters and applications and design of various filters.	3	2	2	2	3	3	3	2	1	3	3	2

UNIT-I:

Transient analysis: Transient response of R, L & C circuits, Formulation of integral differential equations, Initial conditions, Transient Response of RL, RC and RLC (series and parallel) networks subjected to internal energy, Response to impulse, step, and ramp, exponential and sinusoidal excitations.

UNIT-II:

Electrical circuit Analysis using Laplace Transforms: Application of Laplace Transforms to RL, RC and RLC (series and parallel) Networks for impulse, step, and ramp, exponential and sinusoidal excitations.

UNIT-III:

Two port network parameters: Open circuit impedance, short-circuit admittance, Transmission, Hybrid parameters & inter-relationships, Series, parallel and cascade connection of two port networks, System function, and Impedance and admittance functions.

UNIT-IV:

Fourier Series and Integral: Fourier series representation of periodic functions, Symmetry conditions, Exponential Fourier series, Discrete spectrum, Fourier integral and its properties, Continuous spectrum, Application to simple networks

UNIT-V:

Filters: Classification of filters – Low pass, High pass, Band pass and Band Elimination, Constant-k and M-derived filters-Low pass and High pass Filters and Band pass and Band elimination filters (Elementary treatment only)

TEXTBOOKS:

1. Van Valkenburg M.E, "Network Analysis", Prentice Hall of India, 3rd Edition, 2000.
2. Ravish R Singh, "Network Analysis and Synthesis", McGrawHill, 2nd Edition, 2019.

REFERENCE BOOKS:

1. B. Subramanyam, "Electric Circuit Analysis", Dreamtech Press & Wiley, 2021.
2. James W. Nilsson, Susan A.Riedel, "Electric Circuits", Pearson, 11th Edition, 2020.
3. A Sudhakar, Shyammohan S Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 5th Edition, 2017.
4. Jagan N.C, Lakshrninarayana C., "Network Analysis", B.S. Publications, 3rd Edition, 2014.
5. William Hayt H, Kimmerly Jack E. and Steven Durbin M, "Engineering Circuit Analysis", McGraw Hill, 6th Edition, 2002.
6. Chakravarthy A., "Circuit Theory", Dhanpat Rai & Co., First Edition, 1999.

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD
PROPOSED SYLLABUS
ELECTRICAL CIRCUIT ANALYSIS LABORATORY

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

Prerequisites: Elements of Electrical Engineering & Electrical Circuit Analysis

Course Objectives:

- To design electrical systems and analyze them by applying various Network Theorems
- To measure three phase Active and Reactive power.
- To understand the locus diagrams and concept of resonance.

Course Outcomes: After learning the contents of this paper the student must be able to

- Analyze complex DC and AC linear circuits
- Apply concepts of electrical circuits across engineering
- Evaluate response of a given network by using theorems.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To design electrical systems and analyse them by applying various Network Theorems	2	1	2	2	2	2	2	1	1	1	2	3
To measure three phase Active and Reactive power	2	1	2	2	2	2	2	1	1	1	2	3
To understand the locus diagrams and concept of resonance.	2	1	2	2	2	2	2	1	1	1	2	3

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Analyse complex DC and AC linear circuits.	2	1	2	2	2	2	2	1	2	1	2	3
Apply concepts of electrical circuits across engineering	2	1	2	2	2	2	2	1	2	1	2	3
Evaluate response of a given network by using theorems.	2	1	2	2	2	2	2	1	2	1	2	3

The following experiments are required to be conducted as compulsory

1. To draw the locus Diagrams of RL (R-Varying) and RC (R-Varying) Series Circuits.
2. Verification of Series and Parallel Resonance.
3. Determination of Time response of first order RL and RC circuit for periodic non – sinusoidal inputs – Time Constant and Steady state error.
4. Determination of Two port network parameters – Z & Y parameters.
5. Determination of Two port network parameters – A, B, C, D parameters.
6. Determination of Co-efficient of Coupling and Separation of Self and Mutual inductance in a Coupled Circuits.
7. Frequency domain analysis of Low-pass filter.
8. Frequency domain analysis of Band-pass filter.

In addition to the above eight experiments, at least any two of the experiments from the following list arerequired to be conducted

1. Harmonic Analysis of non-sinusoidal waveform signals using Harmonic Analyzer and plotting frequencyspectrum.

2. Measurement of Active Power for Star and Delta connected balanced loads.
3. Measurement of Reactive Power for Star and Delta connected balanced loads.
4. Frequency domain analysis of High-pass filter.
5. Determination of Two port network parameters -Hybrid parameters.
6. To draw the locus Diagrams of RL (L-Varying) and RC (C-Varying) Series Circuits.
7. Determination of Time response of first order RLC circuit for periodic non – sinusoidal inputs – Time Constant and Steady state error.

TEXTBOOKS:

1. Van Valkenburg M.E, "Network Analysis", Prentice Hall of India, 3rd Edition, 2000.
2. Ravish R Singh, "Network Analysis and Synthesis", McGrawHill, 2nd Edition, 2019.

REFERENCE BOOKS:

1. B. Subramanyam, "Electric Circuit Analysis", Dreamtech Press & Wiley, 2021.
2. James W.Nilsson, Susan A. Riedel, "Electric Circuits", Pearson, 11th Edition, 2020.
3. A Sudhakar, Shyammohan S Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 5th Edition, 2017.
4. Jagan N.C, Lakshrninarayana C., "Network Analysis", B.S. Publications, 3rd Edition, 2014.
5. William Hayt H, Kimmerly Jack E. and Steven Durbin M, "Engineering Circuit Analysis", McGraw Hill, 6th Edition, 2002.
6. Chakravarthy A., "Circuit Theory", Dhanpat Rai & Co., First Edition, 1999.

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD

PROPOSED SYLLABUS

BASIC ELECTRICAL ENGINEERING

(Common to CSE, CSE-CYBER SECURITY, CSE-DATA SCIENCE)

B.Tech. I Year I Sem.

L	T	P	C
2	0	0	2

Prerequisites: Mathematics

Course Objectives:

- To understand DC and Single & Three phase AC circuits
- To study and understand the different types of DC, AC machines and Transformers.
- To import the knowledge of various electrical installations and the concept of power, power factor and its improvement.

Course Outcomes: After learning the contents of this paper the student must be able to

- Understand and analyze basic Electrical circuits
- Study the working principles of Electrical Machines and Transformers
- Introduce components of Low Voltage Electrical Installations.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand DC and Single & Three phase AC circuits.	3	2	1		2	0	0	1	2	0	1	2
To study and understand the different types of DC, AC machines and Transformers.	3	2	1	1	3	0	0	0	2	0	1	1
To import the knowledge of various electrical installations and the concept of power, power factor and its improvement.	3	2	0		3	0	0	0	1	2	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand and analyse basic Electrical circuits	3	2	1	0	1	0	0	0	2	0	2	2
Study the working principles of Electrical Machines and Transformers	3	2	1	0	3	1	0	1	1	2	1	2
Introduce components of Low Voltage Electrical Installations.	3	2	1	1	3	2	0	0	1	0	2	2

UNIT-I:

D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT-II:

A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance in series R-L-C circuit. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III:

Transformers: Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT-IV:

Electrical Machines: Construction and working principle of dc machine, performance characteristics of dc shunt machine. Generation of rotating magnetic field, Construction and working of a three-phase induction motor, Significance of torque-slip characteristics. Single-phase induction motor, Construction and working. Construction and working of synchronous generator.

UNIT-V:

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

TEXT BOOKS:

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4^{th} Edition, 2019.
2. MS Naidu and S Kamakshaiah, "Basic Electrical Engineering", Tata McGraw Hill, 2^{nd} Edition, 2008.

REFERENCE BOOKS:

1. P. Ramana, M. Suryakalavathi, G.T. Chandrasheker, "Basic Electrical Engineering", S. Chand, 2^{nd} Edition, 2019.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009
3. M. S. Sukhija, T. K. Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford, 1^{st} Edition, 2012.
4. Abhijit Chakrabarthi, Sudipta Debnath, Chandan Kumar Chanda, "Basic Electrical Engineering", 2^{nd} Edition, McGraw Hill, 2021.
5. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
6. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
7. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD
PROPOSED SYLLABUS
BASIC ELECTRICAL ENGINEERING LABORATORY
(Common to CSE, CSE-CYBER SECURITY, CSE-DATA SCIENCE)

B.Tech. I Year I Sem.

L	T	P	C
0	0	2	1

Prerequisites: Basic Electrical Engineering
Course Objectives:

- To measure the electrical parameters for different types of DC and AC circuits using conventional and theorems approach.
- To study the transient response of various R, L and C circuits using different excitations.
- To determine the performance of different types of DC, AC machines and Transformers.

Course Outcomes: After learning the contents of this paper the student must be able to

- Verify the basic Electrical circuits through different experiments.
- Evaluate the performance calculations of Electrical Machines and Transformers through various testing methods.
- Analyze the transient responses of R, L and C circuits for different input conditions.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To measure the electrical parameters for different types of DC and AC circuits using conventional and theorems approach	3	2	1		2	0	0	1	2	0	1	2
To study the transient response of various R, L and C circuits using different excitations	3	2	1	1	3	0	0	0	2	0	1	1
To determine the performance of different types of DC, AC machines and Transformers	3	2	0		3	0	0	0	1	2	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Verify the basic Electrical circuits through different experiments	3	2	1	0	1	0	0	0	2	0	2	2
Evaluate the performance calculations of Electrical Machines and Transformers through various testing methods	3	2	1	0	3	1	0	1	1	2	1	2

Analyse the transient responses of R, L and C circuits for different input conditions	3	2	1	1	3	2	0	0	1	0	2	2

List of experiments/demonstrations:

PART- A (compulsory)

1. Verification of KVL and KCL
2. Verification of Thevenin's and Norton's theorem
3. Transient Response of Series RL and RC circuits for DC excitation
4. Resonance in series RLC circuit
5. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits
6. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
7. Performance Characteristics of a DC Shunt Motor
8. Torque-Speed Characteristics of a Three-phase Induction Motor.

