INDUS INSTITUTE OF TECHNOLOGY

AND ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

B.TECH ELECTRICAL ENGINEERING

B.Tech Electrical Engineering Teaching Scheme (Bos 2021)

B. Tech Electrical Engineering : Semester 1

			Teaching Scheme				
Sr. No	Code	Subject Name	L*	T*	P*	Cr	Hrs
1	MA0111	Calculus	3	1	0	4	4
2	CH0011	Engineering Chemistry	3	0	2	4	5
3	EN0111	Technical Communication	1	1	0	2	2
4		Open Elective 1#	2	0	2	3	4
5	ME0219	Engineering Graphics	1	0	4	3	5
6	CV0004	Environmental Science	2	0	0	2	2
7		Open Elective 2#	3	0	0	3	3
		Indian Knowledge System				3	
Total			15	2	8	24	15

B. Tech Electrical Engineering : Semester 2

			Teaching Scheme				
Sr. No	Code	Subject Name	L*	T*	P*	Cr	Hrs
1	MA0211	Differential Equations and Linear Algebra	3	1	0	4	4
2	PH0011	Engineering Physics	3	0	2	4	5
3	EN0211	Business Communication and Presentation skills	1	1	0	2	2
4		Open Elective 3#	3	0	0	3	3
5	EL0117	Workshop Practice (EL/EC/CE/CSE/IT)	0	0	4	2	4
6	EL0220	Elements of Electrical Engineering	3	0	2	4	5
		Indian Science and Technology				1	
Total			13	2	8	20	23

B.Tech Electrical Engineering Teaching Scheme 2019-2022 Batch (Sem III)				
SEMESTER - III (w.e.f. Year 2019-22)				
Sr. No.	CODE	Name of the subject	CREDIT	Teaching Scheme (per week)

				Th.	Tut.	Pr.	Total (hr.)
1	MA0313	Integral Transform & Numerical Analysis	4	3	0	2	5
2	EL0322	Signals & Systems	4	3	1	0	4
3	EL0317	Network Analysis	4	3	1	0	4
4	EL0321	Electrical Machines-I	4	3	0	2	5
5	EL0319	Analog & Digital Logic	4	3	0	2	5
6	SS0301	Human values and Professional Ethics	2	2	0	0	2
9	EL0320	Internship	2				
		TOTAL	24	17	2	6	25

B.Tech Electrical Engineering Teaching Scheme 2019-2022 Batch (Sem IV)							
SEMESTER - IV (w.e.f. Year 2019-22)							
Sr. No.	CODE	Name of the subject	CREDIT	Teaching Scheme (per week)			
				Th.	Tut.	Pr.	Total (hr.)
1	EL0416	Electromagnetics	4	3	1	0	4
2	EL0417	Power System I	4	3	0	2	5
3	EL0426	Electrical Machine II	4	3	0	2	5
4	EL0419	Control Theory	4	3	0	2	5
5	EN0411	Soft skill and Interpersonal communication	2	1	0	2	3
	EL0425	Electrical Measurement	4	3	0	2	5
		TOTAL	22	16	1	10	27

In Sem-IV,OE-IV and OE V is optional, student can opt for the subject to earn extra credit

B.Tech Electrical Engineering Teaching Scheme 2019-2022 Batch (Sem V)
SEMESTER - V (w.e.f. Year 2019-22)

Sr. No.	Category	Name of the subject	CREDIT	Teaching Scheme (per week)			
				Th.	Tut.	Pr.	Total (hr.)
1	EL0516	Power System II	4	3	0	2	5
2	EL0517	Microprocessor & Microcontroller Interfacing	4	3	0	2	5
3	EL0526	Power Electronics	4	3	0	2	5
4	EL0519	Elements of Electrical Design (Elective-I)	4	3	1	0	4
	EL0520	Renewable Energy Sources(Elective-I)					
	EL0525	Optimization Technique (Elective-I)					
		MOOC					
	CE0525	Prog for Scientific Computing	4	3	0	2	5
5	EL0523	(OE-VI)	3	3	0	0	3
6	BB0504	Enterpreneurship Development	2	2	0	0	2
7	EL0524	Internship	2				
		TOTAL	27	20	1	8	29

B.Tech Electrical Engineering Teaching Scheme 2019-2022 Batch (Sem VI)							
SEMESTER - VI (w.e.f. Year 2019-22)							
Sr. No.	Category	Name of the subject	CREDIT	Teaching Scheme (per week)			
				Th.	Tut.	Pr.	Total (hr.)
1	EL0616	Power System Operation & Control	4	3	0	2	5
2	EL0617	Electrical Drives and control (Elective-II)	4	3	0	2	5
	EL0622	Digital Signal Processing(Elective-II)					
	EL0623	Advance Control Theory(Elective-II)					

3*	EL0618	Electrical Power Utilization and Control(Elective-III)	3	3	0	0	3
	EL0624	Testing & Commissioning of Electrical Equipment(Elective-III)					
	EL0620	Energy Management (Elective-III)					
4*	CE0630	Data Science (Elective-IV)	4	3	0	2	5
	CE0622	Internet of Things (Elective-IV)					
	CS0602	Data Preparation & Analysis (Elective-IV)					
5*	EL0630	Electrical Energy Storage System (Elective-V)	3	3	0	0	3
	EL0625	Electric & Hybrid Vehicle (Elective-V)					
	EL0631	Energy Audit (Elective-V)					
6		(OE-VII)	3	3	0	0	3
7		Organizational Behaviour	2	2	0	0	2
		TOTAL	20	20	0	6	23

To select two electives from any two basket

B.Tech Electrical Engineering Teaching Scheme 2019-2022 Batch (Sem VII)							
SEMESTER - VII (w.e.f. Year 2019-22)							
Sr. No.	Category	Name of the subject	CREDIT	Teaching Scheme (per week)			
				Th.	Tut.	Pr.	Total (hr.)
1	EL0716	Switchgear & Protection	4	3	0	2	5
2	EL0717	Electrical Machine Design	4	3	0	2	5
3*	EL0730	Smart Grid (Elective-VI)	3	3	0	0	3
	EL0719	Power System Design(Elective-VI)					
	EL0720	Power System Planning (Elective-VI)					
4*	IT0701	Artificial Intelligence (Elective-VII)	4	3	0	2	5
	EL0722	Industrial Automation (Elective-VII)					
	EL0723	Soft computing Technique (Elective-VII)					

5*	EL0731	Bio Medical Instrumentation (Elective-VIII)	3	3	0	0	3
	EL0718	Advance Power Electronics (Elective-VIII)					
	EL0721	Advanced Micro Controller (Elective-VIII)					
5	EL0727	(OE-VIII)	3	3	0	0	3
6	EL0728	(OE-IX)	3	3	0	0	3
	EL0732	Project Stage-I	5			20	20
8	EL0733	Internship	2				
		TOTAL	23	21	0	26	41

To select two electives from any two basket

B.Tech Electrical Engineering Teaching Scheme 2019-2022 Batch (Sem VIII)							
SEMESTER - VIII(w.e.f. Year 2019-22)							
Sr. No.	Category	Name of the subject	CREDIT	Teaching Scheme (per week)			
				Th.	Tut.	Pr.	Total (hr.)
1	EL0817	Project	12	0	0	30	30

Subject: **Elements of Electrical Engineering**								
Program: **B.Tech All Branches**				Subject Code: EL0220			Semester: **II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	24/60	24/60	16/40	16/40	200

Course Outcome

CO-1: Solve various electric circuits with the help of KCL, KVL and network theorems. [BT-3]

CO-2: Derivation of energy stored, charging and discharging status of capacitor. [BT-6]

CO-3: Analyse different terms related to magnetic circuits and compare the terms with electrical parameters. [BT-4]

CO-4: Analysis of various AC circuits with different combinations of R,L and C components, which will enhance their skill in circuit analysis [BT-4]

CO-5: Discussion on 3-phase AC circuits and Measurement of power and power factor with the help of two wattmeter method. [BT-2,5]

CO-6: Recognize construction, working principles and applications of transformers and machines. [BT-2]

SULLABUS

UNIT-I

[10 hours]

DC Circuits

Elementary Concepts:

Ohm's Law and Kirchhoff's Laws, Analysis of series, parallel and series-parallel circuits; Star–Delta conversion; Nodal analysis, Mesh analysis, voltage sources and current sources, Super position theorem, Thevenin's theorem, Norton's theorem, Equvalence of thevenin's and norton's theorem, Maximum power transfer theorem.

