AISSMS
INSTITUTE OF INFORMATION TECHNOLOGY
[IOIT]
ADDING VALUE TO ENGINEERING
An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with "A+" Grade | NBA - 5 UG Programmes

Board of Studies

ELECTRICAL ENGINEERING

Curriculum

TY BTECH AUTONOMOUS

(WITH EFFECT FROM ACADEMIC YEAR 2024-25)

AISSMS INSTITUTE OF INFORMATION TECHNOLOGY
Kennedy Road, Near RTO,
Pune – 411 001, Maharashtra State, India
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BOS-ELECTRICAL ENGINEERING
AISSMS IOIT (AUTONOMOUS),
PUNE-1.

Vision

To be known for imparting quality education in the field of electrical engineering and preparing competent professionals with high human values to serve the society.

Mission

- To train the graduates with the latest technologies through industry institute interactions and experiential teaching learning practices to meet the emerging global challenges.
- To enhance engineering skills, employability skills, and research through professional activities.
- To develop globally competent electrical engineers with professional ethics and commitment to society.

Program Education Objectives (PEOs)

Graduates will

- Investigate problems in electrical engineering and provide effective solutions.
- Excel in the professional career, research, higher studies, and entrepreneurship.
- Engage in lifelong learning by adapting a professional, social, and ethical attitude for contributing to societal needs.

Program Specific Outcomes (PEOs)

- PSO 1: The graduates will be able to proficiently employ the software tools used in the design and analysis of electrical systems.
- PSO2: The graduates will be able to acquire skills in electric mobility, power quality, and renewable energy.

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Electrical Engineering - Third Year B. Tech (Semester –V)												
Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	IOHSM501	Intellectual Property Rights @@	2	--	--	2	--	--	25	--	25	50
2	ELPCC502	Power System Analysis	3	--	--	3	40#	60*	--	--	--	100
3	ELPCC503	Control System Engineering	3	1	--	4	40#	60*	--	--	--	100
4	ELPCC504	Principles of Electrical Machine Design	3	--	--	3	40#	60**	--	--	--	100
5	ELPEC505	Elective-I	3	--	--	3	40#	60*	--	--	--	100
6	ELOEC506	MOOC - Smart Grid: Basics to Advanced Technologies	3	--	--	3	40$	60$$	--	--	--	100
7	ELPCC507	Power System Analysis Lab @@	--	--	2	1	--	--	25	25	--	50
8	ELPCC508	Control System Engineering Lab @@	--	--	2	1	--	--	25	--	25	50
9	ELPCC509	Principles of Electrical Machine Design Lab	--	--	2	1	--	--	25	--	--	25
10	ELPEC510	Elective-I Lab	--	--	2	1	--	--	25	--	--	25
11	IOHSM5AC	Audit Course 5 – Foreign Language Level-I (A. German/ B. Japanese)	1	--	--	1	--	--	25	--	--	25
	Total		**18**	**01**	**08**	**23**	**200**	**300**	**150**	**25**	**50**	**725**
12	ELMNR501	Minor (Principles of Electrical Machine Design)	3	--	--	3	--	75	--	--	--	75
13	ELMNR502	Minor Lab (Principles of Electrical Machine Design Lab)	--	--	2	1	--	--	25	--	--	25
	Minor Total		**03**	**--**	**02**	**04**	**--**	**75**	**25**	**--**	**--**	**100**
Grand Total			**21**	**01**	**10**	**27**	**200**	**375**	**175**	**25**	**50**	**825**

L- Lecture, T-Tutorial, P-Practical

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation:**

In Semester I : Subjective Examination.

In Semester II: Examination - based on Presentation/ Group Discussion/ Laboratory Work/ Course Project/ Home Assignment/ Comprehensive Viva-Voce/ Blog Writing/ Case Study/ Survey/ Gate based Multiple-Choice Questions (MCQ)/ Numerical based Subjective Questions.

$ **For MOOCs:** Assignments marks will be converted on the scale of 40 marks.

$$ **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks.

MOOC - Smart Grid: Basics to Advanced Technologies https://onlinecourses.nptel.ac.in/noc24_ee148/preview

Note: @@ Passing is mandatory in both the examination heads to gain total Course Credits.

Elective-I	
A. Synchronous and Special Purpose Machines	C. Internet of Things
B. Digital Signal Processing	

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Electrical Engineering - Third Year B. Tech (Semester -VI)												
Sr. No.	Code	Course Title	Hours per week			Credits	Examination scheme					
			L	T	P		ISE	ESE	TW	PR	OR	Total
1	IOHSM601	Seminar and Technical Paper writing	1	--	2	2	--	--	50	--	--	50
2	ELPCC602	Switchgear and Protection	3	--	--	3	40#	60*	--	--	--	100
3	ELPCC603	Power System Operation and Control	3	--	--	3	40#	60*	--	--	--	100
4	ELPEC604	A. Electrical Maintenance Design & Costing / B. Electric Drives	3	--	--	3	40#	60**	--	--	--	100
5	ELPEC605	Elective-II	3	--	--	3	40#	60*	--	--	--	100
6	ELVSE606	Electric Vehicle @@	1	--	4	3	--	--	50	50	--	100
7	ELPCC607	Switchgear and Protection Lab @@	--	--	2	1	--	--	25	--	25	50
8	ELPCC608	Power System Operation and Control Lab @@	--	--	2	1	--	--	--	--	25	25
9	ELPEC609	A. Electrical Maintenance Design & Costing Lab/ B. Electric Drives Lab	--	--	2	1	--	--	25	--	--	25
10	ELELC610	Mini Project	--	--	4	2	--	--	--	--	50	50
11	IOHSM6AC	Audit Course 6 – Foreign Language Level-II (A. German/ B. Japanese)	1	--	--	1	--	--	25	--	--	25
12	IOLLC6L3	Lifelong Learning Skills III	--	--	--	1	--	--	25	--	--	25
13	IOLLC6L4	Lifelong Learning Skills IV	--	--	--	1	--	--	25	--	--	25
	Total		15	--	16	25	160	240	225	50	100	775
14	ELMNR601	Minor (Switch Gear and Protection)	3	--	--	3	--	75	--	--	--	75
15	ELMNR602	Minor Lab (Switch Gear and Protection Lab)	--	--	2	1	--	--	25	--	--	25
	Minor Total		03	--	02	04	--	75	25	--	--	100
Grand Total			18	--	18	29	160	315	250	50	100	875

L- Lecture, T-Tutorial, P-Practical

* **End Semester Examination (ESE)** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In Semester Evaluation:**

In Semester I : Subjective Examination.

In Semester II: Examination - based on Presentation/ Group Discussion/ Laboratory Work/ Course Project/ Home Assignment/ Comprehensive Viva Voce/ Blog Writing/ Case Study/Survey/

Gate based Multiple-Choice Questions (MCQ)/ Numerical based Subjective Questions.

Note: @@ Passing is mandatory in both the examination heads to gain total Course Credits.

Elective-II	
A. Modern Control Engineering	C. HVDC and FACTS
B. Restructuring & Deregulation	D. Sustainable Engineering

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Third Year B.Tech.			
Intellectual Property Rights (IOHSM501)			
Course Code :	IOHSM501	**Credit :**	02
Contact Hours :	2 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	TW 25 Marks	OR 25 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work	Internal	25
2.	Oral	External	25

Course Objective:	
1	To explain the significance of Intellectual Property.
2	To study various aspects of Patents.
3	To understand the significance of patent information in Business development.
4	To study patents documents and process for examination.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
501.1	Describe the significance of intellectual property.
501.2	Discuss various aspects of patents.
501.3	Search patent information in database.
501.4	Explain patents documents and process for examination.
501.5	Describe concepts related to trademarks.
501.6	Differentiate copyright from patent.

Unit 01	:	**Intellectual Property Rights (IPR)**	**(04 Hrs)**
IPR-Meaning, Relevance, Business Impact, Types of Intellectual Property, Protection of Intellectual Property, Competing Rationales for Protection of Intellectual Property Rights, The World Intellectual Property Organization (WIPO) and the UNESCO.			
Unit 02	:	**Patent**	**(04 Hrs)**
Concept of Patent, Types of Product / Process Patents & Terminology, Duration of Patents-Law and Policy Consideration, Elements of Patentability (Novelty and Non-Obviousness /Inventive Steps, Industrial Application, Non- Patentable Subject Matter), Procedure for Filing of Patent Application and types of Applications.			

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Unit 03	:	Patent Databases & Patent Information System	(04 Hrs)
Patent Offices in India, Importance of Patent Information in Business Development, Patent search through Internet, Patent Databases.			
Unit 04	**:**	**Patent Documents & Process For Examination**	**(04 Hrs)**
Lab Notebooks/Logbooks/Record Books, Methods of Invention Disclosures, Patent Application and its Contents, Writing of the Patent Document, Publication of Patent Applications, Request for Examination, Process for Examination & Prosecution, Reissue & Re-examination.			
Unit 05	**:**	**Trademarks**	**(04 Hrs)**
Definition and concept of Trademarks, The rationale of protection of trademark, Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks).			
Unit 06	**:**	**Copyrights**	**(04 Hrs)**
Definition of Copyright, Nature of Copyright, Works in which Copyrights subsist, Author & Ownership of Copyright, Rights Conferred by Copyright, Registration of Copyrights & Appeals.			

Text Books:

[T1]	Intellectual Property Rights-Law And Practice By Laser Typesetting

Reference Books:

[R1]	Aswani Kumar Bansal ,"Law of Trademarks in India" ,Commercial Law Publishers, 2001
[R2]	B L Wadehra," Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications" Universal Law Publishing Co Ltd.
[R3]	G.V.G Krishnamurthy ," The Law of Trademarks, Copyright, Patents and Design"
[R4]	Satyawrat Ponkse," The Management of Intellectual Property" Bhate & Ponkshe, 1991
[R5]	S K Roy Chaudhary & H K Saharay ,"The Law of Trademarks, Copyright, Patents and Design.Legal Aspects of Technology Transfer: A Conspectus"

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E-Resources :	
[1]	Patent act: https://ipindia.gov.in/writereaddata/Portal/IPOAct/1_31_1_patent-act-1970-11march2015.pdf
[2]	Practice and procedures: https://ipindia.gov.in/writereaddata/Portal/Images/pdf/Manual_for_Patent_Office_Practice_and_Procedure_.pdf

Third Year B.Tech.			
Power System Analysis (ELPCC502)			
Course Code :	ELPCC502	**Credit :**	**03**
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Prerequisite:

1. Circuit representation and generalized constants of short and medium transmission lines.
2. Inductance and capacitance for symmetrical and unsymmetrical configuration of transmission lines, Efficiency, and voltage regulation of transmission line.

Course Objective:	
1	To Develop analytical ability for Power system.
2	To Introduce concept of EHVAC and HVDC System.
3	To Demonstrate different computational methods for solving problems of load flow.
4	To Analyse the power system under symmetrical and Unsymmetrical fault conditions.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
502.1	Determine power flow in transmission line its performance and its compensation technique.
502.2	Determine pu system and its application to load flow with computational technique.
502.3	Describe EHVAC transmission systems and analyze Corona and its effects.
502.4	Determine power system network under symmetrical fault condition.
502.5	Determine power system network under Unsymmetrical fault condition.
502.6	Demonstrate HVDC transmission systems and its control.

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Unit 01	:	EHV-AC transmission	(06 Hrs)
Role of EHV-AC transmission, standard transmission voltages, average values of line parameters, power handling capacity and line losses, phenomenon of corona, disruptive critical voltages, visual critical voltages, corona loss, factors and conditions affecting corona loss, methods of reducing corona effect, radio and television interference, reduction of interference, Numerical Based on Corona, Corona loss.			
Unit 02	**:**	**Performance of Long Transmission Lines**	**(06 Hrs)**
Evaluation of ABCD constants and equivalent circuit parameters of Long transmission line. Concept of complex power, power flow using generalized constants, receiving end power circle diagram for transmission line (assuming ABCD constants are already given), surge impedance, surge impedance loading, Line efficiency, Regulation and compensation. Numerical based on : ABCD constants of Long transmission line, Power flow through a transmission line.			
Unit 03	**:**	**Per unit system and Load Flow Analysis**	**(06 Hrs)**
Per unit system : Single line diagram, Impedance and reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application of per unit system. Numerical based on network reduction by using per unit system. **Load Flow Analysis :** Network topology, driving point and transfer admittance, concept of Z-bus and formulation of Y-bus matrix using Direct method. Introduction to load flow analysis, power- flow equations generalization to n bus systems, classification of buses, Newton- Raphson method (using polar coordinates - Descriptive treatment only) Numerical based on Y bus Matrix.			
Unit 04	**:**	**Symmetrical Fault Analysis**	**(06 Hrs)**
3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems. Numerical Based on symmetrical fault analysis.			
Unit 05	**:**	**Unsymmetrical Fault Analysis**	**(06 Hrs)**
Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedances of transmission line and zero sequence networks of transformer, solution of unbalances by symmetrical components, L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance. Numerical based on symmetrical components and unsymmetrical fault calculation.			