PART-B (any two experiments from the given list)

1. Verification of Superposition theorem.
2. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star)
3. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation)
4. Measurement of Active and Reactive Power in a balanced Three-phase circuit
5. No-Load Characteristics of a Three-phase Alternator

TEXT BOOKS:

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019.
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2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009
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5. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
6. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
7. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD

PROPOSED SYLLABUS

BASIC ELECTRICAL ENGINEERING

(Common to ECE, CSE-AIML)

B.Tech. I Year II Sem.

L	T	P	C
2	0	0	2

Prerequisites: Mathematics

Course Objectives:

- To understand DC and Single & Three phase AC circuits
- To study and understand the different types of DC, AC machines and Transformers.
- To import the knowledge of various electrical installations and the concept of power, power factor and its improvement.

Course Outcomes: After learning the contents of this paper the student must be able to

- Understand and analyze basic Electrical circuits
- Study the working principles of Electrical Machines and Transformers
- Introduce components of Low Voltage Electrical Installations.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand DC and Single & Three phase AC circuits.	3	2	1		2	0	0	1	2	0	1	2
To study and understand the different types of DC, AC machines and Transformers.	3	2	1	1	3	0	0	0	2	0	1	1
To import the knowledge of various electrical installations and the concept of power, power factor and its improvement.	3	2	0		3	0	0	0	1	2	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand and analyse basic Electrical circuits	3	2	1	0	1	0	0	0	2	0	2	2
Study the working principles of Electrical Machines and Transformers	3	2	1	0	3	1	0	1	1	2	1	2
Introduce components of Low Voltage Electrical Installations.	3	2	1	1	3	2	0	0	1	0	2	2

UNIT-I:

D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT-II:

A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance in series R-L-C circuit. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III:

Transformers: Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT-IV:

Electrical Machines: Construction and working principle of dc machine, performance characteristics of dc shunt machine. Generation of rotating magnetic field, Construction and working of a three-phase induction motor, Significance of torque-slip characteristics. Single-phase induction motor, Construction and working. Construction and working of synchronous generator.

UNIT-V:

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

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5. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
6. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
7. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD

PROPOSED SYLLABUS

BASIC ELECTRICAL ENGINEERING LABORATORY

(Common to ECE, CSE-AIML)

B.Tech. I Year II Sem.

L	T	P	C
0	0	2	1

Prerequisites: Basic Electrical Engineering

Course Objectives:

- To measure the electrical parameters for different types of DC and AC circuits using conventional and theorems approach.
- To study the transient response of various R, L and C circuits using different excitations.
- To determine the performance of different types of DC, AC machines and Transformers.

Course Outcomes: After learning the contents of this paper the student must be able to

- Verify the basic Electrical circuits through different experiments.
- Evaluate the performance calculations of Electrical Machines and Transformers through various testing methods.
- Analyze the transient responses of R, L and C circuits for different input conditions.

Course Objectives	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
To measure the electrical parameters for different types of DC and AC circuits using conventional and theorems approach	3	2	1		2	0	0	1	2	0	1	2
To study the transient response of various R, L and C circuits using different excitations	3	2	1	1	3	0	0	0	2	0	1	1
To determine the performance of different types of DC, AC machines and Transformers	3	2	0		3	0	0	0	1	2	1	1

Course Outcomes	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Verify the basic Electrical circuits through different experiments	3	2	1	0	1	0	0	0	2	0	2	2
Evaluate the performance calculations of Electrical Machines and Transformers through various testing methods	3	2	1	0	3	1	0	1	1	2	1	2

Analyse the transient responses of R, L and C circuits for different input conditions	3	2	1	1	3	2	0	0	1	0	2	2

List of experiments/demonstrations:

PART- A (compulsory)

1. Verification of KVL and KCL
2. Verification of Thevenin's and Norton's theorem
3. Transient Response of Series RL and RC circuits for DC excitation
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5. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits
6. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
7. Performance Characteristics of a DC Shunt Motor
8. Torque-Speed Characteristics of a Three-phase Induction Motor.

PART-B (any two experiments from the given list)

1. Verification of Superposition theorem.
2. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star)
3. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation)
4. Measurement of Active and Reactive Power in a balanced Three-phase circuit
5. No-Load Characteristics of a Three-phase Alternator

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2. MS Naidu and S Kamakshaiah, "Basic Electrical Engineering", Tata McGraw Hill, 2nd Edition, 2008.

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2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009
3. M. S. Sukhija, T. K. Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford, 1st Edition, 2012.
4. Abhijit Chakrabarthi, Sudipta Debnath, Chandan Kumar Chanda, "Basic Electrical Engineering", 2nd Edition, McGraw Hill, 2021.
5. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
6. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
7. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD

M.TECH- POWER ELECTRONICS
PROPOSED COURSE STRUCTURE (ER23) REGULATIONS

I YEAR I SEMESTER

			L	T	P	Credits
Sr.No	**Core/Elective**	**Course Name**				
1.	Program Core-I	Advanced Power Electronic Converters-I	3	0	0	3
2.	Program Core-II	Electrical Drives	3	0	0	3
3.	Program Elective-I	1. Machine Modelling and Analysis 2. Microcontroller Applications to Power Electronics 3. Smart Grid Technologies 4. Modern Control Theory	3	0	0	3
4.	Program Elective-II	1. Power Semiconductor Devices and Modelling 2. Reactive Power Compensation and Management 3. High Frequency Magnetic Components 4. Electric Vehicles and Design	3	0	0	3
5.		Research Methodology & IPR	2	0	0	2
6.	Lab-I	Advanced Power Electronic Converters Lab-I	0	0	4	2
7.	Lab-II	Electrical Drives Lab	0	0	4	2
8.	Audit-I	Audit Course-I	2	0	0	0
		Total Credits	**16**	**0**	**8**	**18**

I YEAR II SEMESTER

			L	T	P	Credits
Sr.No	**Core/Elective**	**Course Name**				
1.	Program Core-III	Advanced Power Electronic Converters-II	3	0	0	3
2.	Program Core-IV	Power Electronics Application to Power Systems	3	0	0	3
3.	Program Elective-III	1. Industrial Load Modelling and Control 2. Advanced Digital Signal Processing 3. Power Quality Improvement Techniques 4. Power Electronics for Renewable Energy Systems	3	0	0	3
4.	Program Elective-IV	1. DSP based Drive Control 2. Distributed Generation 3. Electric Vehicle Charging Techniques 4. Electromagnetic interference and compatibility	3	0	0	3
5.	MPWS	Mini Project with Seminar	0	0	4	2
6.	Lab-III	Advanced Power Electronic Converters Lab-II	0	0	4	2
7.	Lab-IV	Power Electronics Application to Power Systems Lab	0	0	4	2
8.	Audit-II	Audit Course-II	2	0	0	0
		Total Credits	**14**	**0**	**12**	**18**

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15/11/23

II YEAR I SEMESTER

			L	T	P	Credits
Sr.No	**Core/Elective**	**Course Name**				
1.	Program Elective-V	1. Reliability Engineering 2. Dynamics of Electrical Machines 3. Energy Storage Technologies 4. SCADA Systems and Applications	3	0	0	3
2.	Open Elective	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Photovoltaic Systems	3	0	0	3
3.	Dissertation	Dissertation Stage-I	0	0	12	6
		Total Credits	**6**	**0**	**12**	**12**

II YEAR II SEMESTER

			L	T	P	Credits
Sr.No	**Core/Elective**	**Course Name**				
1.	Dissertation	Dissertation Stage-II	0	0	12	6
2.	Dissertation	Dissertation Viva-Voce	0	0	28	14
		Total Credits	**0**	**0**	**40**	**20**

Open Elective

1. Business Analytics (Offered by **CSE** Department)
2. Industrial Safety (Offered by **Chemical Engineering** Department)
3. Operations Research (Offered by **Mechanical Engineering** Department)
4. Cost Management of Engineering Projects (Offered by **Civil Engineering** Department)
5. Composite Materials (Offered by **Metallurgical Engineering** Department)
6. Photovoltaic Systems (Offered by **EEE** Department)

Audit Course I & II

1. English for Research Paper Writing.
2. Disaster Management.
3. Sanskrit for Technical Knowledge.
4. Value Education.
5. Constitution of India.
6. Pedagogy Studies.
7. Stress Management by Yoga.
8. Personality Development through Life Enlightenment Skills.

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD

PROPOSED SYLLABUS for M.TECH-POWER ELECTRONICS

M. Tech – I Semester

L	T	P	C
3	0	0	3

ADVANCED POWER ELECTRONIC CONVERTERS-I
(Program Core-I)

Prerequisite: Power Electronics

Course Objectives:

- To understand various advanced power electronic devices.
- To comprehend the design of rectifiers and inverters.
- To understand the operation of multi-level inverters with switching strategies for high power applications.

Course Outcomes: After completion of the course, students will be able to:

- Develop and analyze various converter topologies.
- Use power electronic simulation packages for analyzing and designing power converters.

UNIT-I:

MODERN POWER SEMICONDUCTOR DEVICES

Modern power semiconductor devices: Symbol, Structure and equivalent circuit of Insulated Gate Bipolar Transistor (IGBT), MOSFET, MOS Turn off Thyristor (MTO), Emitter Turn off Thyristor (ETO), Integrated Gate-Commutated Thyristor (IGCTs), MOS-controlled thyristors (MCTs), Power Integrated Circuits (PICs). Comparison of their features.

UNIT-II:

SINGLE PHASE & THREE PHASE CONVERTERS

Single phase converters: Half controlled and Fully controlled converters, Evaluation of input power factor and harmonic factor, continuous and Discontinuous load current, Single phase dual converters, Power factor Improvements Techniques, Extinction angle control, Symmetrical angle control, Single phase sinusoidal PWM, Single phase series converters, Overlap analysis, Applications & Problems.