UNIT-II **[12 hours]**

Electrostatics:

Electric charge and Laws of electrostatic, Capacitor; Capacitor in series and parallel, variable capacitor, Instantaneous voltage and current in capacitor, charging and discharging of capacitor, Energy stored in a capacitor, types of capacitor.

Magnetic Circuit:

Magneto motive force, magnetic field strength, reluctance, Relation between magnetic circuit parameter, Laws of magnetic circuit, composite magnetic circuit: series magnetic circuit, parallel magnetic circuit, comparison of Electric and magnetic circuit, Effect of magnetic field on current carrying conductor; Statically and dynamically induced EMF; Concepts of self inductance, mutual inductance, energy stored in inductor, coefficient of coupling; Inductance in series and parallel; Hysteresis and Eddy current losses.

UNIT-III

[16 hours]

Single Phase A.C. Circuits:

Generation of sinusoidal voltage, Definition of average value, root mean square value, form factor and peak factor; Phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, R-L, R-C and R-L-C circuits; Concepts of Real power, Reactive power, Apparent power and Power factor, methods to improve power factor, Series, Parallel and Series - Parallel circuits; Power in AC circuit, Resonance in series and parallel circuits.

Three Phase A.C. Circuits:

Necessity and Advantages of three phase systems, Generation of three phase power, definition of Phase sequence, balanced supply and balanced load; Relationship between line and phase values of balanced star and delta connections; Power in balanced three phase circuits, measurement of power by two wattmeter method; Work, Power, Energy, Problems

UNIT-IV **[10 hours]**

Three Phase A.C. Circuits:

Necessity and Advantages of three phase systems, Generation of three phase power, definition of Phase sequence, balanced supply and balanced load; Relationship between line and phase values of balanced star and delta connections; Power in balanced three phase circuits, measurement of power by two wattmeter method; Work, Power, Energy, Problems

Text Books:

1. A. Chakrabarti, "Basic Electrical Engineering", Tata McGraw Hill, 1st edition, 2009, ISBN: 9780070669037.

2. A.E Fitzgerald, David E. Higginbotham, Arvin Grabel, "Basic Electrical Engineering", Tata McGraw Hill, 5th Edition, 2009, ISBN: 9780070682566.

Reference Books:

1. Vincent Del. Toro (2012), "Principles of Electrical Engineering", Prentice Hall, India

2. Electrical Estimating & Costing by Surjit Singh (Dhanpat Rai & sons).

3. J.N. Swamy, "Elements of Electrical Engineering" Mahajan Publishing House.

4. Nagrath I.J. and D. P. Kothari (2001), "Basic Electrical Engineering", Tata McGraw Hill.

5. Rajendra Prasad (2009), "Fundamentals of Electrical Engineering", Prentice Hall, India

Web Resources:

1. www.nptel.ac.in
2. www.youtube.com

Course Outcome:

1. **Fundamental Engineering Analysis Skill**: Ability to apply knowledge of Electrical Engineering.
2. **Information Retrieval Skills:** Ability to design electrical circuits and conduct experiments with electrical engineering as well as to analyze and interpret data.
3. **Engineering Problem Solving Skills:** Ability to identify, formulate and solve engineering problems.
4. **Practical Engineering Analysis Skills:** Ability to acquire new knowledge to use modern engineering tools and equipment's to analyze problems necessary for engineering practice.

Subject: Analog and Digital Logic								
Program: B.Tech. Electrical Engineering				**Subject Code: EL0319**			**Semester: III**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)-Theory**	**Continuous Internal Evaluation (CIE)-Practical**	**Total**
3	0	2	4	40	40	60	60	200

Course Objective:

1) To provide concepts that underpins the disciplines of Analog circuits, digital electronics and Microprocessor systems.

2) To provide the concept of various components

3) To provide basic knowledge of designing Analog and digital circuits

Course outcomes:

CO-1: Explain the components of analog and digital circuits.[BT-2]

CO-2: Design and Simulate Analog Circuits using OPAMP. [BT-6]

CO-3: Calculate and convert of Binary,Octal, Decimal and hexadecimal number System. [BT-3]

CO-4: Design combinational and sequential circuits to enhance the skill in this area.[BT-6]

CO-5: Apply and translate real world problems into digital logic formulations.[BT-5]

CO-6: Explain concepts of microprocessor and micro controller systems using digital circuits.[BT-2]

SYLLABUS

UNIT-I

[11]

Operational Amplifiers and linear applications: Block diagram representation, Ideal Op-amp, Equivalent circuit, Open-loop configuration, Transfer characteristics. Op-amp with negative feedback, Frequency response. Op-amp IC 741 specifications. Basic op-amp applications: Adder, Scalar, Subtractor, Difference amplifier, I-V converter, V-I converters, Integrator, Differentiator, Instrumentation amplifier using 2 and 3 op-amp stages. IC 555 Timer, Astable, and Monostable Multivibrator

UNIT-II

[10]

Number Systems and Codes: Binary, Octal, Decimal and Hexadecimal number Systems and their conversion, Binary Addition and Subtraction , Gray Code, BCD Code, Excess-3 code, ASCII Code. Boolean Algebra and Logic Gates: Theorems and Properties of Boolean Algebra, Standard SOP and POS form, Reduction of Boolean functions using Algebric method, K -map method (2,3,4 Variable).

UNIT-III

[12]

Basic Digital Circuits: NOT,AND,OR,NAND,NOR,EX-OR,EX-NOR Gates.

Combinational Logic Design: Introduction, Half and Full Adder, Half and Full Subtractor, Four Bit Binary Adder, One digit BCD Adder, code conversion, Multiplexers and Demultiplexers, Decoders, 4-bit Magnitude Comparator IC 7485 and ALU IC74181.

UNIT-IV

[12]

Sequential Logic Design: Flip Flops: SR, D, JK, JK Master Slave and T Flip Flop, Truth Tables and Excitation Tables, Flip-flop conversion. Counters: Design of Asynchronous and Synchronous Counters, Modulo Counters, UP- DOWN counter .IC 74193 Shift Registers: Shift Register IC 7496 , SISO, SIPO,PIPO,PISO, Bidirectional Shift Register , Universal Shift Register, Ring and Johnson Counter.