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Unit 06	**:**	**HVDC Transmission**	**(06 Hrs)**
Classification and components of HVDC system, advantages and limitations of HVDC transmission, comparison with HVAC system, introduction to HVDC control methods - constant current, constant ignition angle and constant extinction angle control, HVDC systems in India, recent trends in HVDC system.			
Industrial Visit : Compulsory visit to EHV-AC substation/ HVDC substation			
Text Books:			
[T1]	J. B. Gupta, "Transmission and Distribution", S. K. Kataria& Sons, New Delhi.		
[T2]	V. K. Mehta, Rohit Mehta, "Principles of Power System", S. Chand Publication		
[T3]	J. B. Gupta, "Generation and Economic Considerations", S. K. Kataria& Sons, New Delhi.		
[T4]	Dr. B. R. Gupta, "Generation of Electrical Energy", S. Chand Publication		
[T5]	A Chakraborty, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, "A text book on Power System Engineering", Dhanpatrai& Co., Delhi.		
Reference Books:			
[R1]	Nagrath& Kothari, "Power System Engineering", Tata McGraw Hill Publications.		
[R2]	D. Das, "Electrical Power System", New Age Publication.		
[R3]	W.D. Stevenson, "Power System Analysis", Tata McGraw Hill Publications.		
[R4]	www.mahadiscom.in		
[R5]	www.mercindia.org.in		

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Third Year B.Tech.			
Control System Engineering (ELPCC503)			
Course Code :	ELPCC503	**Credit :**	04
Contact Hours :	3 Hrs./week (L) 1 Hr./week (T)	**Type of Course :**	Lecture Tutorial
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite:
1. Standard test signals – step, ramp, parabolic and impulse signal, Laplace transform

Course Objective:	
1	To introduce basic concepts of the classical control theory.
2	To explain the system performance using time domain analysis.
3	To explain the system performance using frequency domain analysis.
4	To provide knowledge to design controllers for improving performance of system.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
503.1	Classify various types of control systems and simplify using block diagram reduction and signal flow graph techniques.
503.2	Determine time response of second order system.
503.3	Investigate closed loop stability of system using Routh Hurwitz stability criteria and root locus.
503.4	Analyse the system in frequency domain and investigate stability using Polar Plot and Nyquist Criterion.
503.5	Analyse the system in frequency domain and investigate stability using Bode plot.
503.6	Design controllers for system.

Unit 01	:	General	(06 Hrs)
Introduction, types of control system, transfer function, pole and zero concept, Mechanical, Electrical and equivalent system, force-voltage and force current analogy , block diagram algebra, signal flow graph, Mason's gain formula.			

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Unit 02	:	Time response of system	(06 Hrs)
Type and order of control system, time response of first and second order systems to unit step input, steady state errors – static error coefficients. Time domain specifications of second order systems. Derivation of time domain specifications for second-order under-damped system for unit step input.			
Unit 03	**:**	**Time Domain Analysis**	**(06 Hrs)**
Concept of stability- Absolute, Asymptotic, relative and marginal. Nature of system response for various locations of roots in S-plane of characteristics equation. Routh's-Hurwithz criterion. Root Locus. Construction of root locus. Angle and magnitude condition for stable system.			
Unit 04	**:**	**Frequency Domain Analysis-I**	**(06 Hrs)**
Introduction, relation between time and frequency response for second order system. Frequency domain specifications, Polar Plot, Nyquist plot, stability analysis using Nyquist plot.			
Unit 05	**:**	**Frequency Domain Analysis-II**	**(06 Hrs)**
Introduction to Bode plot, Sketching of Bode plot, stability analysis using Bode plot. Introduction to lead, lag and lead-lag compensating networks (excluding design).			
Unit 06	**:**	**Controllers**	**(06 Hrs)**
Basic concept of P, PI, PD and PID controller, Tuning methods of PID controller.			
List of Tutorials :			
1. Reduce the given block diagram and determine overall transfer function. 2. Determine transfer function of the system represented by signal flow graph using Mason's gain formula. 3. Determine time domain specifications of given second order systems. 4. Determine static error constants and steady state error for the given systems. 5. Investigate closed loop stability of a given systems using Routh Hurwitz stability criterion.			

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6. Sketch the root locus of a given systems and comment on stability.
7. Sketch the polar plot of given systems.
8. Sketch the Nyquist plot of a given system, determine stability margins and comment on stability.
9. Sketch the Bode plot of a given systems, determine stability margins and comment on stability.
10. Determine the tuning parameters of PID controller using methods of Ziegler and Nichol.

Text Books:	
[T1]	I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th edition, 2007.
[T2]	S. K. Bhattacharya," Control Systems Theory and Applications", Pearson.
[T3]	S. Palani," Control Systems Engineering", TMH.
[T4]	N. K. Sinha, " Control Systems ", New Age International (P) Limited Publishers.
[T5]	S.Hasan Saeed, " Control Systems", KATSON BOOKS.
[T6]	A.K. Jairath," Solutions and Problems of Control Systems ", CBS Publishers.

Reference Books:	
[R1]	B. C. Kuo, "Automatic Control System", Wiley India, 8th Edition, 2003.
[R2]	Richard C Dorf and Robert H Bishop, "Modern control system", Pearson Education, 12th edition, 2011.
[R3]	D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd., 2005.

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Third Year B.Tech.			
Principles of Electrical Machine Design (ELPCC504)			
Course Code :	ELPCC504	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination Practical or Activity based Evaluation	External	60

Prerequisite:

1. Knowledge of various materials used in electrical machines.
2. Knowledge of types, construction and working of transformer.
3. Knowledge of types, construction and working of three phase induction motor.

Course Objective:	
1	To impart knowledge of various aspects of Electrical Machine Design.
2	To make students aware of recent trends in design.
3	To explain the design procedure for a transformer and an Induction motor.
4	To explain the procedure to determine the various operating parameters of transformer and Induction motor.
5	To discuss and explain the specifications of transformer and Induction motor.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
504.1	Explain the design concepts of electrical machines.
504.2	Calculate the main dimensions of transformers.
504.3	Analyze the performance parameters of transformer.
504.4	Calculate main dimensions of three phase Induction motor.
504.5	Design the stator & rotor of induction motor.
504.6	Analyze the performance parameters of induction motor.

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Unit 01	:	Introduction to machine design	(06 Hrs)
Introduction : transformers and three phase induction motors - types, specifications, constructional features, magnetic and insulating materials used; Basic concept of design, limitation in design , Computer aided design.			
Unit 02	**:**	**Transformer Design - I**	**(06 Hrs)**
Transformer auxiliaries and their functions , output equation, core and yoke cross sections, main dimensions design, optimum design of transformer for minimum cost and loss. Specifications of three phase transformers as per IS 2026(Part I), IS: 1180.			
Unit 03	**:**	**Transformer Design - II**	**(06 Hrs)**
A) **Electric circuit** : Winding types and design, magnetizing current calculation, concept of primary and secondary winding resistances and leakage reactance. Mechanical forces - types, causes and measures to overcome the effect. Estimation of no-load current, losses, efficiency of a transformer. B) **Tank wall dimensions design.** Design of tank with tubes. Design examples of Transformers.			
Unit 04	**:**	**Three phase Induction Motor Design : Part I**	**(06 Hrs)**
Stator design : specific electric and magnetic loadings selection, output equation, main dimensions design, winding - types and design. Factors affecting size of rotating machines, separation of main dimensions.			
Unit 05	**:**	**Three phase Induction Motor Design : Part II**	**(06 Hrs)**
Induction motor rotor design : Air gap length design, cage rotor winding design - slot numbers and shapes, bar and ring dimensions; slip ring rotor winding design - slot numbers and shapes, conductors per slot and its cross sections. Suitable combinations of stator and rotor slots.			
Unit 06	**:**	**Three phase Induction Motor Design : Part III**	**(06 Hrs)**
Induction motor parameters : magneto motive force calculation - air gap, stator and rotor cores and teeth ; no load current - magnetizing and core loss components, types of leakage flux and reactance. IS325, IS1231, IEC 60034. Design criteria of Energy efficient Induction motor.			

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Industrial Visit : Industrial visit to a manufacturing unit of transformer or Induction motor.	
Text Books:	
[T1]	M. G. Say - The Performance and Design of Alternating Current Machines, C.B.S. Pub. and Distri., Delhi.
[T2]	S. K. Sen - Principles of Electrical Machine Design with Computer Programs, Oxford and I.B.H. Company Pvt. Ltd., New Delhi.
[T3]	S. S. Sastry - Introductory Methods of Numerical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.
[T4]	R. K. Agrawal : Principles of Electrical Machine Design, S.K.Kataria and Sons, Delhi
[T5]	A. K. Sawhney – A Course in Electrical Machine Design, 10th Edition, - Dhanpat Rai and sons New Delhi.
Reference Books:	
[R1]	K. L. Narang, "Electrical engineering Drawing", Satya Prakashan, New Delhi 2. K.G. Upadhyay, "Design of Electrical Machines ", New age publication.
[R2]	K. G. Upadhyay- Design of Electrical Machines, New age publication
[R3]	C. G. Veinott, "Theory and design of small induction machines", MGH, 1959.
[R4]	A Shanmugasundarem, "Electrical machine design databook", PHI
[R5]	K. L. Narang, "Electrical engineering Drawing", Satya Prakashan, New Delhi 2. K.G. Upadhyay, "Design of Electrical Machines ", New age publication.

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Third Year B.Tech.			
Synchronous and Special Purpose Machines (ELPEC505A)			
Course Code :	ELPEC505A	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Prerequisite:

1. Basic concepts of Electrical Engineering
2. Fundamentals of Electrical Machines

Course Objective:	
1	To explain synchronous machines in detail.
2	To make the students aware about voltage regulation methods, compare them, and discuss alternator parallel operation.
3	To impart knowledge about synchronous motor starting, phasor diagrams, operation modes, and parameter evaluation.
4	To make students aware about constructional details and applications of special purpose motors.
5	To explain the constructional details and performance analysis of AC series motor.
6	To explain classification, constructional details, characteristics and application of single phase induction motors.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
505A.1	Analyze the constructional details of synchronous machines and construct the equivalent circuit of a synchronous generator.
505A.2	Enumerate methods for determining voltage regulation and evaluate the performance of synchronous generators.
505A.3	List synchronous motor starting methods and summarize performance parameters of synchronous motors.
505A.4	Demonstrate the constructional features and applications of special purpose motors.
505A.5	Describe the constructional details and applications of AC series motors.
505A.6	Classify various single phase motors, evaluate parameters and state the applications of these motors.

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Unit 01	:	Three phase Synchronous Machines	(08 Hrs)
Three phase Synchronous machines: Construction, comparison of salient-pole type and non-salient-pole type. Damper winding, Three phase synchronous generator: cylindrical rotor type and salient pole type, principle of operation. Emf equation and winding factors, rating of generator. Alternator on no-load and on balanced load. Armature reaction and its effect under different load power factors. Per phase equivalent circuit and phasor diagram. Power - power angle relation. Load characteristics. Losses and efficiency, power–flow chart. Slip test.			
Unit 02	**:**	**Performance analysis of Three phase Synchronous generator**	**(06 Hrs)**
Performance analysis of open circuit and short circuit test on synchronous generator, determination of voltage regulation by emf, mmf, and Potier triangle methods. Determination of voltage regulation by direct loading. Short circuit ratio. Comparison between various methods of finding voltage regulation. Parallel operation of 3-phase alternators: Necessity, conditions, Load sharing between two alternators in parallel. Parallel-Generator theorem. Process of synchronizing alternator with infinite bus-bar by lamp methods and by use of synchroscope. Synchronizing torque, power and current.			
Unit 03	**:**	**Three phase synchronous motor**	**(04 Hrs)**
Principle of operation. Methods of starting. Pull-in and pull-out torques. Equivalent circuit, significance of torque angle and torque equation. Losses, efficiency and Power flow chart. Operation of 3-phase Synchronous motor with constant excitation and variable load. Operation with constant load and variable excitation ('V' Curves and 'inverted V' curves). Phenomenon of hunting and its remedies. Applications of 3-ph synchronous motors. Introduction to synchronous – induction motor. Comparison of 3 phase synchronous motor with 3-phase induction motor.			
Unit 04	**:**	**Three phase induction motor, generator and special motors**	**(04 Hrs)**
Speed control of three phase induction motor by various methods (Stator side and rotor side controls). Action of 3-phase induction motor as induction generator, applications as induction generator. Singe phase and three phase Induction voltage regulator: construction, principle of working and applications. Special Motors (Descriptive Treatment Only): Construction, principle of working, characteristics, ratings and applications of Stepper motors (only permanent and variable reluctance type), Permanent Magnet motor and linear induction motors.			