Three phase converters: Half controlled and fully controlled converters, Evaluation of input power factor and harmonic factor, Continuous and Discontinuous load current, Three phase dual converters, Power factor Improvements Techniques, Three phase PWM, Twelve pulse converters, Applications &Problems.

UNIT-III:

PULSE WIDTH MODULATED INVERTERS

Principle of operation, Performance parameters, Single phase bridge inverter, Evaluation of output voltage and current with resistive, inductive and capacitive loads, Voltage control of single phase inverters, Single PWM, Multiple PWM, Sinusoidal PWM, Modified PWM, Phase displacement Control, Advanced modulation techniques for improved performance, Trapezoidal, Staircase, Stepped, Harmonic injection and Delta modulation, Advantages, Applications & Problems.

UNIT-IV

THREE PHASE INVERTERS

Introduction to Three phase inverter, Analysis of 180 degree conduction for output voltage And current with resistive, inductive loads, Analysis of 120 degree Conduction, Voltage control of three phase inverters, Sinusoidal PWM, Third Harmonic PWM, 60 degree PWM, Space vector modulation, Comparison of PWM techniques, Harmonic reductions, Problems.

UNIT-V

MULTILEVEL INVERTERS

Multilevel concept, Classification of multilevel inverters, Principle of operation, main features and comparison of Diode clamped, Improved diode Clamped, Flying capacitors, Cascaded multilevel inverters, Multilevel inverter applications, Reactive power compensation, Back to back intertie system, Adjustable drives, Switching device currents, DC link capacitor voltage balancing.

TEXTBOOKS:

1. Mohammed H. Rashid, "Power Electronics", Pearson Education, 3rd Edition, 1st Indian reprint2004.
2. Ned Mohan Tore M. Undeland and William P. Robbins, "Power Electronics", John Wiley & Sons, 2nd Edition.

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REFERENCES:

1. Milliman Shepherd and Lizang, "Power converters circuits", Chapter 14 (Matrix converter) PP-415-444,
2. M.H.Rashid, "Power Electronics hand book".
3. Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition, "Control in Power electronics", Published by Academic Press, 2002.

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD
PROPOSED SYLLABUS for M.TECH-POWER ELECTRONICS

M. Tech – I Semester

L	T	P	C
3	0	0	3

ELECTRICAL DRIVES
(Program Core-II)

Prerequisite: Power Electronic Converters, Electrical Machines

Course Objectives:

- To understand principle of operation of scalar control of AC motor and corresponding speed-torque characteristics
- To comprehend the vector control for AC motor drive (IM and SM)
- To explain the static resistance control and Slip power recovery drive
- To explain synchronous motor drive characteristics and its control strategies
- To comprehend the principle of operation of brushless DC motor.

Course Outcomes: After completion of the course, students will be able to:

- Develop induction motor for variable speed operations using scalar and vector control techniques.
- Identify the difference between the rotor resistance control and static rotor resistance control method and significance of slip power recovery drives.
- Develop controllers for synchronous motor and variable reluctance motor.

UNIT–I:

RECTIFIER CONTROLLED DC MOTOR

Separately excited DC motors and DC series motors with single phase semi converter and single phase full converter, Three-phase controlled converter, control circuit, control modeling of three phase converter, Steady state analysis of three phase converter control DC motor drive, Two quadrant, Three phase converter controlled DC motor drive, DC motor, load and converter.

CLOSED LOOP CONTROL OF DC DRIVE

Current and speed controllers, Current and speed feedback, Design of controllers, Current and speed controllers, Motor equations, Filter in the speed feedback loop speed controller, Current reference generator, Current controller and flowchart for simulation, Harmonics and associated problems, Sixth harmonics torque.

UNIT–II:

CHOPPER CONTROLLED DC MOTOR DRIVES

Principle of operation of the chopper, Chopper with other power devices, Model of the chopper, Input to the chopper, Steady state analysis of chopper-controlled DC motor drives.

Closed loop operation: Speed controlled drive system, Current control loop, Pulse width modulated current controller, Hysteresis current controller, Modeling of current controller, Design of current controller.

UNIT–III:

CONTROL OF INDUCTION MOTOR

Introduction to motor drive, Torque production, Equivalent circuit analysis, Speed – Torque characteristics with Variable voltage, Variable frequency, Constant v/f, Variable stator current operation, Induction motor characteristics in constant torque and field weakening regions.

STATOR SIDE CONTROL

Scalar control, Voltage fed inverter control, Open loop v/f control, Speed control slip regulation, Speed control with torque and flux control, Current controlled voltage fed inverter drive.

ROTOR SIDE CONTROL OF INDUCTION MOTOR DRIVES

Slip power recovery drives, Static Kramer Drive, Phasor diagram, Torque expression, Speed control of Kramer Drive, Static Scheribus Drive, and Modes of operation.

UNIT–IV:

VECTOR CONTROL OF INDUCTION MOTOR DRIVES

Principles of Vector control, Direct and Indirect methods of vector control, Adaptive control principles, Self tuning regulator Model referencing control, Direct torque control of AC motors.

UNIT–V:

CONTROL OF PERMENANT MAGNET SYNCHRONOUS MOTOR DRIVES

Synchronous motor and its characteristic, Control strategies, Constant torque angle control, Unity power factor control, Constant mutual flux linkage control, Closed loop operation.

TEXTBOOKS:

1. R. Krishnan, "Electric Motor Drives Pearson Modeling, Analysis and control", 1st Edition, 2002.
2. B K Bose, "Modern Power Electronics and AC Drives", Pearson Publications, 1st Edition.

REFERENCES:

1. MD Murthy and FG Turn, "Power Electronics and Control of AC Motors", Bull Pergman Press 1stEdition.
2. BK Bose, "Power Electronics and AC Drives", Prentice Hall Eagle wood diffs New Jersey, 1st Edition.
3. M H Rashid, "Power Electronic circuits Deices and Applications", PHI, 1995.
4. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa publications, 1995.

ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD

PROPOSED SYLLABUS for M.TECH-POWER ELECTRONICS

M. Tech – I Semester

L	T	P	C
3	0	0	3

MACHINE MODELLING AND ANALYSIS

(Program Elective-I.1)

Prerequisite: Electrical Machines

Course Objectives:

- To identify the methods and assumptions in modeling of machines.
- To recognize the different frames for modeling of AC machines.
- To write voltage and torque equations in state space form for different machines.

Course Outcomes: After completion of the course, students will be able to:

- Develop the mathematical models of various machines like, induction motor and Synchronous machines, permanent magnet synchronous motor, brushless DC motor using modeling equations.
- Analyze the developed models in various reference frames.

UNIT-I:

Basic Two-pole DC machine, Primitive 2-axis machine, Voltage and Current relationship, Torque equation. Mathematical model of separately excited DC motor and DC Series motor in state variable form, Transfer function of the motor, Numerical problems. Mathematical model of D.C. shunt motor, D.C. Compound motor in state variable form, Transfer function of the motor, Numerical Problems.

UNIT-II:

Linear transformation, Phase transformation (a, b, c to α, β, o), Active transformation (α. β, o to d, q), Circuit model of a 3-phase Induction motor, Linear transformation, Phase Transformation, Transformation to a Reference frame, Two axis models for induction motor, "d-q" model based DOL starting of induction motors.

UNIT-III:

Voltage and current Equations in stator reference frame, Equation in Rotor reference frame, Equations in a synchronously rotating frame, Torque equation, Equations in state – space form.

UNIT-IV:

Circuit model of a 3-phase Synchronous motor, two- axis representation of Synchronous Motor. Voltage and current Equations in state – space variable form, Torque equation, and "dq" model based short circuit fault analysis, Emphasis on voltage, Frequency and recovery time.

UNIT-V:

Modeling of Permanent Magnet Synchronous motor, Modeling of Brushless DC Motor.

TEXTBOOKS:

1. P.S. Bimbhra, "Generalized Machine theory", Khanna Publishers.
2. Paul C. Krause, Oleg wasynezuk, Scott D. Sudhoff, "Analysis of electric machinery and Drives systems".

REFERENCES:

1. Vedam Subranmanyam, "Thyristor control of Electric Drives".
2. Prabha Kundur, "Power System Stability and Control", EPRI.
3. Article in IEEE Transactions on Energy Conversion, "Performance optimization of induction motors during Voltage-controlled soft starting", July, 2004.
4. Nithin K.S, Dr.Bos Mathew Jos, Muhammed Rafeek, Dr.Babu Paul, "A Novel Method for Starting of Induction Motor with Improved Transient Torque Pulsations", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 8, February 2013.

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ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD
PROPOSED SYLLABUS for M.TECH-POWER ELECTRONICS

M. Tech – I Semester

L	T	P	C
3	0	0	3

MICROCONTROLLER APPLICATIONS TO POWER ELECTRONICS
(Program Elective-I.2)

Prerequisite: Power Electronics and Renewable Energy Systems

Course Objectives:

- To study the internal structure and operation of PIC 16F876 microcontroller and 8051 microcontrollers
- To know assembly language program for the generation of firing and control signals employing these microcontrollers.

Course Outcomes: After completion of the course, students will be able to:

- Understand the architecture of 8051 and 16F876 microcontrollers.
- Develop assembly language programs employing 8051 & 16F876 microcontrollers.
- Analyze the microcontroller programming using MPLAB and develop typical programs for power converter applications.

UNIT-I

8051 microcontrollers: Architecture, Addressing modes, I/O ports, Instruction sets, Simple assembly language programming.

UNIT-II

Use of microcontrollers for pulse generation in power converters, Overview of Zero-Crossing Detectors, Typical firing/gate-drive circuits, Firing/gate pulses for typical single-phase and three-phase power converters.

UNIT III

PIC16F876 Micro-controller: Device overview, Pin diagrams, Memory organization, Special Function Registers, I/O ports, Timers, Capture/ Compare/ PWM modules (CCP).