Text Books:

1. Robert L. Boylestad, Louis Nashelsky, “Electronic devices and circuit Theory”, PHI
2. Ramakant A. Gaikwad, “Op-amp and linear Integrated circuits”, PHI
3. R. P. Jain, “Modern Digital Electronics”, Tata McGraw Hill.
4. M. Morris Mano, “Digital Logic and computer Design”, PHI.
5. J. Bhasker.“ VHDL Primer”, Pearson Education

Reference Books:

1. Martin s. Roden, Gordon L. Carpenter, William R. Wieserman “Electronic Design-From Concept to Reality”, Shroff Publishers and Distributors.
2. D.roy Choudhury,shail B.jain, “Linear integrated Circuits”, New age International Publisher.
3. Subrata Ghosal, ”Digital Electronics”, Cengage Learning.
4. Anil K. Maini, “Digital Electronics Principles and Integrated Circuits”, Wiley India

5. Donald p Leach, Albert Paul Malvino, “Digital principles and Applications”, Tata McGraw

LABORTARY WORK:

1) OP-amp as Inverting and Non-inverting amplifier.
2) Applications of Op-amp.
3) IC 555 as astable Multivibrator.
4) Simulation of any circuit using Pspice.
5) Logic Gates.
6) Code Conversion.
7) Multiplexer, Demultiplexer.
8) Flip-flops using gates and ICs.
9) Design of Sequential circuits.
10) VHDL for Combinational logic.

Subject: Electrical Machine-I								
Program: B.Tech. Electrical Engineering				**Subject Code: EL0321**			**Semester: III**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	5	40	40	60	60	200

Prerequisites:

1) Basic Electrical Engineering Concepts and basic circuit theory concept
2) Basic concepts of law of conservation of energy, electro mechanical energy conversion process.

Course Objectives:

1) To learn different types of machines used in electrical engineering and electromechanical energy conversion process.
2) To know working principle, construction and types of dc machine, types of dc winding and performance characteristics of dc machine.
3) To learn the concept of armature reaction and commutation in dc machine.
4) To know the concept of Single-phase Transformers and three phase transformers, their types, construction, operation and connections, to understand different phase conversion process and learn about auto transformer.

Course Outcome:

CO-1: Describe the basic principles of electromechanical energy conversion and (BT-1)

CO-2: Explain the general construction of electrical machines used in electrical engineering.(BT-2)

CO-3: Illustrate D.C. Machines construction, working principle, types and calculate its performance (BT-3)

CO-4: Apply the concept of armature reaction and commutation in dc machines.(BT-4)

CO-5: Describe the single Phase and poly phase transformer, and Compare its types, operation and constructions (BT-2,5)

CO-6: Design equivalent circuit, phasor diagrams of transformer and perform different types of tests on transformer, thus helping to develop skills to impart practical knowledge in real time solutions.(BT-6)

SYLLABUS

UNIT-I

[12]

Electromechanical Energy Conversion- Electromechanical Energy Conversion devices, features, energy balance equations.

D.C. Generator:

Principle of D.C. generator and motor, construction, types of generators, E.M.F. equation, voltage build up process, critical resistance and speed, characteristics of generators, performance equation and efficiency, No load & load characteristics, power stage diagram, Performance of shunt, series and compound generators, Simplex lap and wave windings, interaction of the fields produced by excitation circuit and armature(armature reaction), Commutation, Causes of bad commutation, methods of improving commutation, effects of brush shifts; Compensating winding, interpole winding.

UNIT-II

[11]

DC Motors

Type of dc motors, back emf, torque equation, shaft torque, power equation, power stage diagram, condition for maximum power, losses and efficiency, starters : Necessity of starter, Three point & four point starter, characteristics of shunt, series & compound motors, Speed control of shunt, series & compound motors, Basic concept of Static speed control of DC machines, Ward Leonard method. direct load test and swinburne test, applications of dc motors. Permanent magnet materials and motors

UNIT-III

[11]

Single-phase Transformers

Construction, types, working principle, operation of ideal and practical transformer, phasor diagram under load and no-load condition for resistive, inductive and capacitive load. O/C and S/C test, derivation of transformer parameter, separation of losses, condition of maximum efficiency, all day efficiency, voltage regulation, % impedance, equivalent circuit, Parallel operation.

UNIT-IV **[11]**

Three-phase Transformers

Various connections and their comparative features, effect of connections and construction on harmonics; Transformer rating, Cooling, Parallel operation of three-phase transformers, sharing of load, Various types of transformer construction as per the type of insulations. O.C and S.C test of 3-ph transformer, Phase Conversion – Open delta or V-V Connection, Scott or T-T Connection 3-phase to 2-phase conversion, 3-phase to 6- phases conversion and vice versa, Testing of transformers- Sumpner's test.

Autotransformers

Principle of operation, advantages, disadvantages, comparison with two winding transformer, application of auto-transformer, voltage and current ratios.

Text Books

1) Fitzgeraid A. E., Kingsley C. and Kusko A., "Electric Machinery", 6th Ed., McGraw-Hill International Book Company. 2008
2) Say M. G. and Taylor E. O., "Direct Current Machines", 3rd Ed.,ELBS and Pitman. 1986.

Reference Books

1) Nagrath I. J. and Kothari D. P., "Electrical Machines", 3rd Ed., Tata McGraw-Hill Publishing Company Limited. 2008.
2) Clayton A. E. and Hancock N., "The Performance and Design of DC Machines", CBS Publishers and Distributors. 2003.
3) J.B. Gupta, 'Theory and Performance of Electrical Machines', Katson Publication.

Web resources

1) https://nptel.ac.in/downloads/108105017/
2) http://www.nptelvideos.in/2012/11/electrical-machines-i.html
3) https://onlinecourses.nptel.ac.in/noc17_ec10/preview

MOOCs

i) https://www.edx.org/
ii) https://www.nptel.ac.in/

https://www.coursera.org/

Subject: Network Analysis								
Program: B.Tech. Electrical Engineering				Subject Code: EL0317				Semester: III
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	1	0	4	40	0	60	0	100

Perquisites:

i) Basic Electrical & Electronics Engineering

ii) Fundamentals of Laplace Transforms

iii) Fundamentals of Differential equations

Course Objective:

(i) To understand different types of Theorems for AC circuit.

(ii) To learn the techniques to apply different theorems and how to solve them.

(iii) To provide knowledge about different network topologies.

(iv) To understand the application of Laplace in analysis of electrical circuits

(v) To understand the concept Laplace Transformation.

(vi) To understand pole and zero concepts & network stability.

(vii) To understand the concept of two port network.

(viii) To understand different parameter calculation process

(ix) To understand the application of computers in network analysis.

Course Outcome:

CO-1: Able to Define all the terms and definitions in Network Analysis. (BT-1)

CO-2: Able to Explain the theories represent mathematical approximations to reality and limitations of those approximations. (BT-2)

CO-3: Apply the knowledge of different network reduction techniques in solving the given circuit with dependent source. (BT-3)

CO-4: Analyze the working of various components of a circuit There by developing skill and employability in various types of network solving techniques. (BT-4)

CO-5: Evaluate frequency response, behavior of different passive elements, different network parameters and enabling the design of complex circuits depending on Specifications. (BT-5)

CO-6: Develop a given electric circuit in terms of ABCD, Z, Y and H parameter model and solve the circuit. (BT-6).

SYLLABUS

UNIT-I **[12]**

Network Theorems

Thevenin ' s, Norton ' s, superposition and maximum power transfer theorem Compensation, reciprocity and Tellegen's theorems, Millman Theorem, Substitution Theorem.(With AC source & dependent source).

UNIT-II **[12]**

Network Topology

Concept of network graphs, tree, link, cut set, network matrices, node incidence matrix, loop incidence matrix, cut set incidence matrix, network analysis using network incidence matrices and tie set matrix.