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Unit 05	:	A.C. series motor	(08 Hrs)

Operation of d.c. series motor on a.c. supply, nature of torque developed, problems associated with a.c. operation and remedies. Plain Series motor: direct and quadrature axis fluxes. Transformer and rotational emfs in the field winding and the armature winding. Approximate phasor diagram (Ignoring leakage fluxes, magnetizing current and currents in the short-circuited armature coils). Circle diagram, performance characteristics from circle diagram. Drawbacks of plain series motor. Compensated series motor: Compensating winding, conductively and inductively compensated motor. Use of compoles for improving commutation. Ratings and applications of Compensated Series motors. Universal motors: ratings, performance and applications, comparison of their performance on a.c. and d.c. supply.

Unit 06	:	Fractional Horse Power motors	(06 Hrs)

Single phase induction motors : Construction, mmf produced by single phase stator winding carrying an alternating current. Double field revolving theory. Cross field theory. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory. Tests to determine the parameters of equivalent circuit and calculation of performance characteristics of motor. Methods of self-starting. Types of single phase induction motors: Split-phase motors (Resistor split-phase motor, Capacitor-start motor, Capacitor start and run motor and permanent capacitor). Shaded pole induction motor – their construction, operation, torque-slip characteristics and applications. Comparison of 1-phase induction motor with 3-phase induction motor.

Text Books:

[T1]	Nagrath and Kothari , Electrical Machines , 2nd Ed.,Tata McGraw Hill.
[T2]	S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.
[T3]	A.S. Langsdorf, Theory of Alternating Current Machinery , Tata McGraw Hill
[T4]	P. S. Bimbhra, Electric Machinery, Khanna Publications.
[T5]	B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.
[T6]	E. Openshaw Taylor, Performance and design of a.c. commutator motors, Wheeler Publishing.
[T7]	V. K. Mehta and Rohit Mehta , Principles of Electrical Machines , S Chand Publications
[T8]	Krishna Reddy –Electrical Machines vol. II and III, SCITECH publications.
[T9]	Ashfaq Husain, Electrical Machines, Dhanpat Rai and Co.
[T10]	M V Deshpande, Electrical Machines, Prentice Hall of India

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Reference Books:	
[R1]	M.G. Say , Performance and Design of A.C. Machines (3rd Ed.) , ELBS
[R2]	J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications
[R3]	Samarjit Ghosh, Electrical Machines, Pearson Publication
[R4]	Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinary and Transformer, 3rd Edition, Oxford University Press. 5. E G Janardanan, Special Electrical Machines, Prentice Hall of India.

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Third Year B.Tech.			
Digital Signal Processing (ELPEC505B)			
Course Code :	ELPEC505B	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite:
1. Fundamentals of Signals and Systems

Course Objective:	
1	To introduce discrete signals and systems.
2	To explain DT signals with Z transform, DTFT and DFT.
3	To introduce Digital filters and analyze the response.
4	To explore applications of DSP in electrical engineering.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
505B.1	Analyze discrete time signals and systems.
505B.2	Explain frequency response of discrete time systems
505B.3	Construct frequency response of LTI system using Fourier Transform.
505B.4	Design and realize IIR filters.
505B.5	Design and realize FIR filters.
505B.6	Apply the concepts of DSP in electrical engineering.

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Unit 01	:	Discrete Signals and systems	(06 Hrs)
Sampling of continuous time signals, quantization, aliasing, Sampling Theorem, Elementary discrete-time signals, classification, sequence operations, Discrete-time systems and Classification, impulse response, linear convolution and its properties, Z transform: basics, properties, inverse Z transform using power series and partial fraction.			
Unit 02	**:**	**Frequency response of discrete time systems**	**(06 Hrs)**
Discrete-time systems described by difference equations, Analysis of LTI discrete systems using z transform, frequency response of first order and second order systems, transfer function, steady state and transient response, phase and group delays, ideal filters and their pole zero locations, zero phase and linear phase transfer functions.			
Unit 03	**:**	**Frequency analysis of discrete time signals**	**(06 Hrs)**
Exponential representation of Fourier series and Fourier transform of continuous time signals, The Fourier series for discrete-Time periodic signals (only concept), The Fourier transform of discrete-time a periodic signals (only concept), Discrete Fourier Transform, Properties: periodicity, linearity, and symmetry properties, Circular convolution, Linear convolution using circular convolution, Fast Fourier Transform: Radix 2 DIT and DIF algorithms.			
Unit 04	**:**	**IIR filters**	**(06 Hrs)**
Advantages and disadvantages of digital filter over analog filters, classification of digital filters: FIR and IIR, design of analog low pass Butterworth filter, Chebyshev filter, design of IIR filters from analog filters using bilinear transformation, impulse invariance. Realization of IIR filters: direct form I, direct form II, cascade and parallel.			
Unit 05	**:**	**FIR filters**	**(06 Hrs)**
Comparison between FIR and IIR filters, symmetric and anti-symmetric FIR filters, design of linear phase FIR filters using windows method and frequency sampling method, Realization of FIR filters by direct form cascade form and parallel form.			

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Unit 06	:	Applications of DSP	(06 Hrs)
Application of DSP in rotating Electric Machines - speed control and condition Monitoring, Application of DSP in transmission line protection, Transformer protection. Harmonic analysis.			

Text Books:	
[T1]	Proakis J., Manolakis D., "Digital signal processing", 3rd Edition, Prentice Hall, ISBN 81-203-0720-8.
[T2]	P. Ramesh Babu, "Digital Signal Processing", 4th Edition SciTech Publication.
[T3]	Dr. S. D. Apte, "Digital Signal Processing",2nd Edition Wiley India Pvt. Ltd ISBN: 97881- 265-2142-5
[T4]	W. Rebizant, J. Szafran, A. Wiszniewski, "Digital Signal Processing in Power system Protection and Control", Springer 2011 ISBN 978-0-85729-801-0
Reference Books:	
[R1]	Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
[R2]	A.V. Oppenheim, R. W. Schafer, J. R. Buck, "Discrete Time Signal Processing", 2nd Edition Prentice Hall, ISBN 978-81-317-0492-9
[R3]	Steven W. Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists",1st Edition Elsevier, ISBN: 9780750674447

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Third Year B.Tech.			
Internet of Things (ELPEC505C)			
Course Code :	ELPEC505C	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite:

1. Programming languages C/C++ and Python.
2. Basic knowledge of electronics and hardware components.
3. Microcontrollers and microprocessors, such as Arduino, Raspberry Pi.
4. Operating Systems

Course Objective:	
1	To Introduce fundamental concepts of Internet of Things (IoT)
2	To provide information of different protocols used for IoT design
3	To demonstrate roles of sensors in IoT
4	To be familiar with data handling and analytics tools in IoT
5	To demonstrate the role of big data, cloud computing and data analytics in a typical IoT system

Course Outcomes : Upon successful completion of this course, the students will be able to:	
505C.1	Explain the various concepts, terminologies, and architecture of IoT systems.
505C.2	Use sensors and actuators for design of IoT
505C.3	Apply various protocols for design of IoT systems
505C.4	Use various techniques of data storage and analytics in IoT
505C.5	Describe the role of big data, cloud computing and data analytics in a typical IoT system.
505C.6	Use IoT in various Electrical applications.T

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Unit 01	:	Introduction to internet of Things	(06 Hrs)
Definition and Characteristics of IoT, Things in IoT, IoT Protocols, IoT Functional Blocks, IoT Communication models, IoT Communication APIs, Communication Protocols, Embedded Systems. IoT Levels & Deployment Templates- IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.			
Unit 02	**:**	**Sensors Networks**	**(06 Hrs)**
Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes.			
Unit 03	**:**	**IoT Platform Design Methodology & IoT system Logical design Using Python.**	**(06 Hrs)**
IoT Design Methodology- Setp 1: Purpose & requirement Specification, Setp 2: Process Specification, Setp 3: Domain model Specification, Setp 4: Information Model Specification, Setp 5: Service Specification, Setp 6: IoT Level Specification, Setp 7: Functional View Specification, Setp 8: Operational View Specification, Setp 9: Device & Component Integration, Setp 10: application Development. **IoT system Logical design -** Installing Python, Python Data Type and Data Structures, Control Flow, Functions, Modules, Packages, File handling, Date/Time Operations, Classes, Python Packages of Interest for IoT.			
Unit 04	**:**	**Data Handling& Analytics**	**(06 Hrs)**
Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications			
Unit 05	**:**	**IoT Servers & Cloud Offerings**	**(06 Hrs)**
Introduction to Cloud Storage Models & Communication APIs, WAMP- AotoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework- Django, Desighning a RESTful Web API, Web services for IoT, skyNet IoT Messaging Platform.			

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Unit 06	:	Applications of IoT	(06 Hrs)
Home Automation, Smart Cities, Energy, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.			

Text Books:

[T1]	"Internet of Things- A Hands-on Approach", Arshadeep Bahga, Vijay Madisetti, Universities Press.
[T2]	"Designing the Internet of Things",Adrian McEwen & Hakim Cassimally, WILEY

Reference Books:

[R1]	"The Internet of Things in the Cloud- A Middleware Perspective", Honbo Zhou, CRC Press.
[R2]	"The Internet of Things- Connecting Objects to the Web", Hakima Chaouchi, WILEY
[R3]	"The Internet of Things- Key Applications & Protocols", Olivier Hersent, David Boswarthick, Omar Elloumi, WILEY

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Third Year B.Tech.			
MOOC – Smart Grid : Basics to Advanced Technology (ELOEC506)			
Course Code :	ELOEC506	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite :

1. Fundamental concept of power and energy in three phase and single phase
2. Basic concepts of Electrical Measurements, power system
3. Electricity tariff

Course Objective :	
1	To provide an opportunity to learn new software, interdisciplinary theory, concepts, technology, etc. not covered in earlier subjects.
2	To make students employable in the industry or pursue a suitable higher education program.
3	To exposure to relevant tools and technologies.
4	To enrich the learning experience by using audio video and multimedia and state of the are pedagogy.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
506.1	Directly engage and learn from the best faculty in the country in order to strengthen the fundamentals.
506.2	Self-learn the given topic.
506.3	Develop critical thinking to solve complex problems in engineering, science and humanities.
506.4	Improve communication skills by interacting with peers and course teachers.

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Guidelines for students:

1. Students must register on the SWAYAM portal.
2. Through the SWAYAM portal, register for the said MOOC course.
3. Students have to submit the assignments as per schedule given by NPTEL course structure and take part in a self-assessment test.
4. Students must register for the certificate examination of NPTEL by paying the required fees.
5. Students will be awarded credits of MOOCs only when they earn the certificate of the registered course.

Link for Course :

https://onlinecourses.nptel.ac.in/noc24_ee148/preview - Smart grid

The detail curriculum & information is available on above link

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Third Year B.Tech.			
Power System Analysis Lab (ELPCC507)			
Course Code :	ELPCC507	**Credit :**	01
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Term Work 25 Marks	Practical 25 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25
2.	Practical Examination	External	25

Prerequisite:

1. Circuit representation and generalized constants of short and medium transmission lines.
2. Inductance and capacitance for symmetrical and unsymmetrical configuration of transmission lines, Efficiency and voltage regulation of transmission line.

Course Objective:	
1	To develop analytical ability for Power system.
2	To introduce concept of EHVAC and HVDC System.
3	To introduce different computational methods for solving problems of load flow.
4	To introduce analysis the power system under symmetrical and Unsymmetrical fault conditions.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
507.1	Determine constants of transmission line
507.2	Identify the requirement & analyst the various compensation techniques for transmission line
507.3	Analyse the performance of transmission line by using graphical method
507.4	Determine power system analysis under symmetrical & unsymmetrical fault condition.

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List of Experiments:

Any **eight experiments** are to be performed from following list.

1. Measurement of ABCD Constants of a medium transmission line.
2. Measurement of ABCD parameters of a long transmission line.
3. Performance study of the effect of VAR compensation using capacitor bank on the transmission line.
4. Plotting of receiving end circle diagram to evaluate the performance of medium transmission line.
5. Formulation and calculation of Y- bus matrix of a given system using software.
6. Static measurement of sub-transient reactance of a salient-pole alternator.
7. Measurement of sequence reactance of a synchronous machine (Negative and zero).
8. Solution of a load flow problem using Newton-Raphson method using software.
9. Simulation of Symmetrical fault of single machine connected to infinite bus.
10. Simulation of Unsymmetrical fault of single machine connected to infinite bus.

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Third Year B.Tech.			
Control System Engineering Lab (ELPCC508)			
Course Code :	ELPCC508	**Credit :**	01
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Term Work 25 Marks	Oral 25 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25
2.	Oral Examination	External	25

Prerequisite:
1. Standard test signals –step, ramp, parabolic and impulse signal, Laplace transform.