UNIT-IV

Analog to Digital Converter module, Instruction set, Instruction description, Introduction to PIC microcontroller programming, Oscillator selection, Reset, Interrupts, Watch dog timer.

UNIT-V

Introduction to MPLAB IDE and PICSTART plus, Device Programming using MPLAB and PICSTART plus, Generation of firing / gating pulses for typical power converters.

TEXTBOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan, "Non-conventional Energy sources", Tata McGraw-hill Publishing Company, New Delhi, 2009.

REFERENCES:

1. Rashid .M. H, "Power electronics Hand book", Academic press, 2001.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. Rai. G.D, "Non-conventional energy sources", Khanna Publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", Prentice Hall linc, 1995.
5. Andrzej M. Trzynnadlowski, "Introduction to Modern Power Electronics", 2nd Edition, Wiley India Pvt. Ltd, 2012.

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M. Tech – I Semester

L	T	P	C
3	0	0	3

SMART GRID TECHNOLOGIES
(Program Elective-I.3)

Prerequisite: Power Systems
Course Objectives:

- To understand concept of smart grid and its advantages over conventional grid
- To know smart metering techniques
- To learn wide area measurement techniques
- To understand the problems associated with integration of distributed generation & its solutionthrough smart grid.

Course Outcomes: After completion of the course, students will be able to:

- Appreciate the difference between smart grid & conventional grid
- Apply smart metering concepts to industrial and commercial installations
- Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
- Come up with smart grid solutions using modern communication technologies

UNIT-I:
Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self-Healing Grid Present development & International policies in Smart Grid

UNIT-II:
Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

UNIT-III:
Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT-IV:
Concept of micro-grid, Need& applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, Fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

UNIT-V:
Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit. Advanced Metering Infrastructure (AMI) and Various Communication means and IP based Protocols.

TEXTBOOKS:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.

REFERENCES:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications",Wiley, 2012.
2. Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions", CRC Press.
3. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer.

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3	0	0	3

MODERN CONTROL THEORY
(Program Elective-I.4)

Prerequisite: Control Systems

Course Objectives:

- To explain the concepts of basics and modern control system for the real time analysis and design of control systems.
- To explain the concepts of state variables analysis.
- To study and analyze nonlinear systems.
- To analyze the concept of stability for nonlinear systems and their categorization.

Course Outcomes: After completion of the course, students will be able to:

- Know various terms of basic and modern control system for the real time analysis and design of control systems.
- Perform state variables analysis for any real time system.
- Examine a system for its stability, controllability and observability.
- Implement basic principles and techniques in designing linear control systems.
- Apply knowledge of control theory for practical implementations in engineering and network analysis.

UNIT I:

MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS

Fields, Vectors and Vector Spaces, Linear combinations and Bases, Linear Transformations and Matrices, Scalar Product and Norms, Eigen values, Eigen Vectors and a Canonical form representation of Linear systems, The concept of state, State space model of Dynamic systems, Time invariance and Linearity, Non uniqueness of state model, State diagrams for Continuous-Time State models, Existence and Uniqueness of Solutions to Continuous-Time State Equations, Solutions of Linear Time Invariant Continuous-Time State Equations, State transition matrix and it's properties.

Complete solution of state space model due to zero input and due to zero state.

UNIT II:

CONTROLLABILITY AND OBSERVABILITY

General concept of controllability, Controllability tests, Different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems, General concept of Observability, Observability tests for Continuous-Time Invariant Systems, Observability of different State transformation forms.

UNIT III:

STATE FEEDBACK CONTROLLERS AND OBSERVERS

State feedback controller design through Pole Assignment, using Ackkermans formula.

State observers: Full order and Reduced order observers.

UNIT IV:

NON-LINEAR SYSTEMS

Introduction to Non-Linear Systems, Types of Non-Linearities, Saturation, Dead-Zone, Backlash, Jump Phenomenon etc., Linearization of nonlinear systems, Singular Points and its types, Describing function, Describing function of different types of nonlinear elements, Stability analysis of Non-Linear systems through describing functions.

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

UNIT V:

STABILITY ANALYSIS

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems, Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method, Generation of Lyapunov functions, Variable gradient method, Krasooviski's method.

TEXTBOOKS:

1. M.Gopal, "Modern Control System Theory", New Age International, 1984.
2. Ogata. K, "Modern Control Engineering", Prentice Hall, 1997.

REFERENCES:

1. N K Sinha, "Control Systems", New Age International, 3rd Edition.
2. Donald E.Kirk, "Optimal Control Theory an Introduction", Prentice Hall Network series, 1stEdition.

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PROPOSED SYLLABUS for M.TECH-POWER ELECTRONICS

M. Tech – I Semester

L	T	P	C
3	0	0	3

POWER SEMICONDUCTOR DEVCES AND MODELLING

(Program Elective-II.1)

Prerequisite: Power Electronics

Course Objectives:

- To improve power semiconductor device structures for adjustable speed motor control applications.
- To understand the static and dynamic characteristics of current controlled power semiconductor devices.
- To understand the static and dynamic characteristics of voltage- controlled power semiconductor devices.
- To enable for the selection of devices for different power electronic applications.
- To understand the control and firing circuit for different devices.

Course Outcomes: After completion of the course, students will be able to:

- Know the operating characteristics of various basic semiconductor devices and switches
- Understand the advanced power semiconductor devices operation.
- Know the modeling of basic and advanced semiconductor devices and switches through simulation.
- Analyze the applications of various power semiconductor switches.

UNIT-I:

POWER DIODES

Basic structure and V-I characteristics, Breakdown voltages and control, On-state losses, switching characteristics, Turn-on, Turn off and reverse recovery transient, Schottky diodes, Snubber requirements for diodes, Diode snubber, Modelling and simulation of Power diodes.

POWER BJT'S

Basic structure and V-I characteristics, Breakdown voltages and control, Secondary breakdown and its control, FBSOA and RBSOA curves, On-state losses, switching characteristics, Resistive switching specifications, clamped inductive switching specifications, Turn-on and turn off transient, Storage time, Base drive requirements, switching losses, device protection, Snubber requirements for BJT's and snubber design, Switching aids, Modeling and simulation of power BJT'S.

UNIT-II:

SILICON CONTROLLED RECTIFIERS (THYRISTORS)

Basic structure, V-I characteristics, Turn-on process, On-state operation, Turn-off process, Switching characteristics, Turn-on transient and di/dt limitations, Turn-off transient, Turnoff time and re-applied dv/dt limitations, Gate drive requirements, Ratings of thyristors, Snubber requirements and snubber design, Modelling and simulation of Thyristor.

TRIACS

Basic structure and operation, V-I characteristics, Ratings, Snubber requirements, Modelling and simulation of triacs.

UNIT-III:

GATE TURNOFF THYRISTOR (GTO)

Basic structure and operation, GTO switching characteristics, GTO turn-on transient, GTO turn-off transient, Minimum on and off state times, Gate drive requirements, Maximum controllable anode current, Overcurrent protection of GTO'S, Modelling and simulation of GTO'S.

POWER MOSFET's

Basic structure, V-I characteristics, Turn-on process, On state operation, Turnoff process, Switching characteristics, Resistive switching specifications, Clamped inductive switching specifications, Turn-on transient and di/dt limitations, Turn-off transient, Turn off time, Switching losses, Effect of reverse recovery transients on switching stresses and losses, dv/dt limitations, Gating requirements, Gate charge, Ratings of MOSFET'S, FBSOA and RBSOA curves, Device protection, Snubber requirements, Modeling and simulation of Power MOSFET'S.

UNIT-IV:

INSULATED GATE BIPOLAR TRANSISTOR's (IGBT's)

Basic structure and operation, latch up IGBT, switching characteristics, Resistive switching specifications, clamped inductive switching specification, IGBT turn-on and turn off transient, Current tailing, Gating requirements, Ratings of IGBT'S, FBSOA and RBSOA curves, switching losses, Minimum on and off state times, Switching frequency capability, Overcurrent protection of IGBT'S, Short circuit protection, Snubber requirements and snubber design.

UNIT-V:

ADVANCED POWER SEMICONDUCTOR DEVICES

MOS gated thyristors, MOS controlled thyristors or MOS GTO'S, Base resistance-controlled thyristors, Emitter switched thyristor, Thermal design of power electronic equipment, Modelling and simulation, Heat transfer by conduction, Transient thermal impedance, Heat sinks, Heat transfer by radiation and convection, Heat sink selection for power semiconductor devices.

TEXTBOOKS:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rd Edition, Wiley India Pvt Ltd, 2011.
2. G. Massobrio, P. Antognetti, "Semiconductor Device Modeling with Spice", McGrawHill, 2ndEdition, 2010.

REFERENCES:

1. B. Jayant Baliga, "Power Semiconductor Devices", 1st Edition, International Thompson Computer Press, 1995.
2. V. Benda, J. Gowar, and D. A. Grant, "Discrete and Integrated Power Semiconductor Devices: Theory and Applications", John Wiley & Sons, 1999.

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M. Tech – I Semester

L	T	P	C
3	0	0	3

REACTIVE POWER COMPENSATION AND MANAGEMENT
(Program Elective-II.2)

Prerequisite: Power Systems

Course Objectives:

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To illustrate reactive power coordination system
- To characterize distribution side and utility side reactive power management.

Course Outcomes: After completion of the course, students will be able to:

- Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads
- Work out on various compensation methods in transmission lines
- Construct models for reactive power coordination
- Distinguish demand side reactive power management & user side reactive power management

UNIT-I:

LOAD COMPENSATION

Objectives and specifications, Reactive power characteristics, Inductive and capacitive approximate biasing, Load compensator as a voltage regulator, Phase balancing and power factor correction of unsymmetrical loads, Examples.

UNIT-II:

STEADY–STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS

Uncompensated line, Types of compensation, Passive shunt and series and dynamic shunt compensation, Examples.

TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS

Characteristic time periods, Passive shunt compensation, Static compensation, Series capacitor compensation, Compensation using synchronous condenser, Examples.