Coupled Circuit

Self-inductance and Mutual inductance, Coefficient of coupling, dot convention, Ideal Transformer, Analysis of multi-winding coupled circuits, Analysis of single tuned and double tuned coupled circuits

UNIT-III **[09]**

Laplace Transformation

Laplace transform fundamentals, properties and theorems, unit step function, other unit functions, the impulse ramp and doublet, Laplace transforms for shifted singular functions, initial and final value theorems Convolution integral.

Transient Network Analysis

Response of RL RC and RLC networks using Laplace Transforms for unit step, impulse and ramp inputs.

UNIT-IV **[12]**

Network Functions

Terminal pairs, network function for one port and two port network, ladder network and non-ladder network. Concept of poles & zeros of network functions, Restriction on Pole and Zero locations of network function.

Two Port Networks and their Characterization

Open circuit, short circuit, Z-parameter, hybrid, inverse hybrid and transmission

parameters Series, parallel and tandem connections of two-port networks, multi-port networks, multi-terminal networks; Indefinite admittance matrix and its properties

Text Books

i) Network Analysis, M E Van Valkenburg, PHI

ii) Circuit Theory- Analysis and Synthesis, A Chakrabarti, DhanpatRai Publications

Reference Book

iii) Electric Circuits and Networks :- By K. S. Suresh Kumar – Pearson Education

iv) Linear Circuits Analysis 2nd edition :-By DeCarlo/ Lin – Oxford University Press (Indian edition)

v) Engineering Circuit Analysis : - By W H Hayt, J E Kemmerly, S M Durbin 6th Edition TMH Publication

vi) Network Analysis & Synthesis By Franklin S. KUO, Wiley Publication

Web Resource

i) https://www.youtube.com/watch?v=cpwMPTFPFKM

ii) https://www.youtube.com/watch?v=UIn8uZSdV3c

iii) https://www.youtube.com/watch?v=3YinmbkU0DE

iv) https://www.youtube.com/watch?v=26GM8Z5vlqw

MOOCS:

i) https://www.edx.org/

ii) https://www.nptel.ac.in/

https://www.coursera.org/

Subject: Signal and System								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0322**			**Semester: III**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	1	0	4	40	-	60	-	100

Perquisites:

i) Differential equations and Integrals (advanced level)

ii) Laplace transform

iii) Ordinary differential equations (and inverse Laplace transform)

iv) Complex numbers (and complex Laplace transform)

v) Series and expansions

vi) Fourier analysis (and complex Fourier Series/transform)

Course Objectives:

(i) To understand the different types of signals & systems.

(ii) To learn the sampling theorem & convolution of LTI System.

(iii) Will learn the Laplace and z-transform in discrete and continuous domain.

(iv) To understand the Fourier series and transform

Course Outcome:

i) Getting familiar with the different types of signals.

ii) Understand and learn the properties of the systems.

iii) Able to do convolution of any LTI System.

iv) Understand the sampling Theorem.

v) Learn and solve the Laplace, Inverse Laplace problem z-Transform and Inverse z-Transform problem.

vi) Able to know the properties and application of Fourier series and Fourier Transform.

SYLLABUS

UNIT-I

[11]

Signals and Systems:

Continuous-Time and Discrete-Time Signals, Transformations of the Independent Variable, Exponential and Sinusoidal Signals, The Unit Impulse and Unit Step Functions, Continuous-Time and Discrete-Time Systems, Basic System Properties.

UNIT-II

[12]

Linear Time-Invariant Systems:

Discrete-Time LTI Systems: The Convolution Sum. Continuous-Time LTI Systems: The Convolution Integral, Properties of Linear Time-Invariant Systems.

Sampling:

Representation of a Continuous-Time Signal by Its Samples: The Sampling Theorem, Reconstruction of a Signal from Its Samples Using Interpolation. The Effect of under sampling: Aliasing, Discrete-Time Processing of Continuous-Time Signals, Sampling of Discrete-Time Signals.

UNIT-III

[11]

The Laplace Transform:

The Laplace Transform. The Region of Convergence for Laplace Transforms. The Inverse Laplace Transform. Properties of the Laplace Transform, Some Laplace Transform Pairs.

The Z-Transform:

The z-Transform, Region of Convergence for the z-Transform, Inverse z-Transform. Properties of the z-Transform, some Common z-Transform Pairs, Analysis and Characterization of LTI Systems using z-Transforms, System Function Algebra and Block Diagram Representations, The Unilateral z-Transforms.

UNIT-IV

[11]

Fourier series Representation of Periodic Signals:

The Response of LTI Systems to Complex Exponentials, Fourier series Representation of Continuous-Time Periodic Signals, Properties of Continuous-Time Fourier series, Fourier series Representation of Discrete-Time Periodic Signals, Properties of Discrete-Time Fourier series, Fourier series and LTI Systems.

The Continuous-Time Fourier Transform:

Representation of a periodic Signal: The Continuous-Time Fourier Transform. The Fourier Transform for Periodic Signals. Properties of the Continuous-Time Fourier Transform, The Convolution Property, The Multiplication Property, Tables of Fourier Properties and Basic Fourier Transform Pairs.

Text Books

i) AlanV.Oppenheim, Alan S.Willsky with S.Hamid Nawab, Signals & Systems, 2nd edn., Pearson Education, 1997.

Reference Books

i) John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, 3rd edn., PHI, 2000.

ii) M.J.Roberts, Signals and Systems Analysis using Transform method and MATLAB, TMH 2003.

iii) Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley, 1999.

Web resources

i) https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/

MOOCs

iii) https://www.edx.org/

iv) https://www.nptel.ac.in/

https://www.coursera.org/

Subject: Control Theory								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0419**			**Semester: IV**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Perquisites:

i) Laplace transform

ii) Linear Algebra

iii) Differential Equations

Course Objectives:

(i) To learn the different types of control systems and its modeling

(ii) To understand time response characteristics of system

(iii) To know Time domain stability.

(iv) To know frequency domain stability.

Course Outcome:

i) Learn the basic concepts of linear control theory and its analysis.

ii) Able to solve different system representations using block diagram reduction and Signal Flow techniques.

iii) Analysis of Transient and steady state response.

iv) Understand the open loop and closed loop frequency responses of systems.

v) Learn stability concept using routh- hurwtiz criterion and root locus.

vi) Analysis of stability in Frequency domain with different methods.

SYLLABUS

UNIT-I

[11]

Introduction

Introduction, Open-loop system and its examples, Closed-loop system and its examples, Open-loop vs Closed-loop

Mathematical Modeling

Modeling of Mechanical system, Modeling of Electronic and electrical system, Modeling of Liquid-level system, Transfer function of system, Modeling in state-space

UNIT-II

[11]

Block diagram and Signal Flow graph

Block diagram formulation, Block diagram reduction, Signal Flow graph, Mason's Gain formula

Transient response analysis

Standard test signals, First-order and second order systems, Higher order systems, Transient response of system,

UNIT-III

[12]

Steady State Response Analysis:

Steady-state error for unit, ramp and parabolic inputs, Effect of Proportional, derivative and integral control, MATLAB simulations,

Time domain Stability Analysis

RH stability criteria, Introduction to Root Locus, Rules for constructing the root locus, System analysis with the help of Root-locus, Root-locus plot using MATLAB

UNIT-IV

[11]

Frequency Response Analysis

Introduction, Specification for frequency response, Polar-plots, Bode plots, Nyquist plots, Stability analysis, MATLAB simulations

Text Books

i) Katsuhiko Ogata, "Modern Control Engineering", 4th Ed, Prentice Hall of India.

ii) Benjamin C.Kuo, "Automatic Control Systems", PHI Learning Private Limited, 2010.