Course Objective:	
1	To explain various control system components.
2	To demonstrate stability in time domain and frequency domain.
3	To provide knowledge of controllers for improving system performance.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
508.1	Learn characteristics of various control systems.
508.2	Investigate closed loop stability of system using root locus using software.
508.3	Analyse the system in frequency domain and investigate stability using Nyquist Criterion using software.
508.4	Analyse the system in frequency domain and investigate stability using Bode plot using software.
508.5	Design controllers for system and understand their effects on performance.

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List of Experiments:

Any **eight experiments** are to be performed from following list.

1. Study of characteristic of DC servomotor.
2. Study of A.C. Servomotor.
3. To demonstrate the synchro characteristic and use a synchro pair as error detector.
4. Experimental analysis of D.C. Motor Position control System.
5. Stability analysis using Root locus. Validation using software.
6. Stability analysis using Nyquist Plot. Validation using software.
7. Stability analysis using Bode plot. Validation using software.
8. Time response of second order system effect of P, PI, PID on it.
9. Effect of addition of pole-zero on root locus of second order system.

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Third Year B.Tech.			
Principles of Electrical Machine Design Lab (ELPCC509)			
Course Code :	ELPCC509	**Credit :**	01
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Prerequisite:	
1.	Knowledge of various materials used in electrical machines.
2.	Knowledge of types, construction and working of transformer.
3.	Knowledge of types, construction and working of three phase induction motor.

Course Objective:	
1	To impart knowledge of various aspects of Electrical Machine Design.
2	To make students aware of recent trends in design.
3	To explain the design procedure for a transformer and an Induction motor.
4	To explain the procedure to determine the various operating parameters of transformer and Induction motor.
5	To discuss and explain the specifications of transformer and Induction motor.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
509.1	Use the FEM software for design.
509.2	Design the single layer winding for three phase induction motor.
509.3	Design the double layer winding for three phase induction motor .
509.4	Use the software (AUTOCAD) for design of windings.
509.5	Design the three phase induction motor

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List of Experiments :

Experiments are based on design; 06 hours are allocated for each practical

1. Application of finite element method in design : Introduction to FEM, Application of FEM technique for design problems. Use of open-source FEM software for 2D design. Computation of performance parameters of machine using FEM software.
2. Design of three phase squirrel cage / slip ring induction motor
3. Details and layout of AC (single layer and double layer) winding with design report. (Sheet in CAD)
4. Details and assembly of three phase transformer with design report. (Sheet in CAD)

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Third Year B.Tech.			
Synchronous and Special Purpose Machines Lab (ELPEC510A)			
Course Code :	ELPEC510A	**Credit :**	**01**
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Prerequisite:
1. Basic Electrical Engineering 2. Fundamentals Electrical Machines

Course Objective:	
1	To explain the principles and methods for determining the regulation of alternators.
2	To make students aware about the performance characteristics of synchronous motors under different load conditions.
3	To explore techniques for speed control of three-phase induction motors.
4	To introduce experimental procedures for conducting load tests on synchronous and induction motors.
5	To develop proficiency in utilizing simulation tools like MATLAB for studying motor performance characteristics.
6	To explain the principles and methods for determining the regulation of alternators.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
510A.1	Demonstrate the differences between EMF and MMF methods for determining alternator regulation and their application to cylindrical rotor alternators.
510A.2	Explain the procedure and principles underlying the Potier method to evaluate the regulation of cylindrical rotor alternators.
510A.3	Apply slip tests to determine the regulation of salient pole alternators, integrating theoretical knowledge with practical experimentation.
510A.4	Examine V and inverted V curves of synchronous motors under constant load conditions, discerning their implications on motor performance.
510A.5	Implement the V/F method for speed control of three-phase induction motors, utilizing alternators to demonstrate practical applications.
510A.6	Analyze the performance characteristics of synchronous and induction motors through load tests, critically evaluating their efficiency and functionality.

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List of Experiments:

Any **eight experiments** are to be performed out of following:

1. Determination of regulation of cylindrical rotor alternator by following methods a) EMF method b) MMF method.
2. Determination of regulation of cylindrical rotor alternator by Potier method.
3. Determination of regulation of salient pole alternator by slip test.
4. V and inverted V curve of synchronous motor at constant load.
5. Speed control of three phase induction motor by V/F method (Using alternator)
6. Determination of Regulation of alternator by Direct loading.
7. Load test on three phase synchronous motor.
8. Load test on 1-phase induction motor.
9. Load test on 1-phase series motor.
10. No load and blocked-rotor test on a Capacitor-start 1-phase induction motor and determination of its equivalent circuit parameters.
11. Performance characteristics of single phase series motor using circle diagram.
12. Synchronization of three phase alternator by Lamp and Synchroscope methods.
13. Simulation of performances characteristics of three phase induction motor on MATLAB.
14. Speed control of three phase induction motor by rotor resistance control method.

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Third Year B.Tech.			
Digital Signal Processing Lab (ELPEC510B)			
Course Code :	ELPEC510B	**Credit :**	**01**
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Prerequisite:
1. Knowledge of basic signals and systems

Course Objective:	
1	To introduce discrete time waveforms.
2	To explain DT signals with Z transform, DTFT and DFT.
3	To introduce Digital filters and analyze the response.
4	To explain harmonic analysis using digital signal processing.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
510B.1	Analyse discrete time signals and systems.
510B.2	To find circular convolution.
510B.3	Design and realize IIR filters.
510B.4	Design and realize FIR filters.
510B.5	Generate sinusoidal signal through filtering.
510B.6	Learn harmonic analysis using digital signal processing.

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List of Experiments:

Any **eight experiments** are to be performed out of following List :

1. To plot Discrete Time Waveforms i) sinusoidal ii) Unit step iii) Exponential.
2. To find the response of given input sequence with impulse sequence using linear convolution.
3. To find Discrete Fourier Transform (DFT) of the input signal x(n).
4. To find circular convolution of sequences x (n) and h(n) using
   i. Using basic formula of circular convolution
   ii. Using DFT and IDFT
5. To find Discrete Fourier Transform (DFT) of the input signal x(n) using DIT-FFT method.
6. To design IIR Butterworth Filter using Bilinear Transformation.
7. To design HP FIR Filter.
8. To generate a sinusoidal signal through filtering.
9. To study harmonic analysis using Digital signal processing.

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Third Year B.Tech.			
Internet of Things Lab (ELPEC510C)			
Course Code :	ELPEC510C	**Credit :**	**01**
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Prerequisite:

1. Programming languages C/C++ and Python.
2. Basic knowledge of electronics and hardware components.
3. Microcontrollers and microprocessors, such as Arduino, Raspberry Pi.

Course Objective:	
1	To study fundamental components of IoT
2	To study configuring IoT devices with Port address and IP Address
3	To study use of sensors in IoT
4	To study processes of interfacing of IoT
5	To study the role of IoT in Energy measurement and Power Quality monitoring.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
510C.1	Demonstrate working and applications of various components of IoT systems.
510C.2	Explain processes of configuring IoT devices with Port address and IP Address
510C.3	Use sensors and actuators for design of IoT
510C.4	Explain process of interfacing of IoT
510C.5	Demonstrate knowledge of application of IoT in Energy measurement
510C.6	Demonstrate knowledge of application of IoT in power quality monitoring

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List of Experiments:

Any **eight experiments** are to be performed out of following List :

1. Study of IoT Devices- working principle and applications.
2. Configuring IoT devices with Port address and IP Address.
3. Measurement of electrical parameters using IoT sensors.
4. On-line simulation of energy meters installed at MSETCL substations.
5. Interfacing of IoT devices with cloud.
6. Measurement of temperature, pressure and humidity using IoT sensors.
7. Interfacing IoT devices with Arduino.
8. Interfacing IoT devices with PLC.
9. IoT based Energy Monitoring and Measurement Systems.
10. IoT based Power Quality Monitoring and Measurement Systems.

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Third Year B.Tech.			
Audit Course 5 – Foreign Language German Level - I (IOHSM5ACA)			
Course Code :	IOHSM5ACA	**Credit :**	**01**
Contact Hours :	1 Hr./week (L)	**Type of Course :**	Lecture
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Course Objective:	
1	To get introduced to the Culture, Routine of the German Society through language.
2	To meet the needs of ever growing German industry with respect to language support.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
5ACA.1	Use German language for basic communication.
5ACA.2	Apply the knowledge of German script.
5ACA.3	Read, write and improve their listening skills.
5ACA.4	Develop interest to pursue profession in Indo-German Industry.
5ACA.5	Grasp the basic sentence structure and build a good foundational vocabulary.

Unit 01	:	Introduction to the German Language-I	(06 Hrs)

Introduction of German Alphabets,

- Spell the names
- Addresses
- Numbers,
- Telephone numbers
- Ordinal Numbers
- Pin code Numbers
- Dates
- Birthdates
- Age
- days of the week
- Months

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Unit 02	:	Introduction to the German Language-II	(06 Hrs)

- Basic Greetings
- Personal Pronouns
- Possessive Pronouns
- Self-Introduction
- Introducing other people, about family, friends, course mates
- Introduction to seasons, and seasons in Germany and in neighboring countries.

Text Books:

[T1]	" Netzwerk A-1 (Deutsch als Fremdsprache) " Goyal Publishers & Distributors Pvt. Ltd

Reference Books:

[R1]	Tipps und Uebungen A1

Online Resources:

1. Practice Material like Listening Module, reading Texts
2. NPTEL Course On German - I Language
3. Online German-English Dictionary www.leo.org

Third Year B.Tech.			
Audit Course 5 – Foreign Language Japanese Level - I (IOHSM5ACB)			
Course Code :	IOHSM5ACB	**Credit :**	**01**
Contact Hours :	1 Hr./week (L)	**Type of Course :**	Lecture
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Course Objective:	
1	To meet the needs of an ever growing industry with respect to language support.
2	To get introduced to Japanese society and culture through language.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
5ACB.1	Demonstrate basic communication skills.
5ACB.2	Show knowledge of Japanese script.
5ACB.3	Apply skills to reading, writing, and listening
5ACB.4	Develop interest to pursue professional Japanese Language courses.

Unit 01	**:**	**Introduction to Japanese Language**	**(06 Hrs)**
Introduction to Japanese Language and scripts (Hiragana, Katakana, and Kanji), Basic greetings. Hiragana: Modified Kana, Double consonant, Letters combined with ya, yu, yo, Long vowels, extended greetings and expression. Self-Introduction: Introducing another person, Numbers, Months, Dates (asking and telling birthday), Telephone numbers, Stating one's age, days of the week. Audio learning			
Unit 02	**:**	**Katakana, Time and Transport Basics**	**(06 Hrs)**
Katakana basic Script, Denoting things (nominal & prenominal demonstratives) Purchasing at the Market / in a shop / mall (asking & stating price). Introduction to counters - Part 1			

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Katakana: Modified kana, double consonant, letters with ya, yu, yo, Long vowels. Describing time, describing starting & finishing time (kara~made) Point in time (denoting the time when any action or the movement occurs). Means of transport (Vehicles), Places, Countries, Indicating movement to a certain place by a vehicle. Audio learning
Text Books:
[T1] Minna No Nihongo, "Japanese for Everyone", Elementary Main Textbook 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd
Reference Books:
[R1] George Trombley, Yukari Takenaka "Japanese from Zero!" Learn From Zero Publisher
Online Resources:
1. NPTEL Course on "**JapaniBhasha –SaralSwaroop (Japanese course taught in Hindi)**" Link of the Course: **https://onlinecourses.nptel.ac.in/noc23_hs76/preview** 2. **NPTEL Course on"** Introduction to Japanese Language and Culture" Link of the Course : https://onlinecourses.nptel.ac.in/noc19_hs52/preview

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Third Year B.Tech.			
Seminar and Technical Paper writing (IOHSM601)			
Course Code :	IOHSM601	**Credit :**	02
Contact Hours :	1 Hr./week (L) 2 Hr./week (P)	**Type of Course :**	Lecture Practical
Examination Scheme :	Termwork 50 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	50

Course Objective:	
1.	To prepare students to communicate effectively as professionals.
2.	To train students to use visual aids effectively.
3.	To implant technical writing skills.
4.	To develop presentation and technical writing skill.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
601.1	Analyze communication-related problems and improve communication skill
601.2	Use various types of technical communication as per need.
601.3	Write proposals and reports
601.4	Develop key skills in research, dissemination, and documentation.

Unit 01	:	**Technical Communication : Oral**	**(06 Hrs)**
Basics of Technical Communication, different forms of communication and advanced communication skills, dynamics of professional presentations , group discussions, etiquettes and mannerisms, job interviews (online/offline mode), public speaking, oral presentation.			
Unit 02	:	**Technical Communication : Written**	**(06 Hrs)**
Technical proposal, technical writing: efficient process to create a report, research paper, report writing and documentation style-LaTex, use of visual aids, ethics in writing using plagiarism tools, resume writing.			