UNIT-III:

REACTIVE POWER COORDINATION

Objective, Mathematical modeling, Operation planning, Transmission benefits, Basic concepts of quality of power supply, Disturbances, Steady–state variations, Effect of under-voltages, Frequency, Harmonics, Radio frequency and electromagnetic interference.

UNIT-IV:

DEMAND SIDE MANAGEMENT

Load patterns, Basic methods load shaping, Power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT

System losses, Loss reduction methods, Examples, Reactive power planning, Objectives, Economics Planning capacitor placement, Retrofitting of capacitor banks.

UNIT-V:

USER SIDE REACTIVE POWER MANAGEMENT

KVAR requirements for domestic appliances, Purpose of using capacitors, Selection of capacitors, Deciding factors, Types of available capacitor, Characteristics and Limitations.

REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES

Typical layout of traction systems, Reactive power control requirements, Distribution transformers, Electric arc furnaces, Basic operation, Furnaces transformer, Filter requirements, Remedial measures, Power factor of an arc furnace.

TEXTBOOKS:

1. T.J.E.Miller, "Reactive power control in Electric power systems", John Wiley and sons, 1982.
2. D.M. Tagare," Reactive power Management", Tata McGraw Hill, 2004.

REFERENCES:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, "Reactive Power Compensation: A Practical Guide", Wiley Publication, April2012.

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PROPOSED SYLLABUS for M.TECH-POWER ELECTRONICS

M. Tech – I Semester

L	T	P	C
3	0	0	3

HIGH FREQUENCY MAGNETIC COMPONENTS
(Program Elective-II.3)

Prerequisite: None

Course Objectives:

- To have a knowledge on magnetic circuits
- To know the skin effect and proximity effect

Course Outcomes: After completion of the course, students will be able to:

- Design of magnetic components (i.e., inductor and transformer) in a converter.
- Perform steady-state analysis of switched mode power supply.
- Understand core loss in an electromagnetic device, recognize& describe its effect.
- Describe the engineering uses of electromagnetic waves, by frequency band, and the respective hazards associated with them.

UNIT-I:

FUNDAMENTALS OF MAGNETIC DEVICES

Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Volt-Second Balance, Inductance, Inductance Factor, Magnetic Energy, Self-Resonant Frequency, Classification of Power Losses in Magnetic Components, Non-inductive Coils.

MAGNETIC CORES

Introduction, Properties of Core Materials, Magnetic Dipoles, Magnetic Domains, Curie Temperature, Magnetization, Magnetic Materials, Hysteresis, Core Permeability, Core Geometries, Iron Alloy Cores, Amorphous Alloy Cores, Nickel–Iron and Cobalt–Iron Cores, Ferrite Cores, Powder Cores, Nano-crystalline Cores, Superconductors, Hysteresis Core Loss, Eddy-Current Core Loss, Total Core Loss, Complex Permeability.

UNIT-II:

SKIN EFFECT & PROXIMITY EFFECT

Introduction, Magnet Wire, Wire Insulation, Skin Depth, Ratio of AC-to-DC Winding Resistance, Skin Effect in Long Single Round Conductor, Current Density in Single Round Conductor, Impedance of Round Conductor, Magnetic Field Intensity for Round Wire, Other Methods of Determining the Round Wire Inductance, Power Density in Round Conductor, Skin Effect on Single Rectangular Plate. Proximity and Skin Effects in Two Parallel Plates, Anti-proximity and Skin Effects in Two Parallel Plates, Proximity Effect in Multiple-Layer Inductor, Appendix: Derivation of Proximity Power Loss.

WINDING RESISTANCE AT HIGH FREQUENCIES

Introduction, Winding Resistance, Square and Round Conductors, Winding Resistance of Rectangular Conductor, Winding Resistance of Square Wire, Winding Resistance of Round Wire, Leakage Inductance, Solution for Round Conductor Winding in Cylindrical Coordinates, Litz Wire, Winding Power Loss for Inductor Current with Harmonics, Effective Winding Resistance for Non-sinusoidal Inductor Current, Thermal Model of Inductors.

UNIT-III:

TRANSFORMERS

Introduction, Neumann's Formula for Mutual Inductance, Mutual Inductance, Energy Stored in Coupled Inductors, Magnetizing Inductance, Leakage Inductance, Measurement of Transformer Inductances, Stray Capacitance, High-Frequency Transformer Model, Non-interleaved Windings, Interleaved Windings, AC Current Transformers, Winding Power Losses with Harmonics, Thermal Model of Transformers.

DESIGN OF TRANSFORMERS

Introduction, Area Product Method, Optimum Flux Density, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM.

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UNIT-IV:

INTEGRATED INDUCTORS

Introduction, Resistance of Rectangular Trace, Inductance of Straight Rectangular Trace, Construction of Integrated Inductors, Meander Inductors, Inductance of Straight Round Conductor, Inductance of Circular Round Wire Loop, Inductance of Two-Parallel Wire Loop, Inductance of Rectangle of Round Wire, Inductance of Polygon Round Wire Loop, Bond-wire Inductors, Single-Turn Planar Inductor, Inductance of Planar Square Loop, Planar Spiral Inductors, Multi-metal Spiral Inductors, Planar Transformers, MEMS Inductors, Inductance of Coaxial Cable, Inductance of Two-Wire Transmission Line, Eddy Currents in Integrated Inductors, Model of RF Integrated Inductors, PCB Inductors.

DESIGN OF INDUCTORS

Introduction, Restrictions on Inductors, Window Utilization Factor, Temperature Rise of Inductors, Mean Turn Length of Inductors, Area Product Method, AC Inductor Design, Inductor Design for Buck Converter in CCM, Inductor Design for Buck Converter in DCM method.

UNIT-V:

SELF-CAPACITANCE

Introduction, High-Frequency Inductor Model, Self-Capacitance Components, Capacitance of Parallel-Plate Capacitor, Self-Capacitance of Foil Winding Inductors, Capacitance of Two Parallel Round Conductors, Capacitance of Round Conductor and Conducting Plane, Self-Capacitance of Single-Layer Inductors, Self-Capacitance of Multi-layer Inductors, Capacitance of Coaxial Cable.

TEXTBOOKS:

1. Umanand L, Bhat, S.R, "Design of Magnetic Components for Switched Mode Power Converters", ISBN: 978-81-224-0339-8, Wiley Eastern Publication, 1992.
2. Marian K. Kazimierczuk, "High-Frequency Magnetic Components", ISBN: 978-0-470-71453-9, John Wiley& Sons, Inc.

REFERENCES:

1. G.C. Chryssis, "High frequency switching power supplies", McGraw Hill, 1989 (2nd Edition.)
2. Eric Lowdon, "Practical Transformer Design Handbook", Howard W. Sams & Co., Inc., 1980
3. Thompson, "Electrodynamic Magnetic Suspension.pdf"
4. Witulski, "Introduction to modeling of transformers and coupled inductors"
5. Beattie,"Inductance 101.pdf"
6. P. L. Dowell, "Effects of eddy currents in transformer windings.pdf"
7. Dixon, "Eddy current losses in transformer windings.pdf"
8. J J Ding, J S Buckkeridge, "Design Considerations for A Sustainable Hybrid Energy System" IPENZ Transactions, 2000, Vol. 27, No. 1/EMCh.
9. Texas Instruments, "Windings.pdf"
10. Texas Instruments, "Magnetic core characteristics.pdf".
11. Ferroxcube, "3f3 ferrite datasheet.pdf".
12. Ferroxcube, "Ferrite selection guide.pdf", Magnetics, Inc., Ferrite Cores (www.mag-inc.com).

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PROPOSED SYLLABUS for M.TECH-POWER ELECTRONICS

M. Tech – I Semester

L	T	P	C
3	0	0	3

ELECTRIC VEHICLES AND DESIGN
(Program Elective-II.4)

Prerequisite: Power Semiconductor Drives, Electrical Drives and Control, Utilization of Electric Energy

Course Objectives:

- To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To know the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used energy storage devices, etc.

Course Outcomes: After completion of the course, students will be able to:

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

UNIT-I:

INTRODUCTION

Conventional Vehicles: Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance.

UNIT-II:

INTRODUCTION TO HYBRID ELECTRIC VEHICLES

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-Trains: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT-III:

ELECTRIC TRAINS

Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive train topologies, Power flow control in electric drive-train topologies, Fuel efficiency analysis.

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, Drive system efficiency.

UNIT-IV:

ENERGY STORAGE

Energy Storage: Introduction to Energy Storage, Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, selecting the energy storage technology, Communications, Supporting subsystems.

UNIT-V:

ENERGY MANAGEMENT STRATEGIES

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies, Implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

TEXT BOOKS:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

REFERENCES:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

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L	T	P	C
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ADVANCED POWER ELECTRONIC CONVERTERS LAB-I

(Lab-I)

Prerequisite: Power Electronic Converters

Course Objectives:

- To simulate various AC-AC, AC-DC, DC-AC converter topologies

Course Outcomes: After completion of the course, students will be able to:

- Design controlled rectifiers
- Design conventional multi-level inverters for industrial applications.

List of Experiments

1. Characteristics of IGBT, MTO, ETO, IGCT, MCT
2. Single phase and three-phase fully controlled converter.
3. Single phase and three-phase Half controlled converter.
4. Single phase Extinction angle control.
5. Single phase symmetrical angle control.
6. Single phase PWM controlled full converter.
7. Sinusoidal pulse width modulated single phase inverter.
8. Sinusoidal pulse width modulated three phase inverter.
9. Space vector modulated three phase inverter.
10. Single phase diode clamped Multi-level inverter.
11. Single phase flying capacitor Multi-level inverter.
12. Single phase cascaded Multi-level inverter.

Note: From the above list, minimum of 10 experiments are to be conducted using suitable software.