Reference Books

i) Norman S Nise, "Control system Engineering", 4th Ed., Wiley-India Edition.

ii) I J Nagrath, M Gopals "Control system Engineering", 5th Ed., New Age International Publisher.

Web resources

i) https://onlinecourses.nptel.ac.in/noc19_ee30/

ii) https://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/lecture-notes-labs/

iii) www3.imperial.ac.uk

iv) mitra.ac.in

MOOCs

v) https://www.edx.org/

vi) https://www.nptel.ac.in/

vii) https://www.coursera.org/

Subject: Electrical Measurement								
Program: B.Tech. Electrical Engineering				**Subject Code: EL0425**			**Semester: IV**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	16/40	16/40	24/60	24/60	200

Perquisites

i) Basic mathematics

ii) Network analysis

Course Objectives

i) To present a problem oriented introductory knowledge of Electrical measurement techniques.

ii) To focus on the study of electrical measurements.

Course Outcome

CO-1: Able to describe the working principal and construction of the measuring instruments and recorders. [BT-1]

CO-2: Able to explain how to measure various electrical and physical quantities and parameters using meters and transducers. [BT-2]

CO-3: Apply various analog meters in various measurements. [BT-3]

CO-4: Classify various methods for the measurement of resistance, inductance and capacitor. [BT-4]

CO-5: Able to measure power, & energy, thus developing skill and employability in studnts [BT-5]

CO-6: Derive and construct instrument transformers for measurement applications. [BT-6]

SYLLABUS

UNIT– I

Potentiometers & Instrument transformers

Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate type's standardization – applications. CT and PT – Ratio and phase angle errors

UNIT –II

Measurement of Power & Energy

Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced systems. Single phase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading using R.S.S. meter. Three phase energy meter – tri-vector meter, maximum demand meters.

UNIT – III

DC & AC bridges

Method of measuring low, medium and high resistance – sensitivity of Wheat-stone's bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance-Maxwell's bridge, Hay's bridge, Anderson's bridge – Owen's bridge. Measurement of capacitance and loss angle –Desaunty's Bridge – Wien's bridge – Schering Bridge.

UNIT-IV

Transducers

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Piezo electric transducers, photovoltaic, photo conductive cells, and photo diodes. Measurement of Non-Electrical Quantities: Measurement of strain, Gauge sensitivity,

Displacement, Velocity, Angular Velocity, Acceleration, Force, Torque, Temperature, Pressure, Vacuum, Flow and Liquid level.

TEXT BOOKS:

"G. K. Banerjee", "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2nd Edition, 2016

"S. C. Bhargava", "Electrical Measuring Instruments and Measurements", BS Publications, 2012.

REFERENCE BOOKS:

"A. K. Sawhney", "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications, 2005.

"R. K. Rajput", "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd., 2007.

"Buckingham and Price", "Electrical Measurements", Prentice – Hall, 1988.

"Reissland, M. U", "Electrical Measurements: Fundamentals, Concepts, Applications", New Age International (P) Limited Publishers, 1st Edition 2010.

"E.W. Golding and F. C. Widdis", "Electrical Measurements and measuring Instruments", fifth Edition, Wheeler Publishing, 2011.

Web Resource

1. www.eng.hmc.edu/NewE80/PDFs/BasicElectricalMeasurements2012.pdf
2. nptel.ac.in/downloads/108105053/
3. https://www.youtube.com/watch?v=xLjk5DrScEU
4. https://www.youtube.com/watch?v=EXtfLWBIxHc
5. https://www.youtube.com/watch?v=xLjk5DrScEU&list=PLt5syl71JKf0IacRzLI-02Q_udP4nJiJg

MOOCS:

iii) https://www.edx.org/

iv) https://www.nptel.ac.in/

v) https://www.coursera.org/

Laboratory Experiment List

1. Measurement of low resistance using Kelvin bridge
2. Measurement of inductance using Maxwell bridge
3. Measurement of capacitance using Schering bridge
4. To Study Characteristics of LVDT or Displacement Transducers
5. Measurement of strain and linear range of operation using Strain Gauge transducer
6. Characteristics of Thermocouple temperature transducer.
7. To find the characteristics of thermocouple and to measure the temperature using thermocouple.
8. Proximity sensor and its applications
9. Analyze analog and digital multimeter for various measurements.

Demonstrate functionality of function generator and its use as a test and measurement equipment.

Subject: Electrical Machines-II								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0426**			**Semester: IV**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Perquisites:

(i) Fundamentals of Electrical Engineering

(ii) Electrical Machines -I

Course Objectives:

(i) To learn construction, working principle and applications of Induction motor.

(ii) To understand starting methods and speed control of Induction motor.

(iii) To learn construction, working principle and applications of single phase motors.

(iv) To understand synchronous machine working, features and its applications.

Course Outcome:

CO 1: Explain the fundamental operation and characteristics of Induction motor. [BT-2]

CO 2: Analyze the characteristics features of Induction machine. [BT-4]

CO 3: Describe the working concept and performance of Synchronous motor and single-phase Induction motor. [BT-2]

CO 4: Design and calculate the circuit parameters of Ac Machines, to fulfil the requirements of present day employers, who demand sound engineering skills employability. [BT-6]

CO 5: Calculate the losses and efficiency of the machines. [BT-3]

CO 6: Analyze the performance features and applications of the electrical machines. [BT-4]

SYLLABUS

UNIT-I

Induction Motor

[15]

Constructional features of wound rotor and squirrel cage induction machine. Qualitative description of working of poly-phase induction machine from rotating field view point; torque slip characteristic and equivalent circuit of induction motor, phasor diagram, effect of slip on rotor circuit, rotor current, rotor torque, starting torque, maximum torque, blocked rotor test and no load test of induction motor, circle diagram, Double-cage and deep-bar squirrel cage rotor induction motor, Induction generator.

UNIT-II

[15]

Speed Control of Induction Motor

Different Starters for starting induction motors; Principles of speed control (i)stator voltage control (ii) control of speed of rotating field (iii) control of slip speed (iv) rotor resistance control (v) V/f control. Effect of voltage injection in secondary of slip-ring induction motor, Cogging and crawling of induction motor, braking methods in induction motor.

UNIT-III

[15]

Single phase motors

Types of single phase motor, revolving field theory, starting and running performance of single phase IM, Split Phase Motors, Capacitor Type Motor, Shaded Pole Induction Motor, Self Starting Synchronous Reluctance Motor, Hysteresis Motor, AC series Motor, Universal Motor, Speed Control of Universal Motors, stepper motor, SRM and servo motors

UNIT-IV

[15]

Alternators

Construction, Principle of Operation, Method of excitation, armature winding of alternator, winding factor, emf equation of alternator, armature reaction and voltage regulation, alternator on load, parallel operation of alternator.

Synchronous Motor

Construction, Principle of Operation, Starting of synchronous motors, Motor on load with constant excitation and different excitation, Equivalent circuit and phasor diagram, Power developed by a synchronous motor, Effect of Excitation on Armature Current and Power Factor, Construction of V curves, Speed Control of Synchronous Motor, Hunting in synchronous motor, synchronous condensers, Synchronous motor application.