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List of Assignments / Activities :

Any eight of the following

1. Introduction to technical communication
2. Group Discussion
3. Official/Public Speaking
4. Communication ethics
5. Conversational skills for job interviews
6. Theme based seminar/ oral presentation /poster presentation
7. Writing ethics-letter of application, resume e-mails.
8. Develop proposal in LaTex for selected research project
9. Publication process: How to write and submit paper for conference, journal, the evaluation process, how to communicate with the editors, copyright, plagiarism.

Note: The assessment for the subject shall be based on presentation and report submission.

Text Books:

[T1]	Sunita Mishra, "Communication Skills for Engineers" Pearson Education
[T2]	Prof. K. R. Laxminarayanan and Dr. T. Murugavel "Communication Skills for Engineers" SCITECH.
[T3]	Sharon J Gerson and Steven Gerson "Technical Writing - Process& Product", Pearson Education.
[T4]	Danial Riordan, Steven E. Pauley Technical Report Writing Today
[T5]	Krishna Mohan, Meera Banerji "Developing Communication skills", Laxmi Publications.
[T6]	Meenakshi Raman and Sangeeta Sharma," Technical Communication Principles and Practice", Oxford University Press.

Reference Books:

[R1]	Sanjay Kumar and Pushp Lata, "Communication Skills" Oxford University Press.
[R2]	Davies J.W. "Communication for engineering students", Longman
[R3]	Eisenberg, "Effective Technical Communication", Mc. Graw Hill.
[R4]	Robert A. Day, "How To Write and Publish a Scientific Paper", Fifth Edition, Oryx Press, Phoenix, AZ, 1998.

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Third Year B.Tech.			
Switchgear and Protection (ELPCC602)			
Course Code :	ELPCC602	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite:

1. Fundamental concepts of Power System

Course Objective:	
1.	To explain the need, qualities, principles and basic terminology in switchgear and protection.
2.	To make students able to draw, identify, specify, and familiarize with various LT & HT switchgears.
3.	To explain testing of various switchgears to find characteristics and select ratings of switchgears.
4.	To explain selection of different protective schemes for transformers, alternators and transmission lines.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
602.1	Demonstrate the arc interruption and analyze the RRRV in circuit breakers
602.2	Demonstrate the construction and working principle of air brake circuit breakers, SF6 circuit breakers, and a vacuum circuit breaker.
602.3	Demonstrate the fundamentals of protective relaying.
602.4	Explain the characteristics of static and digital relays and their applications in power systems.
602.5	Apply the differential protection scheme to large transformers, alternators, and induction motors.
602.6	Apply distance protection, three stepped protection for transmission line.

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Unit 01	:	Arc Interruption Process	(06 Hrs)
Need for protective system, nature and causes of fault, types of faults, effects of faults, Trip circuit of circuit breaker, Voltage - current characteristics of arc, Principles of DC and AC arc interruption, high resistance and current zero interruption, arc voltage, Transient Restriking Voltage (TRV), Recovery voltage, RRRV, current chopping, resistance switching, capacitive current interruption.			
Unit 02	**:**	**Circuit Breakers**	**(06 Hrs)**
Classification of circuit breakers, ratings of circuit breakers, brief study of construction and working of Air break circuit breaker, Air Blast circuit breaker, SF6 circuit breaker, Vacuum circuit breaker, DC circuit breaker. disadvantages and applications of each type of circuit breakers, Auto reclosing.			
Unit 03	**:**	**Fundamentals of protective relaying**	**(06 Hrs)**
Evolution of protective relaying, classification of relays, zones of protection, primary and backup protection, essential qualities of protective relaying. Various basic operating principles of protection- over current, (current graded and time graded), directional over current, differential, distance, induction type relay, torque equation in induction type relay, current and time setting in induction relay, Numericals on TSM , PSM and operating time of relay			
Unit 04	**:**	**Static and Digital Relaying**	**(06 Hrs)**
Overview of Static relay, block diagram, operating principal, merits and demerits of static relay. Numerical Relays :-Introduction and block diagram of numerical relay, Sampling theorem, Anti –Aliasing Filter, Block diagram of phasor measurement unit (PMU).			
Unit 05	**:**	**Protection of Transformer, Alternator and Induction Motor**	**(06 Hrs)**
Transformer Protection: Types of faults. Percentage differential protection, Restricted E/F protection, incipient faults, Buchholz relay. Protection against over fluxing. Protection against inrush current. **Alternator Protection:** Fundamentals of alternator, faults, abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover.			

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Three Phase Induction Motor Protection: Abnormal conditions and causes of failures, single phasing protection, Overload protection, Short circuit protection.			
Unit 06	**:**	**Transmission Line Protection**	**(06 Hrs)**
Over current protection for feeder using directional and non-directional over current relays, Introduction to distance protection, impedance relay, reactance relay, mho relay and Quadrilateral Relays, Introduction to PLCC, block diagram, advantages, disadvantages, three stepped distance protection, Effect of arc resistance, and power swing on performance of distance relay. Realization of distance relays (impedance, reactance, and mho relay) using numerical relaying algorithm (flowchart, block diagram), Introduction to Wide Area Measurement (WAM) system. Bus bar protection.			

Text Books:

[T1]	S. Rao, "Switchgear Protection and Power Systems", Khanna Publications
[T2]	J.B.Gupta " Switchgear and Protection", S.K. Kataria and Sons.
[T3]	Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India

Reference Books:

[R1]	Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear", Tata McGraw Hill Publishing Co. Ltd.
[R2]	Bhavesh Bhalja,R.P. Maheshwari, N.G. Chothani," Protection and Switchgear", Oxford University Press, 2011 Edition.
[R3]	J Lewis Blackburn , "Protective Relaying- Principles and Applications", Dekker Publications.
[R4]	Prof. Dr S.A. Soman, IIT Mumbai, A Web course on "Digital Protection of power System" http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/Course_home_L27.html
[R5]	A.G. Phadke, J.S. Thorp ,Computer relaying for Power System , Research Studies Press LTD, England.(Joh Willy and Sons Inc New York)
[R6]	Mason C.R., "Art and Science of Protective Relaying", Wiley Eastern Limited.
[R7]	Arun Ingole, "Switchgear and Protection", Pearson.

Third Year B.Tech.			
Power System Operation & Control (ELPCC603)			
Course Code :	ELPCC603	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite:

1. Basics of Power System

Course Objective:	
1.	To develop ability to analyze and use various methods to improve stability of power systems.
2.	To understand the need for generation and control of reactive power & impart knowledge about various advanced controllers such as FACTs controllers.
3.	To illustrate the automatic frequency and voltage control strategies and analyze the effects, knowing the necessity of generation control.
4.	To understand formulation of unit commitment and economic load dispatch tasks and solve it using optimization techniques & to illustrate various ways of interchange of power between interconnected utilities.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
603.1	Identify and analyze the dynamics of power system and suggest means to improve stability of system.
603.2	Understand the effect of reactive power on Power system and suggest the suitable means of reactive power management & selection of appropriate FACTs devices
603.3	Analyze the generation-load balance in real time operation and its effect on frequency and develop automatic control strategies with mathematical relations.
603.4	Formulate objective functions for optimization tasks such as unit commitment and economic load dispatch and get solution using computational techniques.
603.5	Illustrate various ways of interchange of power between interconnected utilities.
603.6	Evaluate reliability indices of Power system.

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Unit 01	:	Power System Stability	(06 Hrs)
Introduction to stability, dynamics of synchronous machine, swing equation, power angle equation and curve, types of power system stability (concepts of steady state, transient, dynamic stability), equal area criterion, applications of equal area criterion (sudden change in mechanical input, effect of clearing time on stability, critical clearing angle, short circuit at one end of line, short circuit away from line ends and reclosure), solution of swing equation by point by point method, methods to improve steady state and transient stability, numerical based on equal area criteria.			

Unit 02	:	Reactive Power management & FACTs Technology	(06 Hrs)
Reactive Power management : Necessity of reactive power control, reactive power generation by a synchronous machine, effect of excitation, loading capability curve of a generator, compensation in power system: series and shunt compensation using capacitors and reactors, Problems with Series Compensation, synchronous condenser. **FACTs Technology :** Problems of AC transmission system, evolution of FACTs technology, Working principle, circuit diagram, VI characteristics, applications, advantages and limitations of SVC, TCSC, STATCOM and UPFC.			

Unit 03	:	Real power - frequency control	(06 Hrs)
Fundamentals of speed governing mechanism and modelling, Load sharing between two synchronous machines in parallel; concept of control area, LFC control of a single-area system, Multi-area systems: Two-area system modelling, tie line with frequency bias control of two-area system derivation, state variable model.			

Unit 04	:	Economic Load Dispatch and Unit Commitment	(06 Hrs)
Economic load dispatch : Introduction, revision of cost curve of thermal and hydropower plant, plant scheduling method, equal incremental cost method, method of Lagrange multiplier (neglecting transmission losses), B_{mn} coefficient, economic scheduling of thermal plant considering effect of transmission losses, penalty factor, procedure of load dispatch at state level load dispatch center, Regional Load Dispatch Center, numerical on penalty factor, exact coordination equation. **Unit commitment :** Concept of unit commitment, constraints on unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming, Numerical on priority list method.			

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Unit 05	:	Energy Control:	(06 Hrs)
Interchange of power between interconnected utilities, economy interchange evaluation, interchange evaluation with unit commitment, types of interchange, capacity and diversity interchange, energy banking, emergency power interchange, inadvertent power exchange, power pools.			
Unit 06	**:**	**Planning and Reliability of Power Systems**	**(06 Hrs)**
Need of short term planning and long term planning in generation, transmission, distribution expansion. Definition of reliability of power system, Hierarchical levels for reliability study, Reliability evaluation of generation system, loss of load probability (LOLP), loss of load expectation (LOLE), Expected Energy Not Supplied (EENS), generation model, load model, risk model, composite system reliability evaluation, Distribution system reliability evaluation for radial and parallel system, customer oriented and energy based reliability indices.			
Industrial Visit : Compulsory one visit to Power Station / LDC			
Text Books:			
[T1]	I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Co. Ltd. (Edition 2)		
[T2]	Hadi Saadat, "Power System Analysis", Tata McGraw Hill		
[T3]	P. S. R. Murthy, "Power System Operation and Control", Tata McGraw Hill Publishing Co. Ltd.		
[T4]	P. S. R. Murthy, "Operation and Control in Power System", B. S. Publication.		
[T5]	R. Mohan Mathur, Rajiv K. Varma, "Thyristor based FACTs controller for Electrical transmission system", John Wiley and Sons Inc.		
[T6]	Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control", Prentice Hall of India.		
[T7]	Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTS", IEEE Press.		
Reference Books:			
[R1]	Allen J. Wood, Bruce F. Wollenberg, "Power Generation, Operation, and Control", Wiley India Edition.		
[R2]	"Electrical Power System Handbook", IEEE Press.		
[R3]	Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTs Concepts and Technology of Flexible AC Transmission Systems," IEEE Press.		
[R4]	Olle I. Elgerd, "Electrical Energy System Theory", 2nd Edition, Tata McGraw Hill. Publishing Co. Ltd.		
[R5]	Prabha Kundur, "Power System Stability and Control", Tata McGraw Hill.		

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Third Year B.Tech.			
Electrical Maintenance Design & Costing (ELPEC604A)			
Course Code :	ELPEC604A	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination Practical or Activity based Evaluation	External	60

Prerequisite:

1. Basic concepts of Electrical Engineering
2. Fundamentals of Electrical Machines

Course Objective:	
1	Equip students with comprehensive knowledge of maintenance strategies, condition monitoring techniques, and advanced tools for ensuring optimal performance and reliability of electrical equipment
2	To familiarize students with the necessity, types, testing methods, and design principles of earthing systems, ensuring safety and reliability in electrical installations
3	To provide students with an in-depth understanding of substations, including their classification, equipment, and bus bar arrangements.
4	To impart knowledge on the purpose of estimating, qualities of estimators, essential elements of estimating, and tendering guidelines.
5	To equip students with the skills to design domestic and residential wiring systems, covering electrical installations costing.
6	To impart skills in designing and costing small industrial and commercial wiring systems.

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Course Outcomes : Upon successful completion of this course, the students will be able to:	
604A.1	Implement various maintenance strategies, conduct condition monitoring using advanced tools, and perform testing and fault location methods for electrical equipment.
604A.2	Conduct earth resistance testing, and design substation earthing grids in accordance with IEEE standard 80-2000.
604A.3	Classify substations, identify and describe various substation equipment with specifications.
604A.4	State the significance of estimating and costing and demonstrate qualities of a competent estimator.
604A.5	Design efficient electrical installations for buildings and estimate internal wiring requirements.
604A.6	Design wiring systems for small industrial and commercial settin and effectively design control panels.

Unit 01	:	Maintenance and Condition Monitoring	(06 Hrs)
Importance and necessity of maintenance, different maintenance strategies, Insulation stressing factors, Insulation deterioration, polarization index, dielectric absorption ratio. Concept of condition monitoring of electrical equipment. Advance tools and techniques of condition monitoring, Thermography, Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods - Vibration Signature Analysis, Motor Current Signature Analysis. Testing of Power cables - Causes of cable failure, fault location methods and Remedial actions.			