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ELECTRICAL DRIVES LAB
(Lab-II)

Prerequisite: Power Electronic Devices and Circuits and Electrical Machines

Course Objectives:

- To understand principle of operation of scalar control of AC motor and corresponding speed-torque characteristics
- To comprehend the vector control for AC motor drive (IM and SM)
- To explain the static resistance control and Slip power recovery drive
- To explain synchronous motor drive characteristics and its control strategies
- To comprehend the principle of operation of brushless DC motor.

Course Outcomes: After completion of the course, students will be able to:

- Develop induction motor for variable speed operations using scalar and vector control techniques.
- Identify the difference between the rotor resistance control and static rotor resistance control method and significance of slip power recovery drives.
- Develop controllers for synchronous motor and variable reluctance motor.

List of Experiments:

1. Speed control of separately excited DC Motor Drive with 1 quadrant chopper
2. Speed control of separately excited DC Motor Drive with 4 quadrant chopper.
3. Speed control of BLDC Motor Drive.
4. Multi-level inverter-based AC Induction Motor Drive control equipment.
5. Speed control of 3-phase wound rotor Induction Motor Drive.
6. Speed control of 3-phase doubly fed Induction Motor Drive.
7. Speed control of 5-phase Induction Motor Drive.
8. Speed control of 3-phase Induction Motor Drive using V/F control.
9. Speed control of 3-phase Induction Motor Drive using Vector Control technique.
10. Speed Measurement and closed loop control using PMDC Motor Drive.
11. Speed measurement and closed loop control of PMDC Motor Drive with thyristor circuit.
12. Matrix Converter
13. Speed measurement and closed loop control of IGBT used single 4 quadrant chopper for PMDC Motor Drive.
14. Isolated Gate Drive circuits for MOSFET / IGBT based circuits.

Note: From the above list, minimum of 10 experiments are to be conducted

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ADVANCED POWER ELECTRONIC CONVERTERS-II
(Program Core-III)

Prerequisite: Power Electronics, Power Electronic Converters

Course Objectives:
- To comprehend the concepts of different power converters and their applications
- To analyze and design switched mode regulators for various industrial applications.
- To develop resonant power converters with better performance

Course Outcomes: After completion of the course, students will be able to:
- Select an appropriate power semiconductor device and design a power converter for the required application
- Model existing and modified power converters based on real time applications
- Analyze and design power converters and feedback loops.

UNIT-I:
NON-ISOLATED D.C. TO D.C. CONVERTERS
Analysis of step-down and step-up dc to dc converters with Resistive and Resistive-Inductive loads, Switched mode regulators, Analysis of Buck Regulators, Boost regulators, Buck and boost regulators, Cuk regulators, Condition for continuous inductor current and capacitor voltage, Comparison of regulators, Multi output boost converters, Advantages, Applications, Problems, State space analysis of regulators.

UNIT-II:
ISOLATED D.C. TO D.C. CONVERTERS
Classification, switched mode dc power supplies, Fly back Converter, Forward converter, Push-pull converter, Half bridge converter, Full bridge converter, Control circuits, Magnetic design considerations, Applications.

UNIT-III:
RESONANT PULSE INVERTERS
Resonant pulse inverters, Series resonant inverters, Series resonant inverters with unidirectional switches, Series resonant inverters with bidirectional switches, Analysis of half bridge resonant inverter, Evaluation of currents and voltages of a simple resonant inverter, Analysis of half bridge and full bridge resonant inverter with bidirectional switches, Frequency response of Series resonant, Parallel resonant, Series loaded, Parallel loaded, Series and Parallel loaded inverters, Voltage control of resonant inverters, Class-E resonant inverter, Class-E resonant rectifier, Evaluation of values of 'C' and 'L' for Class-E inverter and Class-E rectifier, Numerical problems.

UNIT-IV:
ZCS & ZVS RESONANT CONVERTERS
Resonant converters, zero current switching resonant converters, L-type and M-type ZCS resonant converter, zero voltage switching resonant converters, Comparison between ZCS and ZVS resonant converters, Two quadrant ZVS resonant converters, Resonant dc-link inverters, Evaluation of 'L' and 'C' for a zero current switching inverter, Numerical problems.

UNIT-V
POWER CONDITIONERS
Power line disturbances, Power conditioners, Uninterruptible Power supplies, Applications
ADVANCED CONVERTERS
Principle of operation of SEPIC converter, Matrix Converter, Luo Converter, Interleaved Converter.

TEXTBOOKS:

1. Mohammed H. Rashid, "Power Electronics", Pearson Education, 3rd Edition, 1st Indian reprint, 2004.
2. Ned Mohan Tore M. Undeland and William P. Robbins, "Power Electronics", John Wiley & Sons, 2nd Edition.

REFERENCES:

1. Milliman Shepherd and Lizang, "Power converters circuits", Chapter 14 (Matrix converter) pp.415-444.
2. M.H.Rashid,"Power Electronics Hand Book".
3. Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition, "Control in Power Electronics",Published by Academic Press, 2002.

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POWER ELECTRONICS APPLICATION TO POWER SYSTEMS
(Program Core-IV)

Prerequisite: Power System, Power Electronics

Course Objectives:

- Understand the basics of formation of bus admittance matrix, modeling of transmission line, and analyze the load flow.
- Teach the analysis of sensitivity and the basics of power system security.
- Explain the voltage stability, proximity indicators and participation factors.
- Familiarize with FACT systems for controlling the power and configuration of various FACT devices.
- Introduce the thyristor-controlled series capacitor, its analysis, different modes of operation and various models.

Course Outcomes: After completion of the course, students will be able to:

- Create the bus admittance matrix, describe the reactive power of transmission line, model the transmission line, define the model of OLTC and analyze the load flow of lines.
- Analyze the sensitivity of different distribution factors, explain the power system security, and select and evaluate the contingency.
- Determine the voltage stability, proximity indicators and participation factor based on model analysis.
- Describe the FACT's controllers for power system and configure various FACT devices.

UNIT-I:

Power System components models formation of bus admittance matrix, algorithm for formation of bus impedance matrix, Reactive power capability of an alternator, transmission line model and loadability, Reactive power transmission and associated difficulties, regulated shunt compensation, Models of OLTC and Phase shifting transformer, load flow study.

UNIT-II:

Sensitivity analysis: Generation shift distribution factors, line outage distribution factors, Compensated shift factors. Power system security levels, contingency selection and evaluation, security constrained economic dispatch. Pre-contingency corrective rescheduling.

UNIT-III:

Voltage stability: Proximity indicators e.g., slope of PV-curve, Minimum Eigen value of reduced load flow Jacobian, participation factors based on modal analysis and application.

UNIT-IV:

Flexible ac transmission systems, Reactive power control, Brief description and definition of FACT's controllers, Shunt compensators, Configuration and operating characteristics of TCR, FC-TCR, TSC, Comparison of SVCs.

UNIT-V:

The Thyristor-controlled series capacitor (TCSC), Advantages of the TCSC, Basic principle and different mode of operation, Analysis, Variable-reactance model and transient stability model of TCSC.

TEXTBOOKS:

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill 2011.
2. A. J. Wood and B. F. Wollenberg, "Power generation, operation and control", second edition John Wiley and Sons 1996.
3. N. G. Hingorani and L. Gyugyi, "Understanding facts: Concepts and Technology of flexible AC transmission systems", Wiley Press 2000.

REFERENCES:

1. P. Kundur, "Power System Stability and control", McGraw-Hill edition 2008.
2. R. M. Mathur and R. K. Varma, "Thyristor Based FACTS Controllers for electrical Transmission systems", John Wiley and sons 2002.

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INDUSTRIAL LOAD MODELLING AND CONTROL
(Program Elective-III.1)

Prerequisite: Power Systems

Course Objectives:
- To understand the energy demand scenario
- To understand the modeling of load and its ease to study load demand industrially
- To know electricity pricing models
- To study reactive power management in Industries

Course Outcomes: After completion of the course, students will be able to:
- Acquire knowledge about load control techniques in industries and its application.
- Understand different types of industrial processes and optimize the process using tools like LINDO and LINGO.
- Apply load management to reduce demand of electricity during peak time.
- Apply different energy saving opportunities in industries.

UNIT-I:
Electric Energy Scenario, Demand Side Management, Industrial Load Management. Load Curve, Load Shaping Objective, Methodologies.
Barriers: Classification of Industrial Loads, Continuous and Batch processes, Load Modeling.

UNIT-II:
Direct load control, Interruptible load control. Bottom- u p approach, Scheduling, Formulation of load models, Optimization and control algorithms, Case studies. Reactive power management in industry, Controls, Power quality impacts, Application of filters, Energy saving in industries.

UNIT-III:
Cooling and heating loads, Load profiling, Modeling. Cool storage, Types, Control strategies.
Optimal operation, Problem formulation, Case studies.

UNIT-IV:
Captive power units, Operating and control strategies, Power Pooling, Operation models. Energy banking, Industrial Cogeneration.

UNIT-V:
Selection of Schemes, Optimal Operating Strategies. Peak load saving, Constraints, Problem formulation Case study. Integrated Load management for Industries.

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TEXTBOOKS:

1. C.O. Bjork, "Industrial Load Management-Theory, Practice and Simulations", Elsevier, the Netherlands, 1989.
2. C.W. Gellings and S.N. Talukdar, "Load management concepts", IEEE Press, New York, 1986,pp.3-28.

REFERENCES:

1. Y. Manichaikul and F.C. Schweppe, "Physically based Industrial load", IEEE Trans. on PAS, April1981.
2. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Inter science Publication, USA, 1989.
3. I.J.Nagarath and D.P.Kothari,"Modern Power System Engineering", Tata McGraw Hill Publishers, New Delhi, 1995.
4. IEEE Bronze Book, "Recommended Practice for Energy Conservation and cost-effective planning inIndustrial facilities", IEEE Inc, USA.