Text Books

1) Fitzgeraid A. E., Kingsley C. and Kusko A., " Electric Machinery " , 6th Ed., McGraw-Hill International Book Company.2008
2) Say M. G., " The Performance and Design of Alternating CurrentMachines " , CBS Publishers and Distributors.2005
3) Bimbhra P.S., Generalized Machine Theory, Khanna Publisher

Reference Books

1) Nagrath I. J. and Kothari D. P., "Electrical Machines " , 3rd Ed., Tata McGraw-Hill Publishing Company Limited. 2004
2) Langsdorf A. S., "Theory of AC machines " , 2nd Ed., Tata McGraw-Hill Publishing Company Limited. 2008
3) Kimbark E.W., " Power System Stability, Vol. III: SynchronousMachines " , Wiley India.2008
4) Chapman S. J., "Electric Machinery Fundamentals", 4th Ed.,McGraw-Hill International Book Company.2005

Web resources

1) https://nptel.ac.in/courses/108106072/
2) https://nptel.ac.in/courses/108108076/39
3) https://nptel.ac.in/courses/108106072/pdf/2_6.pdf

MOOCs

viii) https://www.edx.org/

ix) https://www.nptel.ac.in/

https://www.coursera.org/

Subject: Electromagnetics								
Program: B.Tech. Electrical Engineering				Subject Code: EL0416				Semester: IV
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	1	0	4	40	0	60	0	100

Perquisites:

iv) Basic Electrical & Electronics Engineering

v) Fundamentals of Differential Equations

vi) Fundamentals of multiple integral.

Course Objective:

(x) To understand different types of coordinate systems.

(xi) To learn the concept of electric flux and flux density for different charge configurations.

(xii) To learn the concept of electric field intensity for different charge configurations.

(xiii) To understand application of Gauss's law.

(xiv) To understand the concept of divergence.

(xv) To understand boundary conditions for different boundaries.

(xvi) To understand magnetic field and magnetic force.

(xvii) To understand the concept of time varying field.

Course Outcome:

CO1: Able to transform one system to another coordinate system.[BT3]

CO-2: Able to determine electric and magnetic fields due to specified charge and current distributions. [BT3]

CO-3: Able to determine potential and energy relationship for different charge configuration.[BT3]

CO-4: Able to evaluate boundary conditions.[BT4]

CO-5: Able to acess electrostatic and electromagnetic laws.[BT5]

CO-6: Access problems involving one-dimensional Poisson's , Laplace's and maxwell's equations, to fulfil the requirements of present day employers,. [BT5]

SYLLABUS

UNIT-I

[12]

Vector Analysis: Scalars & Vectors, Dot and cross products, Co-ordinate systems and conversions.

Electrostatics I: Coulomb's law, Electric field intensity, Field due to continuous volume charge distribution, field of a Line charge, Field of a Sheet of charge.

UNIT-II

[10]

Electrostatics II:

Concept of electric flux density, Gauss's law, Divergence of D, Divergence theorem, Maxwell's first eqn., Energy expended in moving a point charge in electric field, Energy and potential , potential difference, potential gradient, Dipole, Energy density in electrostatic field.

UNIT-III

[12]

Conductors, Dielectrics and Capacitance:

Current and current density, Relation between J and volume charge density, continuity equation, conductor properties, conductor- free space boundary, method of images, capacitance of a boundary condition for perfect dielectric materials, Poisson's and Laplace equation, Uniqueness theorem, Examples.

Steady Magnetic Field:

Biot-Savart's law, Ampere's circuital law, Point form of Ampere's circuital law, concept of flux density, Scalar and vector magnetic potential, Stoke's theorem for magnetic field,

UNIT-IV

[11]

Magnetic forces, Time varying Field and Maxwell's Equation

Force on a moving charge, Force and torque on a closed circuit, Force between differential current element, Magnetic boundary conditions, Magnetic circuit, Energy density in magneto static field, Inductance and mutual inductance

Faraday's law, Displacement current, Maxwell's equations in point and integral forms for time varying fields

Text Books:

1. Engineering Electromagnetics, W H Hayt, J A buck, 7th Edition, TMH Publication

Reference Books:

1. Electromagnetic Waves & Radiating Systems, Edward C. Jordan, Keith G. Balmain, 2nd Edition, PHI publication.
2. Fields and Waves in Communication Electronics, Simon Ramo, John R. Whinnery, Wiley Publication

Web Resource:

1. nptel.ac.in/downloads/115101005/
2. https://www.studynama.com/.../368-Electromagnetic-Theory-pdf-lecture-notes -ebook..

MOOCS:

vi) https://www.edx.org/

vii) https://www.nptel.ac.in/

https://www.coursera.org/

Subject: Power System-I								
Program: B.Tech. Electrical Engineering				Subject Code: EL0417				Semester: IV
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	2	4	40	40	60	60	200

Perquisites:

vii) Fundamental of Electrical circuits

viii) Fundamental of Numerical methods.

Course Objective:

i) To understand different way of generating electrical energy.

ii) To understand different distribution system.

iii) To understand different types of tariff.

iv) To Understand the economic scheduling of power system

Course Outcome:

CO-1: Identify and address current and future electrical engineering problems related to energy sources.[BT1]

CO-2: Identify generation, conversion, transmission, utilization, efficiency, protection, and control within a broader framework of sustainable development.[BT1]

CO-3: Calculate monthly energy bill as per the tariff of power distribution Company.[BT3]

CO-4: Explain the transmission line parameter for single phase and three phase system.[BT1]

CO-5: Identify the characteristics of underground cables.[BT1]

CO-6: Describe the Mechanical aspects, supply system, helping to develop skills to impart practical knowledge in real time solutions.[BT1]

SYLLABUS

UNIT-1

[10]

Generation, Transmission and Distribution Systems

Fundamentals of Thermal,Gas,Hydro &Nuclear power Station, Electrical supply system,

comparison of AC and DC systems, overhead versus underground systems, choice of working voltages for transmission and distribution transmission and distribution system architecture, cost comparison of overhead and underground systems

UNIT-II

[10]

Load on Power Station

Structure of power system, Types of load, Variable load on power station, Load curve, important terms and factors, load duration curve, selection of generating units, base load and peak load, interconnected grid system.

Economics of power generation & Tariff:

Cost of electrical energy, Expressions for cost of electrical energy, Methods of depreciation, Cost analysis of power plants, types of tariffs- flat rate, block rate, two-part and three-part, fixed and running charges, comparison of tariffs and computation of monthly/annual bill.

UNIT-III

[12]

Overhead Transmission Lines:

Components of overhead line, line support, types of conductors; Overhead line insulators, types of insulators- pin, suspension and strain insulators, insulator materials, insulator string; Calculation of voltage distribution and string efficiency, methods of equalizing voltages, use of guard rings, sag in overhead lines, calculation of sag with equal level support and unequal level support with effect of wind and ice loading.

Corona:

Theory of corona formation, factors affecting corona, calculation of potential gradient, merits and demerits of corona.

UNIT-IV

[13]

Line Parameters:

Inductance of a single phase 2 wire line, conductor types, Flux linkage of one conductor in a group, Inductance of a composite conductor lines, Transposition, Inductance of a three phase lines, Double circuit three phase lines, bundled conductors, skin effect, proximity effect, Capacitance of a 2 wire line, Capacitance of a three phase line with equilateral spacing and unsymmetrical spacing, effect of earth on transmission line capacitance, method of GMD, Potential Gradient.

Underground Cables and their Characteristics:

Elements of a power cable, properties of the insulation and sheath materials, classification of power cables: belted, screened and pressure cables, dielectric stress in cable insulation, grading of cables: capacitance grading and inter-sheath grading, measuring capacitances and charging current in a cable, HVDC cables, faults in AC & DC cables.