Unit 02	:	Earthing	(06 Hrs)
Earthing: Necessity of Earthing, Types of earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation earthing grid as per IEEE standard 80 - 2000.			

Unit 03	:	Substation	(06 Hrs)
Substation: Classification of substations, Various equipment's used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.			

Unit 04	:	**Elements of Estimating and concepts of contracting**	**(06 Hrs)**
Purpose of estimating and costing, qualities of good estimator, essential elements of estimating and costing, tender, guidelines for inviting tenders, quotation,			
Unit 05	:	**Design and costing of domestic and residential wiring**	**(06 Hrs)**
Electrical installation in buildings, control at commencement of supply, capacity of circuit, internal wiring estimates, arrangement of apparatus, selection, rating and installation of necessary equipment on the main switch board.			
Unit 06	:	**Design and costing Of Small Industrial and commercial wiring**	**(06 Hrs)**
Wiring of motors, internal wiring estimates, important guidelines about power wiring in small industries, control panels.			
Industrial Visit : Visit to any substation			
Text Books:			
[T1]	Surjit Singh, Electrical Estimation and Costing, Dhanpat Rai and company, New Delhi.		
[T2]	S. L. Uppal, Electrical Wiring and Costing Estimation, Khanna Publishers, New Delhi		
[T3]	B. R. Gupta- Power System Analysis and Design, 3rd edition, Wheelers publication		
[T4]	S. K. Shastri - Preventive Maintenance of Electrical Apparatus - Katson Publication House.		
[T5]	J B Gupta A course in Electrical Installation, Estimating and costing S K Kataria and Sons		
Reference Books:			
[R1]	Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi		
[R2]	B.D. Arora-Electrical Wiring, Estimation and Costing,- New Heights, New Delhi.		
[R3]	M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.		
IS/IEEE Standards:			
[R4]	IS : 900:1992 - Code of practice for installation and maintenance of Induction Motors.		

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[R5]	IEEE 80:2000 – IEEE Guide for Safety in AC Substation Grounding.
[R6]	IEEE 142 Guide for Earthing
[R7]	IS: 4029 – Testing of 3 Phase Induction Motor
[R8]	IS : 2026 – Power Transformer, IS : 1180 – Distribution Transformer.

Third Year B.Tech.			
Electric Drives (ELPEC604B)			
Course Code :	ELPEC604B	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination Practical or Activity based Evaluation	External	**60**

Prerequisite:

1. Construction, working and characteristics of different electrical motors.
2. Power Electronic Applications such as converter, inverter, chopper etc.
3. Basic concept of control system.

Course Objective:	
1.	To study the stable steady-state operation and transient dynamics of a motor-load system.
2.	To study and analyze the operation of the converter, chopper fed dc drive.
3.	To study the operation of both classical and modern induction motor drives.
4.	To study vector control for induction drives.
5.	To study and analyze the operation of Permanent magnet synchronous machine (PMSM) and Brushless DC Motor (BLDC) drives.
6.	To study classes and duty cycles of motors and select suitable drives in various industrial applications.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
604B.1	Reproduce motor load dynamics and multi quadrant operation of Drives
604B.2	Analyse the operation of the converter, chopper fed dc drive.
604B.3	Analyse the operation of both classical and modern induction motor drives.
604B.4	Elaborate vector control for induction drives.
604B.5	Elaborate synchronous motor, reluctance motor drive.
604B.6	Differentiate between classes and duty cycles of motors and select suitable drives in various industrial applications

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Unit 01	:	Electric Drives	(06 Hrs)
Basics of Electric Drives and Control- Definition, Advantages of electrical drives, Components of Electric drive system, Selection Factors, status of Electrical Drives (DC & AC), fundamental torque equation, speed torques characteristics DC motor & Induction motor, multi quadrant operation of the drive, classification of mechanical load torques, steady state stability of the drive, constant torque and constant HP operation of the drive.			
Unit 02	**:**	**DC motor drives**	**(06 Hrs)**
Methods of speed control, starting and breaking operation, single phase and three phase full controlled and half controlled converter fed DC drives, dual converter fed DC drives, circulating and non – circulating mode of operation, chopper control of DC shunt and series motor drives.			
Unit 03	**:**	**Induction motor drives**	**(06 Hrs)**
Principles of speed control, starting and speed control methods, Torque-Slip characteristic, Variable voltage operation, Variable frequency operation, Constant flux operation, Constant Torque and Constant power operation, Implementation of V/f control with slip compensation scheme, closed loop control of induction motor drives.			
Unit 04	**:**	**Speed Control of Induction Motor**	**(06 Hrs)**
Speed control of VSI and CSI fed drives. Closed loop control schemes - dynamic and regenerative braking - speed reversal, Regenerative braking and multi quadrant operation of Induction motor drives. Principle of vector control, Block diagram of Vector control of induction motor.			
Unit 05	**:**	**Special Machine Drives**	**(06 Hrs)**
Synchronous motor types, operation with fixed frequency, variable speed drives, open loop and closed loop speed control of Permanent magnet synchronous machine. Permanent Magnet Brushless DC Motor Drive: Half Wave drives, Sensor less control. Switched reluctance motor drives- torque equation, converter circuits, operating modes and applications.			

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Unit 06	:	Drive Selection and Industrial Applications	(06 Hrs)

Drive Selection: Selection criteria of motors, motor duties, inverter duty motors. Load diagram, Heating and cooling, Thermal Resistance, determination of HP rating of motor based on duty cycle

Industrial Applications: Process/operation – Requirements of load – Suitable Drive – Advantages in following applications: 1) Rolling mills 2) Centrifuged Pump, 3) Traction drives

4) Aeronautic applications 5) Electric and Hybrid Vehicle 9) Solar Pumps

Text Books:

[T1]	"Fundamentals of Electrical Drives", G. K. Dubey, Narosa publication, 2nd edition
[T2]	"Modern Power Electronics and AC drives" by B. K. Bose, Prentice Hall of India Pvt. India
[T3]	"Electrical Drives - Concept and application" Vedam Subramanyam, Tata Mc-Graw Hill (An imprint of Elsevier).
[T4]	P. C. Sen, "Principles of Electric Machines and Power Electronics ", John Wiley and Sons Publication, second edition 1997
[T5]	"Power Electronics - Converter application" By N. Mohan T.M. undeland and W. P. Robbins, John Wiely and sons.

Reference Books:

[R1]	"Electrical motor and drives: Fundamental, types and applications" By Austin Huges, Heinemann Newnes, London
[R2]	"Power Electronics -Circuits, devices and Applications" By M. H. Rashid, 3rdEdition, PHI Pub. 2004.
[R3]	"Practical Variable Speed Drives and Power Electronics", By Malcolm Barnes, Elsevier Newnes Publications
[R4]	"Electric Motor Drives – Modeling Analysis and Control" By R. Krishnan, PHI India

Third Year B.Tech.			
Modern Control Engineering (ELPEC605A)			
Course Code :	ELPEC605A	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite:

1. Matrix algebra, Root locus, Bode plot.

Course Objective:	
1.	To introduce the concept of state and able to represent a system in the state space format
2.	To demonstrate the design of control system using state space techniques.
3.	To explain with various nonlinearities and stability analysis.
4.	To explain the concept of compensation and it's design.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
605A.1	Represent physical system using state space representation
605A.2	Analyse a physical system in state space format.
605A.3	Determine the stability of the system in state space.
605A.4	Explain the various nonlinearities in a physical system.
605A.5	Design appropriate compensator for the physical system in time and frequency domain

Unit 01	:	**Introduction to state space**	**(06 Hrs)**
Definitions – state, state variable, state vector, state space, state equation, output equation. State space representation for electrical network, nth order differential equation, and transfer function. Conversion of transfer functions to state model and vice versa.			

Unit 02	:	**State space analysis**	**(06 Hrs)**
Concept of diagonalization, eigen values, eigenvectors, diagonalization of system matrices with distinct and repeated eigen values, Vander Monde matrix. Solution of homogeneous and non-homogeneous state equation in standard form, state transition matrix (STM), its properties, Evaluation of STM using Laplace transform method, infinite series method and Cayley Hamilton Theorem			
Unit 03	:	**Control system design using State Space**	**(06 Hrs)**
Concept of controllability and observability, controllability and observability Tests, condition for controllability and observability from the system matrices in Canonical form, Jordan canonical form, effect of pole zero cancellation on the controllability and observability of the system, duality property. Pole placement design by state variable feedback. Necessity of an observer, design of full order observer.			
Unit 04	:	**Nonlinear control system analysis**	**(06 Hrs)**
Introduction, classification, some common types of non-linearities such as saturation, deadzone, backlash, friction and relays, Jump resonance, Limit cycle, Describing function method, Phase plane technique, Stability analysis of using phase plane and describing methods for Ideal Relay.			
Unit 05	:	**Compensation Techniques and Design of controller in time domain**	**(06 Hrs)**
Lead, Lag and Lag-lead compensators and their role in improvement of system behaviour, Design of controller with root locus: improvement of steady state and transient response with lead, lag, lead lag compensator design.			
Unit 06	:	**Design of controller in time and frequency domain**	**(06 Hrs)**
Design of controller with bode plot: improvement of steady state and transient response with lead, lag, lead lag compensator design.			

Text Books:

[T1]	I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th edition, 2007.
[T2]	Benjamin C. Kuo, "Automatic Control Engineering", Prentice Hall of India Pvt. Ltd.

[T3]	Ajit K.Madal, "Introduction to Control Engineering: Modeling, Analysis and Design" New Age Internationa
[T4]	Hasan Saeed,"Automatic Control System",S.K.Kataria &Sons.
[T5]	Norman Nise ,"Control system Engineering", John-Willey (3rd edition,),2000.
Reference Books:	
[R1]	K. Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd.
[R2]	M. Gopal, "Digital Control and State Variable Methods", Tata McGraw-Hill.
[R3]	Bijnan Bandyopadhyay, "Control Engineering – Theory and Practice", Prentice Hall of India Ltd. Delhi
[R4]	Norman Nise ,"Control system Engineering", John-Willey (3rd edition,),2000.

Third Year B.Tech.			
Restructuring & Deregulation (ELPEC605B)			
Course Code :	ELPEC605B	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Prerequisite:

1. Basics of Power Systems

Course Objective:	
1.	Give brief introductions about the various institutions and their roles in the Indian Power sector and introduce the restructured power system.
2.	Introduce Fundamentals of Power Sector economics.
3.	Educate about the process and operation of restructuring of power systems and tariff setting principles.
4.	Explain Power Sector Restructuring Models and to introduction concept of energy trading.
5.	Introduce the concept of electricity markets and various operations involved in the market.
6.	Explain the fundamental concept of congestion, its management and transmission pricing and concept of transmission pricing.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
605B.1	Identify the various institutions in the Indian power sector and explain their role in the Indian power sector.
605B.2	Explain the various fundamentals of power sector economics.
605B.3	Describe the regulatory process in India and list the steps involved in tariff determination and explain the phases of tariff determination.
605B.4	Describe and explain different power sector restructuring models and explain the concept of energy trading.
605B.5	Explain the types of electricity markets and compare the types of electricity markets.
605B.6	State different transmission pricing methods and describe and compare various congestion management methods.

Unit 01	:	Power Sector in India	(06 Hrs)
Introduction to various institutions in the Indian Power sector such as the Ministry of Power, MNRE, CEA, Planning Commissions, PGCIL, PFC, CERC, SERC, Load dispatch centers (National, regional and state) and their roles. Critical issues / challenges before the Indian power sector, Need of regulation and deregulation of the power industry. Conditions favoring deregulation in the power sector. An overview of the restructured power system, Difference between integrated power system and restructured power system.			
Unit 02	**:**	**Fundamentals of Power Sector Economics**	**(06 Hrs)**
Introduction, Consumer behaviour, Supplier behaviour, Short-run and Long-run costs, Various costs of production, Relationship between short-run and long-run average costs, Typical cost components and cost structure of the power sector, Concept of life cycle cost, annual rate of return. Elasticity of demand and BE Electrical (2019 Course) 57 supply curve, Market equilibrium, Consumer and supplier surplus. Perfectly competitive market. Key Indices for assessment of utility performances. (Generation, transmission and distribution).Financial tools to compare investment option			
Unit 03	**:**	**Power Sector Regulation**	**(06 Hrs)**
Regulatory process in India, types and methods of Regulation - rate of return regulation, benchmarking or yardstick regulation, performance-based regulation. Role of regulatory commission. Considerations of socio-economic aspects in regulation. Principles of Tariff setting, Phases of Tariff determination. Consumer tariff structures and considerations, different consumer categories. Comparison of different tariff structures for different load patterns. The Electricity Act 2003, The Electricity Act 2010, National Electricity policy. Recently Amended Electrical policy.			
Unit 04	**:**	**Introduction to Power Sector Restructuring Models and Introduction to energy trading**	**(06 Hrs)**
Introduction, models based on energy trading or structural models – monopoly, single buyer, wholesale competition, retail competition. Models based on contractual arrangements – pool model, bilateral dispatch, pool and bilateral trades, multilateral trades, ownership models, ISO models. Introduction to energy exchange, Day ahead market (DAM) and Term ahead market (TAM), procedure adopted in energy exchanges and trading of Renewable energy credits and carbon credits.			