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ADVANCED DIGITAL SIGNAL PROCESSING

(Program Elective-III.2)

Prerequisite: Digital Signal Processing

Course Objectives:

- To understand the difference between discrete-time and continuous-time signals
- To understand and apply Discrete Fourier Transforms (DFT)

Course Outcomes: After completion of the course, students will be able to:

- Acquire knowledge about the time domain and frequency domain representations as well analysis of discrete-time signals and systems
- Study the design techniques for IIR and FIR filters and their realization structures.
- Acquire knowledge about the finite word length effects in implementation of digital filters.
- Gain knowledge about the various linear signal models and estimation of power spectrum of stationary Random signals
- Design of optimum FIR and IIR filters

UNIT-I:

Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signal, Discrete time Fourier transforms, Discrete Fourier series, Discrete Fourier transform, Z-transforms, Properties of different transforms.

UNIT-II:

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bi-linear transformation method.

UNIT-III:

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations, Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

UNIT-IV:

A/D conversion noise, Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models.

UNIT-V:

All pole, All zero and Pole-zero models, Power spectrum estimation, Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals, Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

TEXTBOOKS:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ", TMH Edition, 1998.
2. Dimitris G.Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", TMH International Editions, 2000.

REFERENCES:

1. S Salivahanan. A. Vallavaraj C. Gnanapriya, "Digital Signal Processing", TMH, 2nd reprint 2001.
2. Lourens R Rebinarand Bernold, "Theory and Applications of Digital Signal Processing".
3. Auntoniam, "Digital Filter Analysis and Design", TMH.

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POWER QUALITY IMPROVEMENT TECHNIQUES
(Program Elective-III.3)

Prerequisite: Power Systems and Power Electronics

Course Objectives:

- To know different terms of power quality.
- To illustrate power quality issues for short and long interruptions.
- To study of characterization of voltage sag magnitude and three-phase unbalanced voltage sag.
- To know the behavior of power electronics loads, induction motors, synchronous motor etc. by the power quality issues
- To know mitigation of power quality problems by using VSI converters.

Course Outcomes: After completion of the course, students will be able to:

- Know the severity of power quality problems in distribution system
- Understand the concept of voltage sag transformation from up-stream (higher voltages) to down-stream (lower voltage)
- Compute the power quality improvement by using various mitigating custom power devices.

UNIT-I:

INTRODUCTION AND POWER QUALITY STANDARDS

Introduction, Classification of Power Quality Problems, Causes, Effects and Mitigation Techniques of Power Quality Problems, Power Quality Terminology, Standards, Definitions, Monitoring and Numerical Problems.

UNIT-II:

CAUSES OF POWER QUALITY PROBLEMS

Introduction to Non-Linear Loads, Power Quality Problems caused by Non-Linear Loads, Analysis of Non-Linear Loads, Numerical Problems.

UNIT-III:

PASSIVE SHUNT AND SERIES COMPENSATION

Introduction, Classification and Principle of operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators for Single-Phase System, Three-Phase Three Wire System and Three-Phase Four Wire System.

UNIT-IV:

ACTIVE SHUNT AND SERIES COMPENSATION

Introduction to Shunt compensators: Classification of DSTATCOM's, Principle of Operation of DSTATCOM.

Different Control Algorithms of DSTATCOM: PI Controller, I-Cosφ Control Algorithm, Synchronous Reference Frame Theory, Single-Phase PQ theory and DQ Theory Based Control Algorithms, Analysis and Design of Shunt Compensators, Numerical Problems.

Introduction to Series Compensators: Classification of Series Compensators, Principle of Operation of DVR.

Different Control Algorithms of DVR: Synchronous Reference Frame Theory-Based Control of DVR, Analysis and Design of Active Series Compensators, Numerical Problems.

UNIT-V:

UNIFIED POWER QUALITY COMPENSATORS

Introduction to Unified Power Quality Compensators (UPQC), Classification of UPQCs, Principle of Operation of UPQC.

Control of UPQCs: Synchronous Reference Frame Theory-Based UPQC, Analysis and Design of UPQCs, Numerical Problems.

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TEXTBOOKS:

1. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality Problems and Mitigation Techniques", Wiley Publications, 2015.
2. Math H J Bollen, "Understanding Power Quality Problems", IEEE Press, 2000.

REFERENCES:

1. R.C. Dugan, M.F. McGranaghan and H.W. Beaty, "Electric Power Systems Quality", New York, McGraw-Hill, 1996.
2. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007.
3. J. Arrillaga, "Power System Quality Assessment", John wiley, 2000.
4. G.T. Heydt," Electric Power Quality", 2ndEdition, West Lafayette, IN, Stars in Circle Publications,1994.
5. R. SastryVedamMulukutlaS.Sarma, "Power Quality VAR Compensation in Power Systems", CRC Press.
6. A Ghosh, G. Ledwich," Power Quality Enhancement Using Custom Power Devices", Kluwer Academic, 2002.

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POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS
(Program Elective-III.4)

Prerequisite: Power Electronics, Renewable Energy Sources

Course Objectives:

- To impart knowledge on different types of renewable energy systems.
- To analyze the operation of electrical generators used for the wind energy conversion Systems.
- To know the operation of AC-DC, DC-DC and AC-AC power converters used in renewable energy systems.
- To know the principles of standalone, grid connected and hybrid operation in renewable energy systems.

Course Outcomes: After completion of the course, students will be able to:

- Demonstrate the various types of renewable energy technologies that are used to harness electrical power.
- Demonstrate the operating principle and analysis of various types of Wind generators.
- Identify a suitable converter such as AC-DC, DC-DC and AC-AC converters for renewableenergy systems.
- Demonstrate and analyze the various types of wind and PV systems.
- Interpret the stand alone, grid connected and hybrid renewable energy systems

UNIT-I:

Solar cell characteristics and their measurement, PV Module, PV array, Partial shading of a solar cell and a module, The diode, Power conditioning unit, maximum power point tracker, Implementation of Perturb and Observe Method, Incremental Conductance Method, Battery charger/discharge controller.

UNIT-II:

Centralized Inverters, String Inverters, Multi-string Inverters, Module Integrated Inverter/Micro-inverters, Inverter Topology, Model of Inverter, Sizing Batteries and Inverters for a Solar PV System.
Types of PV Systems: Grid-Connected Solar PV System, Stand-Alone Solar PV System.

UNIT-III:

Introduction to wind: Characteristics, Wind Turbine, Fixed and Variable-Speed Wind Turbines, Components of WECS, Description of Components, Types of Wind Turbine Generators, Economics of Wind Energy Conversion Systems, Linking Wind Turbines onto the Grid, Power Converter Topologies for Wind Turbine Generators.

UNIT-IV:

Modeling of Permanent Magnet Synchronous Generators, Doubly Fed Induction Generators, Squirrel cage Induction Generators wind turbine, Control of Power converters for WECS.

UNIT-V:

Hybrid Energy Systems, Need for Hybrid Energy Systems, Range and types of Hybrid systems, Hybrid Solar PV/Wind Energy System, Architecture of Solar-Wind Hybrid System and Grid connected issues.

TEXTBOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.

REFERENCE BOOKS:

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
2. Rashid .M. H, "Power Electronics Hand book", Academic Press, 2001.
3. Rai. G.D, "Non-conventional energy sources", Khanna Publishers, 1993.
4. Rai. G.D," Solar energy utilization", Khanna Publishes, 1993.
5. Gray, L. Johnson, "Wind energy system", Prentice Hall of India, 1995.
6. B.H.Khan "Non-conventional Energy sources", Mc Graw-hill, 2nd Edition, 2009.

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DSP BASED DRIVE CONTROL
(Program Elective-IV.1)

Prerequisite: Signals and Systems, Digital Signal Processing

Course Objectives:

- To enrich the learner with digital controller concepts and its application in the field of Power Electronic drives

Course Outcomes: After completion of the course, students will be able to:

- Understand the architecture of DSP core and its functionalities.
- Acquire knowledge on operation of interrupts and peripherals
- Explore the possibilities of hardware implementation using PLDs and FPGAs.
- Design controllers for power electronic drives.

UNIT-I

Introduction to the C2xx DSP core and code generation, the components of the C2xx DSP core, mapping external devices to the C2xx core, Peripherals and Peripheral Interface, System configuration registers, Memory, Types of Physical Memory, Memory addressing Modes, Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

UNIT II

Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers, Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

UNIT III

ADC Overview, Operation of the ADC in the DSP, Overview of the Event manager (EV), Event Manager Interrupts, General Purpose (GP) Timers, Compare Units, Capture Units and Quadrature Enclosed Pulse (QEP) Circuitry, General Event Manager Information.

UNIT IV

Introduction to Field Programmable Gate Arrays (FPGA), CPLD Vs FPGA, Types of FPGA, Xilinx XC3000 series, Configurable logic Blocks (CLB), Input/output Block (IOB), Programmable Interconnect Point (PIP), Xilinx 4000 series, HDL programming, Overview of Spartan 3E and Virtex II pro FPGAboards case study.

UNIT V

Control of DC motor, Permanent magnet Brushless DC motor, Permanent magnet synchronous motor.

TEXTBOOKS:

1. John.F.Wakerly, "Microcomputer Architecture and Programming", John Wiley and Sons, 1981.
2. Ramesh S.Gaonker, "Microprocessor Architecture, Programming and Applications with the8085", Penram International Publishing (India), 1994.

REFERENCE BOOKS:

1. Hamid.A.Toliyat and Steven G.Campbell, "DSP Based Electro Mechanical Motion Control", CRC Press New York, 2004.
2. XC 3000 series datasheets (version 3.1). Xilinx, Inc., USA, 1998.
3. XC 4000 series datasheets (version 1.6). Xilinx, Inc., USA, 1999.
4. Wayne Wolf, "FPGA based system design, Prentice Hall, 2004.

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DISTRIBUTED GENERATION
(Program Elective-IV.2)

Prerequisite: Power Systems, Power Electronics
Course Objectives:

- To understand renewable energy sources.
- To explore the working of off-grid and grid-connected renewable energy generation schemes.