Text Books:

i) Weedy B.M. and Cory B.J., "Electric Power Systems", 4th Ed.,Wiley India.**2008.**

ii) Grainger J. J. and Stevenson W.D., "Elements of Power System Analysis", Tata McGraw-Hill Publishing Company Limited.**2008**

Reference Books

i) Gonen T., "Electric Power Transmission System Engineering: Analysis and Design", John Wiley and Sons.**1990.**

ii) Nagrath I. J. and Kothari D. P., "Modern Power System Analysis", 3rd Ed., Tata McGraw-Hill Publishing Company Limited. **2008.**

iii) Roy S., "Electrical Power System- Concepts, Theory and Practices", Prentice Hall of India Private Limited. **2007.**

iv) V.K. Mehta and Rohit Mehta ,"Principles of power system" , S Chand & Co.Ltd

Subject: Elements of Electrical Design								
Program: B.Tech. Electrical Engineering				Subject Code: EL0519				Semester: V
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	1	0	4	40		60		100

Perquisites:

ix) Basic Electrical Engineering

x) Electrical Machines

Course Objective:

(xviii) To understand application of magnetic circuit.

(xix) To learn design of lifting magnets.

(xx)To learn design of starter and regulator.

(xxi) To understand control circuit of automatic starters.

(xxii) To understand estimation and costing.

(xxiii) To understand Design consideration of Electrical Installation.

Course Outcome:

i) Able to calculate MMF for air gap and teeth of electrical machines.

ii) Able to design lifting magnets.

iii) Able to design starters and field regulator.

iv) Able to design control circuit of automatic starter.

v) Able to determine estimation and costing.

vi) Able to determine parameters of electrical installation.

SYLLABUS

UNIT-I

[8]

General Design Aspects

Basic principles of magnetic circuits – use of B-H curves in magnetic circuits – Calculations of MMF for air gap and teeth – Real and apparent flux density – Effect of saturation – flux density distribution -calculation of magnetizing current – Field Form – Introduction – carter's fringe curves – flux plotting – air gap flux distribution factor (field form factor) – actual flux distribution factor.

UNIT-II

[8]

Design of starters, field regulators & control panels:

Grading of starting resistance for DC shunt motor, DC series motor , Determination of the size of resistance element, field regulator in case of DC shunt motor and DC shunt generator, design problem, and control panels.

Automatic Starters:

Back emf starter, Time delay starter, DOL Starter, Primary resistance starter, Auto transformer starter, Star-Delta starter, Rotor Resistance starter

UNIT-III **[6]**

Design of small Transformers and Ballast:

Design of Small single-phase transformers — Design of variable air gap single-phase choke coil. Design of variable air gap three-phase choke coil. Design of ballast.

Design consideration of Electrical Installation:

Types of load, Electrical Supply Systems, Wiring systems, Load Assessment, Permissible voltage drops & Conductor size calculations, Control panel, Illumination Schemes.

Estimating Costing for Residential, Commercial &Service Connections (1- ø &3-ø):

Tenaments , Row houses , Internal Wiring Estimation (Length of wire) Commercial Complexes. Internal Wiring Estimation (Length of wire).

UNIT-IV

[8]

Armature Windings

DC windings

Simplex & Duplex windings, Lap & Wave windings, Applications, Basic terms related to armature windings, Dummy Coils, Equalizer connections, split coils.

AC windings

Introduction, No. of phases, Phase spread, concentric winding, Mush winding, Double layer windings.

Text Books:

1. Electrical Estimating & Costing by N. Alagappan & S. Ekambaram (TTTI, Madras) - (Tata mcgrawhill Ltd).
2. Electrical Estimating & Costing by Surjit Singh (Dhanpat Rai & sons).

3. Elements of Electrical Design by Dr. J G Jamnani

Reference Book

1. Electrical Machine Design by A. K. Shawney, Dhanpatrai & sons. Pub.
2. Electrical Installation, Estimating & Costing By J.B. Gupta (S.K.Kataria & Sons).
3. Electrical Machine Design by S. K. Sen, Oxford Publications.
4. Electrical Design, Estimating & Costing By K.B.Raina & S.K.Bhattacharya (TTTI, Chandigarh) – (Wiley Eastern Ltd.).

Web resource

www.nptel.ac.in

MOOCS:

viii) https://www.edx.org/

ix) https://www.nptel.ac.in/

x) https://www.coursera.org/

Subject: Microprocessor & Microcontroller Interfacing								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0517**			**Semester: V**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)-Theory**	**Continuous Internal Evaluation (CIE)-Practical**	**Total**
3	0	2	4	40	40	60	60	200

Perquisites:

i) Digital Logic Design

Course Objectives:

(v) To understand the difference between microprocessor and microcontroller.

(vi) To understand the assembly language of 8051 and also develop logic

(vii) To know programming in embedded c with peripheral interfacing

(viii) To know application of microcontroller and its interfacing.

Course Outcome:

i) Know the microprocessor and Microcontroller difference.

ii) Getting familiar with the architecture of 8051 family microcontrollers.

iii) Learn the assembly language of 8051 and able to write program.

iv) Learn the embedded C language Programming of 8051.

v) Able to configure 8051 peripherals and its working.

vi) Learn the interfacing of microcontroller and based on that develop various Application using Microcontroller.

SYLLABUS

UNIT-I

[12]

Microprocessor System Architecture

Introduction, Registers, concept of address and data buses, system, control signals, basic bus timing, memory (RAM, ROM), input output devices, Microcomputer systems, over view of 8-16-32 bit Microprocessor and microcontroller family. Bus and instruction timing diagram, de-multiplexing of buses, generation of control signals.

The 8051 Microcontroller Architecture

Introduction to 8051 family microcontrollers, hardware architecture, input/output pins,

I/O ports and circuits, on chip ram, general purpose registers, special function registers.

UNIT-II

[11]

Assembly Language Programming of 8051

Concept of IDE (assembler, compiler, linker, de-bugger), addressing modes, data move instructions, arithmetic and logical instructions, jump, loop and call instructions, Bit addressable instructions and special instructions concept of timers-counters and interrupt.

UNIT-III

[11]

Programming In Embedded C

Introduction, Date types in embedded C, arithmetic and logical operators, Control statements and loops in embedded C, Functions and Arrays in embedded C. Programming of input/ output ports, Programming of Timer & counters, writing interrupt service routines in Embedded C, concepts of subroutines, interrupt service routine

UNIT-IV

[11]

8051 Interfacing

Concept of Serial Communication, 8051 interfacing and programming of UART in embedded C. Introduction, Interfacing and C programming of 8051 with keyboard, Interfacing and C programming of 8051 with 7-segment display, Interfacing and C programming of 8051 with LCD display, Interfacing and C programming of 8051 with ADC-DAC and sensors.

Text Books

i) R.S.Gaonker, “Microprocessor Architecture, programming, and application”, wiley eastern limited.

ii) Kenneth J. Ayala, “The 8051 Microcontroller”, Penram International 3rd edition.

iii) M. Mazidi and others, “The 8051 Microcontroller and Embedded Systems”,

PRENTICE Hall Of India, 3rf edition.

Reference Books

i) Michael slater, “Microprocessor based Design”, PRENTICE Hall Of India, 3rd edition.

ii) B. Ram, “Fundamentals of microprocessors and microcomputers”, Dhanpat Rai.