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Unit 05	:	Electricity markets	(06 Hrs)
Rules that govern electricity markets, peculiarity of electricity as a commodity. Various electricity markets such as spot markets, forward contracts and forward markets, future contracts and future markets, day ahead market, reserve market, ancillary services market, market for differences, Options contracts. Market operation- settlement process, Market Clearing Price (MCP), Market efficiency, Market power.			
Unit 06	**:**	**Transmission Pricing and Congestion Management**	**(06 Hrs)**
Cost components of transmission system, cost allocation of transmission system, Transmission pricing methods, physical transmission rights, Open access. Congestion in power networks, reasons for congestion, congestion management methods. Non-market methods, Market based methods. Definition of terms - Total transfer capability (TTC), Available transfer capability (ATC), Transmission Reliability Margin (TRM), Capacity Benefit Margin (CBM), Existing Transmission Commitments (ETC). Locational marginal Pricing (LMR), Firm Transmission Right (FTR)			

Text Books:

[T1]	Know Your Power: A citizen Primer on the electricity Sector, Prayas Energy Group, Pune
[T2]	Daniel S. Kirschen, Goran Strbac, "Power System Economics" John Wiely and Sons Publication Ltd. August 2006.
[T3]	Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured Electrical Power Systems: Operation Trading and Volatility" CRC Press, 06-Jun-2001

Reference Books:

[R1]	Steven Stoft, "Power System Economics: Designing Markets for Electricity", John Wiley and Sons, 2002
[R2]	Sally Hunt, "Making Competition Work in Electricity", 2002, John Wiley Inc
[R3]	Geoffrey Rothwell, Tomas Gomez, "Electricity Economics Regulation and Deregulation" A John Wiley and Sons Publication 2003
[R4]	Mohammad Shahidehpour, Hatim Yamin, Zuyi Li, "Market operations in Electric Power System" A John Wiley and Sons Publication

Third Year B.Tech.			
HVDC and FACTS (ELPEC605C)			
Course Code :	ELPEC605C	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite:
1. The student should have a basic knowledge of electrical power transmission systems.

Course Objective:	
1.	To develop understanding of modern trends in power transmission.
2.	To make students describe the operation of HVDC System and Control.
3.	To make students describe applications of power electronics in the control of power transmission.
4.	To understand fundamentals of FACTS Controllers.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
605C.1	Choose a proper FACTS controller for the specific application based on system requirements.
605C.2	Analyze shunt, series, and combined controllers to explore different benefits.
605C.3	Compare EHVAC and HVDC systems and to describe various types of DC links.
605C.4	Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems.

Unit 01	:	**Fundamental Concepts of HVDC**	**(06 Hrs)**
Introduction of DC Power transmission technology – Historical preview, Comparison of AC and DC transmission, Application and Description of DC transmission system, Planning for HVDC transmission, Modern trends in DC transmission, Types of HVDC Systems, Case Study on installation and commissioning of HVDC Project .			
Unit 02	:	**Converters in HVDC**	**(06 Hrs)**
Pulse Number-Choice of converter configuration, simplified analysis of Gratez circuit, 12-pulse converter based HVDC systems and their characteristics, Control of Converters.			
Unit 03	:	**Power Quality issues in HVDC**	**(06 Hrs)**
Harmonics– Generation of Harmonics, Design of AC filters and DC filters, HVDC light and HVDC PLUS (Power Universal Link), Series and Parallel operation of converters. Other Power Quality issues such as Over voltages, Under voltages, Sags and Swells, Flicker, Transients, interruptions.			
Unit 04	:	**Basic concepts of FACTS**	**(06 Hrs)**
The concept of flexible AC transmission – reactive power control in electrical power transmission lines, uncompensated transmission lines, Introduction to FACTS devices and its importance in transmission Network, Introduction to basic types of FACTS controllers, Comparison of HVDC and FACTS.			
Unit 05	:	**Shunt and Series Compensation**	**(06 Hrs)**
Principles of series and shunt compensation, description of static var compensators (SVC), thyristor controlled series compensators (TCSC), static phase shifters (SPS), static synchronous series compensator (SSSC), STATCOM.			
Unit 06	:	**Hybrid FACT Controllers**	**(06 Hrs)**
Unified Power Flow Controller (UPFC) – Principle of operation, modes of operation, applications, IPFC, Modeling and analysis of FACTS Controllers.			
Industrial Visit :			
1. One day industrial visit at HVDC substation such as 500 kV HVDC substation, Padghe/ Chandrapur. 2. One day industrial visit at SVC/STATCOM manufacturing plant.			

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Text Books:	
[T1]	K.R. Padiyar, "HVDC Power Transmission System", Wiley Eastern Limited, New Delhi, First Edition 1990.
[T2]	T.J.E. Miller, "Reactive Power Control in Electrical System", John Wiley and Sons, New York, 1982.
[T3]	N.G. Hingorani, "Understanding FACTS: Concepts and Technology of FACTS Systems", IEEE Press, 2000.
[T4]	K.R. Padiyar" FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
[T5]	A.T. John, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE) 1999.
Reference Books:	
[R1]	J.Arrillaga, " High Voltage Direct Current Transmission", Peter Pregnnus, London 1983.
[R2]	Edward Wilson Kimbark," Direct Current Transmission", Vol.1 iley Interscience, New York, London Sydney 1971.
[R3]	Colin Adamson and N.G.Hingorani ," High Voltage Direct Current Power Transmission", Garraay Limited, London 1960.
[R4]	Narin G. Hingorani, "Power Electronics in Electric Utilities: Role of Power Electronics in Future power systems", Proc. of IEEE, Vol.76, no.4, April 1988.
[R5]	Einar V. Larsen, Juan J. Sanchez-Gasca, Joe H. Chow, "Concepts for design of FACTS Controllers to damp power swings", IEEE Trans On Power Systems, Vol.10, No.2, May 1995.
[R6]	Gyugyi L., "Unified power flow control concept for flexible AC transmission", IEEE Proc-C Vol.139, No.4, July 1992.

Third Year B.Tech.			
Sustainable Engineering (ELPEC605D)			
Course Code :	ELPEC605D	**Credit :**	03
Contact Hours :	3 Hrs./week (L)	**Type of Course :**	Lecture
Examination Scheme :	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	40
2.	End-sem. Examination	External	60

Prerequisite:
1. Basics of electrical engineering. 2. Fundamentals of power system engineering

Course Objective:	
1.	To elaborate the concept of sustainability and different sustainable practices.
2.	To explain the different types of environmental pollutions and various environmental standards and regulations to prevent pollution.
3.	To introduce the different policies related to energy.
4.	To elaborate the concept of conventional and non-conventional energy sources.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
605D.1	Explain the concept of sustainability and the global initiatives in this direction.
605D.2	Explain the different types of environmental pollution problems and their sustainable solutions.
605D.3	Describe the various environmental management standards and regulations.
605D.4	Describe the concepts related to conventional and non-conventional energy
605D.5	Follow the sustainable practices.
605D.6	Describe and summarize the various energy policies.

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Unit 01	:	Sustainability	(06 Hrs)
Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM)			
Unit 02	**:**	**Environmental Pollution**	**(06 Hrs)**
Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.			
Unit 03	**:**	**Environmental management standards**	**(06 Hrs)**
ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.			
Unit 04	**:**	**Resources and its utilization**	**(06 Hrs)**
Basic concepts of Conventional and non-conventional energy Energy generation from Solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.			
Unit 05	**:**	**Sustainability practices**	**(06 Hrs)**
Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.			
Unit 06	**:**	**Energy Policy**	**(06 Hrs)**
Review of Energy policies of developed and undeveloped countries, Indian Energy Policy, Renewable Energy Policy and Programmes, Review of State Energy Policies and Programmes in India. Summarize the various policies.			

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Text Books:	
[T1]	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall. 2. 3. 4. 5. 6.. 7. 8.
[T2]	Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
[T3]	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
[T4]	Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
[T5]	Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication
Reference Books:	
[R1]	Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional
[R2]	ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
[R3]	Environment Impact Assessment Guidelines, Notification of Government of India, 2006

Third Year B.Tech.			
Electric Vehicle (ELVSE606)			
Course Code :	ELVSE606	**Credit :**	03
Contact Hours :	1 Hr./week (L) 4 Hrs./week (P)	**Type of Course :**	Lecture Practical
Examination Scheme :	Termwork 50 Marks	Practical 50 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Termwork Evaluation	Internal	50
2.	Practical Examination	External	50

Prerequisite:
1. Basic concept of Batteries, Electrical motors, Power electronic conversion

Course Objective:	
1.	To introduce electric And Hybrid vehicle.
2.	To explain the procedure EV components design.
3.	To explain battery energy system, different charging levels and battery management system.
4.	To explain the procedure EV components design.
5.	To introduce electric And Hybrid vehicle.
6.	To explain the procedure EV components design.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
606.1	Explain the need for and importance of electric and hybrid vehicle and different types of vehicles.
606.2	Design EV components.
606.3	Describe different charging infrastructures and BMS.
606.4	Explain various recent research in the field of EV Battery Technology

Unit 01	:	**Introduction to Electric and Hybrid vehicle**	**(02 Hrs)**
Need and importance of Electric Vehicle and Hybrid Electric Vehicles,. Hybrid Electric vehicles: Concept and architecture of HEV drive train (Series, parallel and series-parallel). Micro Hybrid, Mild Hybrid, Full Hybrid, Plug-in Hybrid, Electric vehicles			
Unit 02	:	**Energy Storage**	**(02 Hrs)**
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles . Battery specifications, Battery based energy storage and its analysis			
Unit 03	:	**Drives and Charging**	**(02 Hrs)**
PMSM drive and BLDC drive, Sizing of motor, Charging Levels: 01,02 and 03, Charging Standards: CCS, CHAdeMO, SAE J1772, IEC 60309, Bharat DC 001, Bharat AC 001			
Unit 04	:	**Battery Management system**	**(02 Hrs)**
Battery Management System: Functions of BMS, Block diagram of BMS. SoC Estimation methods, Thermal Management of Battery			
Unit 05	:	**EV component design**	**(04 Hrs)**
Criteria for battery selection , Forces on EV calculation, Power for EV calculation, Sizing the Power Converter, Sizing of Electric Machine for EVs and HEVs, Motor Torque Calculation, BLDC motor control, Battery pack design			

List of Experiments :

Any **eight experiments** are to be performed from following list.

(Maintain Record in file or separate notebook)

1. Study & Demonstration of various systems used in electric vehicle.
2. Study of various components of electric vehicle.
3. Analysis of different motors used in electric vehicle.
4. Study and Demonstration of Battery Voltage Measurement Methods.
5. Survey of Batteries used for electric vehicles on road.

6. Battery pack design for given EV application (Testing Various series parallel combinations for given application).
7. Study of battery testing standards.
8. Estimation of power rating of traction motor for different gradeability by using software.
9. Estimation of power rating of traction motor for maximum vehicle speed by using software.
10. Simulation of EV Power Train by using MATLAB/ Simulink.
11. Case study on recent research in the field of EV propulsion system.
12. Case study on challenges & future scope of electric vehicle.
13. Case study on recent research in the field of EV Battery Technology.
14. Sizing of power converter.

Text Books:

[T1]	Iqbal Hussain, "Electric & Hybrid Vehicles - Design Fundamentals", Second Edition, CRC Press, 2011
[T2]	James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.

Reference Books:

[R1]	Modem Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals,Theory, and Design, Mehrdad Ehsaniand Yimin Gao, Power Electronics and application series
[R2]	Build Your Own Electric Vehicle, Seth Leitman arid Bob Brant
[R3]	Electric and Hybrid Vehicles: DesignFundamentals, Iqbal Husain, CRC Press, 2003
[R4]	Fundamental of vehicle dynamics, Thomas D Gillipse, Society of Automotive Engineers, second edition
[R5]	James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
[R6]	Gregory L. Plett, Battery Management Systems, Volume I: Battery Modeling, Artech House, London
[R7]	Gregory L. Plett, Battery Management Systems Volume II, Equivalent-Circuit Methods, Artech House, London

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Third Year B.Tech.			
Switch Gear and Protection Lab (ELPCC607)			
Course Code :	ELPCC607	**Credit :**	01
Contact Hours :	2 Hrs./week (L)	**Type of Course :**	Practical
Examination Scheme :	Termwork 25 Marks	Oral 25 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Termwork Evaluation	Internal	25
2.	Oral Examination	External	25

Course Objective:	
1.	To explain the need, qualities, principles and basic terminology in switchgear and protection.
2.	To make students able to draw, identify, specify, and familiarize with various LT & HT switchgears.
3.	To explain testing of various switchgears to find characteristics and select ratings of switchgears.
4.	To explain selection of different protective schemes for transformers, alternators and transmission lines.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
607.1	Use the switchgear testing kit to showcase practical demonstrations.
607.2	Demonstrate the testing of MCB, ACB and contactors.
607.3	Understand the fundamentals and testing of protective relaying.
607.4	Apply the differential protection scheme to transformers, alternators, and induction motors.
607.5	Apply distance protection for transmission line.