Course Outcomes: After completion of the course, students will be able to:

- Understand the planning and operational issues related to Distributed Generation.
- Acquire knowledge about Distributed Generation Learn Micro-Grids

UNIT-I:
Need for Distributed generation, Renewable sources in distributed generation and current scenario in Distributed Generation.

UNIT-II:
Planning of DGs, Sitting and sizing of DGs optimal placement of DG sources in distribution systems, Grid integration of DG's, Different types of interfaces, Inverter based DG's and rotating machine- b a s e d interfaces, Aggregation of multiple DG units.

UNIT-III:
Technical impacts of DG' on Transmission systems and Distribution Systems, De-regulation, Impact of DGs upon protective relaying, Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis.

UNIT-IV:
Economic and control aspects of DG's Market facts, Issues and challenges, Limitations of DG's, Voltage control techniques, Reactive power control, Harmonics, Power quality issues, Reliability of DG based systems.

UNIT-V:
Introduction to micro-grids, Types of micro-grids, Autonomous and non-autonomous grids, Sizing of micro-grids, Modeling & analysis of Micro-grids with multiple DG's, Micro-grids with power electronic interfacing units, Transients in micro-grids, Protection of micro-grids, Case studies, Advanced topics.

TEXTBOOKS:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation-Planning and Evaluation", MarcelDecker Press.
2. M.Godoy Simoes, Felix A.Farret, "Renewable Energy Systems-Design and Analysis with Induction Generators", CRC press.

REFERENCES:

1. Stuart Borlase, "Smart Grid: Infrastructure Technology Solutions", CRC Press.

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ELECTRIC VEHICLE CHARGING TECHNIQUES
(Program Elective-IV.3)

Prerequisite: Electric and Hybrid Vehicles, Power Electronics, Smart Grid Technologies

Course Objectives:

- To understand the charging infrastructure for EV's
- To explore the working of grid connected with EV's.

Course Outcomes: After completion of the course, students will be able to:

- Understand the planning and operational issues related to EV's charging.
- Acquire knowledge about EV's charging implementation models.

UNIT-I:

AN OVERVIEW OF EV CHARGING INFRASTRUCTURE:

Orients the reader to EV charging infrastructure, providing a brief introduction to technical concepts of electric vehicle supply equipment, AC and DC charging, power ratings, and charging standards.

UNIT-II:

LOCATION PLANNING AND LAND ALLOCATION:

Covers the location and site planning aspects for EV charging, by framing the principles of location planning and demonstrating a methodology for spatial allocation of charging demand, and identifies enabling processes and policies to integrate public charging in urban planning.

UNIT-III:

CONNECTING EVs TO THE ELECTRICITY GRID:

Focuses on supply of electricity for charging infrastructure, familiarizing readers with the regulations that govern electricity supply for EV charging, the role of DISCOMs in provision of EV charging connections, and the three methods of arranging for power supply for charging infrastructure.

UNIT-IV:

ACHIEVING EFFECTIVE EV-GRID INTEGRATION:

Zooms out from site-level considerations for supply of electricity to assess grid-level impacts, and then highlights the need for smart charging to minimize adverse impacts of EV charging loads on the grid.

UNIT-V:

MODELS OF EV CHARGING IMPLEMENTATION

Defines the typical roles within an implementation model for EV charging infrastructure and identifies three models in India – the government-driven model, the consumer-driven model and the charge point operator-driven model – for charging infrastructure implementation.

TEXTBOOKS:

1. Sulabh Sachan, P. Sanjeevikumar, Sanchari Deb, "Smart Charging Solutions for Hybrid and Electric Vehicles",Wiley Publications, March 2022.
2. Handbook of Electric Vehicle Charging Infrastructure Implementation Version-1

REFERENCES:

1. Vahid Vahidinasab, Behnam Mohammadi-Ivatloo, "Electric Vehicle Integration via Smart Charging, Springer, 2022.
2. Alam, Mohammad Saad, Pillai, Reji Kumar, Murugesan, N, "Developing Charging Infrastructure and Technologies for Electric Vehicles", IGI Global Publisher, December 2021,

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ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY
(Program Elective-IV.4)

Prerequisite: Power Systems, Power Electronics
Course Objectives:

- To enumerate sources of Electromagnetic interferences
- To design EMI Filter for insertion loss and for switch mode power supplies
- To understand concept of Faraday screens for EMI Prevention

Course Outcomes: After completion of the course, students will be able to:

- Recognize the sources of Conducted and radiated EMI in Power Electronic Converters and consumer appliances and suggest remedial measures to mitigate the problems.
- Assess the insertion loss and design EMI filters to reduce the loss
- Design EMI filters, common-mode chokes and RC-snubber circuits measures to keep the interference within tolerable limits

UNIT-I:
INTRODUCTION:
Sources of conducted and radiated EMI, EMC standardization and description, measuring instruments, conducted EMI references, EMI in power electronic equipment: EMI from power semiconductors circuits.

UNIT-II:
NOISE SUPPRESSION IN RELAY SYSTEMS:
AC switching relays, shielded transformers, capacitor filters, EMI generation and reduction at source, influence of layout and control of parasites.

UNIT-III:
EMI FILTER ELEMENTS:
Capacitors, choke coils, resistors, EMI filter circuits. Ferrite breeds, feed through filters, bifilar wound choke filter, EMI filters at source, EMI filter at output.

UNIT-IV:
EMI IN SWITCH MODE POWER SUPPLIES:
EMI propagation modes, power line conducted-mode inference, safety regulations (ground return currents), Power line filters, suppressing EMI at sources, Line impedance stabilization network (LISN), line filter design, common-mode line filter inductors- design& example, series –mode inductors and problems, EMI measurements.

UNIT-V:
FARADAY SCREENS FOR EMI PREVENTION:
Faraday Screens for EMI prevention in switching devices, transformers, safety screens, faraday screens on output components, reducing radiated EMI on gapped transformer cores, metal screens, electrostatic screens in transformers.

TEXTBOOKS:

1. Electromagnetic Compatibility in Power Electronics, Laszlo Tihanyi, IEEE Press
2. EMI Filter Design, Pullen Timotty. M. Ozenbaugh, N. Richard Lee, CRC Press, Taylor & Francis
3. Practical Design for Electromagnetic Compatibility, R. F. Ficchi Hayden Book Co.

REFERENCES:

1. Stuart Borlase, "Smart Grid: Infrastructure Technology Solutions", CRC Press.
2. Handbook on Switch-Mode Power Supplies, Keith H. Billings, McGraw-Hill Publisher, 1989
3. https://www.ee.iitb.ac.in/web/academics/courses/EE785

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ELLENKI COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), HYDERABAD
PROPOSED SYLLABUS for M.TECH-POWER ELECTRONICS

M. Tech – II Semester

L	T	P	C
0	0	4	2

ADVANCED POWER ELECTRONIC CONVERTERS LAB-II
(Lab-III)

Prerequisite: Power Electronic Converters

Course Objectives:

- To know gate drive circuit configurations for converter circuits
- To analyze advanced converter topologies

Course Outcomes: After completion of the course, students will be able to.

- Design the gate driver circuits for converter topologies.
- Design concern topologies based on industrial applications

List of Experiments:

1. Buck Converter
2. Boost Converter
3. Cuk converter
4. Push pull converter
5. Fly back converter
6. Forward converter
7. Series resonant converter
8. Parallel resonant converter
9. ZVS
10. ZCS
11. UPS
12. SEPIC Converter

Note: From the above list, minimum of 10 experiments are to be conducted using any simulation tool

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0	0	4	2

POWER ELECTRONICS APPLICATION TO POWER SYSTEMS LAB
(Lab-IV)

Prerequisite: Power Electronic Converters, Power Systems, FACTS
Course Objectives:

- To understand the various power electronic devices simulation used in power systems
- To analyze advanced converter topologies for power system applications

Course Outcomes: After completion of the course, students will be able to.

- Model the different power converters for power system applications.
- Simulate and test the various designs of converter topologies based on needs of power and energy requirements.

List of Experiments:

1. Simulation of Thyristor Controlled Series Capacitor (TCSC) (Phasor Model)
2. Simulation of Steady-state and transient performance of a simple 6-Pulse HVDC Transmission System (Phasor Model)
3. Simulation of Unified Power Flow Controller (UPFC) (Phasor Model)
4. Simulation of Static Synchronous Compensator (STATCOM) used for midpoint voltage regulation on a transmission line (Phasor Model)
5. Simulation of Distribution STATCOM (D-STATCOM) (Average Model)
6. Simulation of Static Synchronous Series Compensator (SSSC) used for power oscillation damping (Phasor Model)
7. Simulation of Steady-state and dynamic performance of the static var compensator model SVC (Phasor Model)
8. Simulation of Shunt active harmonic filter (Three-Phase Active Harmonic Filter) to minimize the harmonic content propagated to the source from a non-linear load
9. Simulation of a typical transformer-less photovoltaic (PV) residential system connected to the electrical utility grid (Grid-Connected PV Array)
10. Simulation of Steady-state and transient performance of a 12-pulse, HVDC transmission system (Thyristor-Based HVDC Transmission System (Detailed Model))
11. Simulation of Thyristor Controlled Series Capacitor (TCSC) (Detailed Model).
12. Simulation of 48-Pulse, GTO-based unified power flow controller UPFC (Detailed Model)
13. Simulation of Static Synchronous Compensator using 22 power modules per phase STATCOM (Detailed MMC Model with 22 Power Modules per Phase)
14. Simulation of VSC-Based HVDC Transmission System (Detailed Model)
15. Simulation of A 48-pulse GTO based STATCOM (Detailed Model)
16. Simulation of Distribution STATCOM. D-STATCOM (Detailed Model)
17. Simulation of Static Var Compensator (SVC) (Detailed Model)
18. Simulation of Transient stability of a two-machine transmission system with Power System Stabilizers (PSS) and Static Var Compensator (SVC) SVC and PSS (Phasor Model).

Note: From the above list, minimum of 10 experiments are to be conducted using any simulation tool.

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