List of Experiments:

Any **eight experiments** are to be performed out of following list :

1. Drawing sheet-showing construction of Circuit Breakers. Single Line Diagram of Substation.
2. Study of switchgear testing kit.
3. Study and testing of Fuse, MCB and MCCB
4. Study of various LT switchgears like RCCB, timers
5. Study and testing of contactors.
6. Study and testing of ACB.
7. Study and testing of thermal overload relay for Induction Motor protection.
8. Study and plot Characteristics of IDMT type Induction over current relay
9. Study and plot Characteristics of digital over current relay.
10. Percentage differential protection of transformer.
11. Protection of alternator.
12. Protection of Transmission line using Impedance relay.
13. Study of bus-bar protection schemes.

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Third Year B.Tech.			
Power System Operation & Control Lab (ELPCC608)			
Course Code :	ELPCC608	**Credit :**	01
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Oral 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Oral Examination	External	25

Prerequisite:

1. Basics of Power System

Course Objective:	
1	To develop ability to analyze and use various methods to improve stability of power systems
2	To understand the need for generation and control of reactive power & impart knowledge about various advanced controllers such as FACTs controllers.
3	To illustrate the automatic frequency and voltage control strategies and analyze the effects, knowing the necessity of generation control.
4	To understand formulation of unit commitment and economic load dispatch tasks and solve it using optimization techniques & to illustrate various ways of interchange of power between interconnected utilities.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
608.1	Identify and analyze the dynamics of power system and suggest means to improve stability of system.
608.2	Understand the effect of reactive power on Power system and suggest the suitable means of reactive power management & selection of appropriate FACTs devices
608.3	Analyze the generation-load balance in real time operation and its effect on frequency and develop automatic control strategies with mathematical relations.
608.4	Formulate objective functions for optimization tasks such as unit commitment and economic load dispatch and get solution using computational techniques.

List of Experiments:

Any **eight experiments** are to be performed out of following list :

1. To determine Steady state stability of medium transmission line
2. To plot swing curve by Point by Point method for transient stability analysis
3. To apply equal area criteria for analysis stability under sudden rise in mechanical input.
4. To study reactive power compensation using simulation of TCR or TCSC.
5. To study reactive power compensation using any device.
6. To study Lagrange multiplier technique for economic load dispatch
7. To develop dynamic programming method for unit commitment.
8. To solve the Unit Commitment problem by priority list method/ dynamic programming (DP) approach
9. To study load frequency control using approximate and exact model.
10. To study load frequency control with integral control.
11. To study the two area of load frequency control.
12. To study the optimum loading of generators considering transmission losses (penalty factor).

Third Year B.Tech.			
Electrical Maintenance Design & Costing Lab (ELPEC609A)			
Course Code :	ELPEC609A	**Credit :**	**01**
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Prerequisite:
1. Basics of Power System

Course Objective:	
1	To discuss the dielectric properties of insulation materials and their significance in electrical equipment.
2	To teach the measurement techniques for insulation resistance in motors using MTR 105 instrument.
3	To explain how to analyze thermograph images for identifying potential faults in electrical systems.
4	To provide hands-on experience in the construction, operation, and troubleshooting of household electrical equipment.
5	To introduce troubleshooting of household equipment using Portable Appliance Tester (PAT 420).
6	To explain measurement of the Earth resistance of the campus premises and understand its importance in electrical safety.
7	To explain designing an earthing grid for a 132/220 kV substation considering safety and efficiency.
8	To explain design, estimate, and cost residential wiring systems ensuring compliance with safety standards and regulations.
9	To discuss troubleshooting techniques for electrical equipment through actual visits to repair workshops, focusing on three-phase induction motors and transformers.

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Course Outcomes : Upon successful completion of this course, the students will be able to:	
609A.1	Measure Dielectric Absorption Ratio and Polarization Index of insulation.
609A.2	Achieve proficiency in using MTR 105 for measuring insulation resistance in motors.
609A.3	Analyze thermograph images and identifying potential faults.
609A.4	Hands-on skills in constructing, operating, and troubleshooting household electrical equipment.
609A.5	Achieve proficiency in troubleshooting household equipment using PAT 420.
609A.6	Measure Earth resistance and understanding its significance.
609A.7	Design an earthing grid for a substation considering various factors.
609A.8	Design residential wiring systems, estimate costs, and ensure compliance with regulations.
609A.9	Practically apply troubleshooting techniques for electrical equipment, particularly three-phase induction motors and transformers, through real-world visits to repair workshops.

List of Experiments:

1. Measurement of Dielectric Absorption Ratio and Polarization Index of insulation
2. Measurement of insulation resistance of motors using MTR 105
3. Study of thermograph images and analysis based on these images
4. Construction, working and troubleshooting of any two household Electrical equipments (Fan, Mixer, Electric Iron, Washing Machines, Electric Oven, Microwave - Limited to electrical faults)
5. Troubleshooting of household equipment using PAT 420
6. Measurement of Earth resistance of Campus premises.
7. Design of earthing grid for 132/220 kV substation
8. Residential wiring design, estimation and costing.
9. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (Any One).i) Three phase induction motor ii) Transformer

Third Year B.Tech.			
Electrical Drives Lab (ELPEC609B)			
Course Code :	ELPEC609B	**Credit :**	**01**
Contact Hours :	2 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Prerequisite:
1. Construction, working and characteristic of different electrical motors.
2. Power Electronic Applications such as converter, inverter, chopper etc.
3. Basic concept of control system.

Course Objective:	
1	To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics
2	To study the operation of the converter, chopper fed dc drive.
3	To study the operation of classical and modern induction motor drives.
4	To evaluate the use of computer-based analysis tools to review the major classes of machines and their physical basis for operation.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
609B.1	Identify relevant information to supplement to the Electric Drives course.
609B.2	Set up control strategies to synthesize the voltages in dc and ac motor drives.
609B.3	Develop testing and experimental procedures applying basic knowledge in electronics, electrical circuit analysis, and electrical machines.
609B.4	Develop an ability to use standard methods to determine accurate simulation parameters for various general purpose electrical machines and power electronics devices required for designing a system.
609B.5	Combine the use of computer based simulation tools relevant to electrical Drives with practical laboratory experimentation.

List of Experiments:

Compulsory experiments:

1. Study of Electrical braking of D.C. Shunt motor (Rheostatic, Plugging).
2. Study speed control characteristics of single phase fully converter fed separately excited D.C. motor
3. Study of Chopper fed D.C. series/separately motor speed control characteristics.
4. Study of electrical braking of 3 phases Induction Motor (DC Dynamic Braking, Plugging).
5. Study of VSI fed 3 phase Induction motor (using V/f control PWM inverter) speed control
   Characteristics.

Any three experiments are to be performed out of following:

1. Simulation of starting characteristics of D.C. / 3 phase Induction motor.
2. Study of Closed loop speed control of separately excited D.C. motor/ Induction Motor.
3. Study of Closed loop speed control of Permanent Magnet Synchronous Motor.
4. Simulation of an electric drive system for steady state and transient analysis.
5. Simulation/programming of controller design of Permanent Magnet Synchronous Motor /Brushless DC motor

Computer Usage / Lab Tool: Simulation on Matlab.

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Third Year B.Tech.			
Mini Project (ELELC610)			
Course Code :	ELELC610	**Credit :**	02
Contact Hours :	4 Hrs./week (P)	**Type of Course :**	Practical
Examination Scheme :	Oral Examination 50 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Oral Examination	External	50

Prerequisite:
1. Basics of Electrical Engineering

Course Objective:	
1.	To acquire the skills of electrical and electronic circuit design and assembly.
2.	To develop the skills of analysis and fault diagnosis of the electrical and electronic circuit as per design.
3.	To test the electrical and electronic circuit assembly.
4.	To develop student's abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
610.1	Understand the basics concepts used in Mini Project.
610.2	Analyze and infer the reference literature critically and efficiently.
610.3	Constructing the model of the project.
610.4	Evaluate the performance of the project.
610.5	Write and present the report of the project.
610.6	Understand the basics concepts used in Mini Project.

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Course Contents:

1. Visit to a local industry for the study of problems of industry.
2. Prepare the problem-based hardware Mini project.
3. Prepare a report on the same.

Report writing

A project report with following contents shall be prepared:

- Title
- Specifications
- Block diagram
- Circuit diagram
- Selection of components, calculations
- Testing procedures
- Enclosure design
- Results
- Conclusion
- References

Third Year B.Tech.			
Audit Course-6 Foreign Language German Level II (IOHSM6ACA)			
Course Code :	IOHSM6ACA	**Credit :**	01
Contact Hours :	1 Hr./week (L)	**Type of Course :**	Lecture
Examination Scheme :	Term Work 25 Marks	**Examination Scheme :**	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Course Objective:	
1	To get introduced to the Culture, Routine of the German Society through language.
2	To meet the needs of ever growing German industry with respect to language support.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
6ACA.1	Develop reading, writing and listening skills.
6ACA.2	Use tenses in German Language.
6ACA.3	Develop interest to pursue a German language course.
6ACA.4	Get a comprehensive understanding of basic German Language and build a good enough vocabulary to articulate themselves in any given daily life situation.

Unit 01	:	**Introduction of Cases**	(06 Hrs)
Introduction of Cases: Nominative, Akkusative, Personal & Possessive Pronouns in Nominative, Akkusative.			
Unit 02	:	**Prepositions and Tenses**	(06 Hrs)
Prepositions:- Akkusative Tenses:- Past tense of sein & haben Verbs . Simple sentences and questions using vocabulary. Formal and informal conversations.			

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Text Books:	
[T1]	"Netzwerk A-1 (Deutsch als Fremdsprache) " Goyal Publishers & Distributors Pvt. Ltd
Reference Books:	
[R1]	Tipps und Uebungen A1

Online Resources:

1. Practice Material like online Worksheets regarding the Grammar.
2. NPTEL Course On German -II Language
3. Online German-English dictionary www.leo.org

Third Year B.Tech.			
Audit Course 6 – Foreign Language Japanese Level - II (IOHSM5ACB)			
Course Code :	IOHSM5ACB	**Credit :**	01
Contact Hours :	1 Hr./week (L)	**Type of Course :**	Lecture
Examination Scheme :	Term Work 25 Marks		

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term Work Evaluation	Internal	25

Course Objective:	
1	To understand the basics of the Japanese writing system, including Kanji characters.
2	To indicate an action or motion in progress, describe habitual actions, and express permission and prohibition.

Course Outcomes : Upon successful completion of this course, the students will be able to:	
5ACB.1	Demonstrate basic communication skills.
5ACB.2	Describe their daily routines in Japanese.
5ACB.3	Describe things, people, and places using appropriate adjectives.
5ACB.4	Express the existence or presence of a thing or a person in different contexts.

Unit 01	:	Kanji Basics	(06 Hrs)
Introduction to Kanji Script, Describing one's daily routine. To ask what someone does. Expressions of Giving & Receiving. Adjectives (Types of adjectives) Asking for an impression or an opinion about a thing / person / place that the listener has experienced, visited, or met, Describing things / person / places with the help of the adjectives. Expressions of Like & Dislikes. Expressing one 's ability. Talking about one's hobbies. Comparison between objects, persons & cities. Audio Learning			

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Unit 02	:	Spatial, Action and Progressive Basics	(06 Hrs)

Stating existence or a presence of thing (s), person (s) Relative positions,

Introduction to counters - Part II

Expressing one 's Desire & wants, Verb groups, Asking, instructing a person to do something.

Indicating an action or motion is in progress. Describing habitual action Describing a certain continuing state which resulted from a certain action in the past. Express permission & prohibition. Audio Learning

Text Books:

[T1]	Minna No Nihongo, "Japanese for Everyone", Elementary Main Textbook 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd

Reference Books:

[R1]	George Trombley, Yukari Takenaka "Japanese from Zero!" Learn From Zero Publisher

Online Resources:

1. NPTEL Course on "JapaniBhasha –SaralSwaroop (Japanese course taught in Hindi) "
   Link of the Course : https://onlinecourses.nptel.ac.in/noc23_hs76/preview
2. NPTEL Course on "Introduction to Japanese Language and Culture"
   Link of the Course : https://onlinecourses.nptel.ac.in/noc19_hs52/preview