Web resources

v) http://www.zseries.in/embedded%20lab/8051%20microcontroller/difference%20between%20microprocessor%20and%20microcontroller.php#.Wz8P9NIza1s

vi) https://www.elprocus.com/difference-between-avr-arm-8051-and-pic-microcontroller/

vii) http://www.keil.com/dd/docs/datashts/intel/ism51.pdf

viii) https://www.electronicshub.org/interfacing-7-segment-display-8051/

ix) http://www.circuitstoday.com/interfacing-seven-segment-display-to-8051

MOOCs

x) https://www.edx.org/

xi) https://www.nptel.ac.in/

xii) https://www.coursera.org/

Subject: Optimization Techniques								
Program: B.Tech. Electrical Engineering				Subject Code: EL0525				Semester: V
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	1	0	4	40	0	60	0	100

Perquisites:

xi) Differential Equation

xii) Vector calculus, Matrix Algebra

Course Objective:

(xxiv) To understand different optimization techniques.

(xxv) To learn the concept of system constraints.

(xxvi) To learn the concept of single variable optimization

(xxvii) To understand application of multivariable optimization.

(xxviii) To understand the concept of linear programming.

(xxix) To understand application of non linear programming.

Course Outcome:

CO-1: Able to define and recall various concept of optimization. [BT-1]

CO-2: Able to describe about the optimal solution of single variable problem. [BT-2]

CO-3: Able to apply the ideas about constraint surface. [BT-3]

CO-4: Able to analyze multivariable optimization with given constraints. [BT-4]

CO-5: Evaluate problems with linear programming methods. [BT-5]

CO-6: Design problems with non linear programming methods, which will help in developing employability skills [BT-6]

SYLLABUS

UNIT-I

[12]

Introduction

Goals of optimization, classical optimization method, Numerical methods, Advanced optimization Techniques, Hill climbing, simulated annealing, Ant colony algorithm, Genetic Algorithm, Neural Network, Fuzzy logic, schematic of optimization process.

UNIT-II

[12]

Single Variable and Multi variable Optimization

System constraints, constraint surface, classification of optimization, global minima, local minima, necessary and sufficient condition, Multi variable optimization with no constraints, saddle point, direct substitution method, constraint variation method, langrage multiplier method, multi variable optimization with inequality constraints, Kuhn-tucker condition

UNIT-III

[10]

Linear Programming

Simplex method, standard form of a linear programming, characteristic of a linear programming, Transformation of LP problems, Geometry of LP, Geometrical characteristics of the graphical solution of LP Problems, Product mix problem, Blending problem, Production scheduling problem, Transportation problem, Duality.

UNIT-IV

[11]

Non Linear Programming

One dimensional minimization methods, Unimodal function, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden Section Method, Interpolation methods, Quadratic Interpolation Method, Newton Method , Quasi-Newton Method.

Text books:

1. Rao,S.S., Optimization :Theory and Application" Wiley Eastern Press, 2nd edition 1984.

Reference Book

2. Taha,H.A., Operations Research –An Introduction, Prentice Hall of India,2003.

3. Fox, R.L., „Optimization methods for Engineering Design", Addition Welsey, 1971

Web Resource

nptel.ac.in/courses/105108127/pdf/Module_1/M1L2_LN.pdf

www.nptel.ac.in/courses/105108127/pdf/Module_1/M1L4_LN.pdf

MOOCS:

xi) https://www.edx.org/

xii) https://www.nptel.ac.in/

https://www.coursera.org/

Subject: Power Electronics								
Program: B.Tech. Electrical Engineering				**Subject Code: EL0526**			**Semester: V**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	60	60	40	40	200

Perquisites:

1) Basic Electronics
2) Mathematical Equations.

Course Objective:

1) To understand the characteristics and principle of operation of modern power semi-conductor devices.
2) To comprehend the concepts of different power converters and their applications
3) To analyze and design switched mode regulators for various industrial applications.

Course Outcome:

After completion of this course, expected outcome from the students,

1) Relate basic semiconductor physics to properties of real devices, and combine circuit mathematics and characteristics of linear and non-linear devices to formulate and analyse system designs.
2) The static and dynamic characteristics of fundamental power semiconductor devices.
3) Learn the basic concepts of operation of different types of converters in steady state in continuous and discontinuous modes and be able to analyze basic converter topologies.
4) Apply skills in engineering estimation to analyze real-world situations, identify the important features and develop a valid approach to the solution.
5) Simulate simple power electronic circuits using simulation packages like Spice or MATLAB/Simulink.

6) Conduct experiments with converters and compare the results with theoretical concepts and simulations.

SYLLABUS

UNIT-I

[12]

Solid State Power Devices

Power Semiconductor Devices Construction and Characteristics of Power diodes, Power Transistors, Power MOSFET, Insulated Gate Bipolar transistors (IGBTs) Introduction to Thyristor family : SCR, DIACs, TRIACs, Light Activated SCRs (LASCRs), Reverse Conducting Thyristor , (RCT), Asymmetrical SCR (ASCR), Gate turn-off Thyristors (GTOs), Integrated Gate- Commutated Thyristors (IGCTs), MOS controlled Thyristors (MCTs) Power Integrated circuits (PICs), Intelligent Modules. Gate Drive/Triggering circuits. di/dt and dv/dt protection, Design of Snubber Circuit.

UNIT-II

[10]

Phase Controlled (AC to DC) Converters:

Review of half-wave and full-wave diode rectifier (with RL load); Principle of phase controlled converter operation; Operation of 1-phase half wave converter with R, RL and RLE load; Significance of freewheeling diode ; 1- phase full wave converter : Center-tapped and Bridge Configuration; Operation and analysis with R,RL, RLE load; Analysis; Gating Requirements; Operation and analysis of 1-phase Semi-converter/ Half controlled converter: Asymmetric and Symmetric Configurations; 3-phase converters : Operation of half wave converter; Full wave fully controlled converters: Semi-controlled converter; Dual Converter: Principle and operation; 1-phase and 3-phase configurations, Power factor improvement techniques, Applications of AC-DC converters

UNIT-III

[10]

DC to AC converters:

Performance parameters of Inverters; Classification of Inverters: Voltage source inverters and Current source inverters; Single phase inverters: series, parallel and bridge type (Half wave and Full wave) inverters; Forced Commutated, Line commutated and Self-Controlled Switches based Inverters; Three phase bridge inverters: 180 degree conduction, 120 degree conduction and their comparison PWM Inverters: Principle of PWM control, PWM techniques classifications, Comparison of Voltage and Current source Inverters.

UNIT-IV

[13]

AC Voltage Controllers

Concept of On-Off or integral cycle control and Phase control; Various single phase full wave ac-ac controllers with R, L and RL load; Analysis for phase control and integral cycle control; Gating requirements; Sequence Control of AC regulators.

DC to DC Converters

The chopper, Basic principle of DC chopper, Classification of DC choppers, Control strategies Basic DC-DC converter (switch regulator) topologies : Principle, operation and analysis for Step-down (Buck), Step-up (Boost), Step up/down (Buck-Boost), Continuous conduction and Discontinuous conduction operation, Application of DC to DC converters. E-mobility : Power Electronic converters & their control for Electric vehicles, Control of
electric motors for traction.

Text Books

1. Bimbhra, P. S., "Power electronics", Khanna Publishers, New Delhi, 2001
2. Rashid, M. H., " Power Electronics Circuits, Devices, and Applications, Prentice-Hall of India Pvt. Ltd., New Delhi, 2nd edition, 1999.
3. Singh, M. D., Khanchandani, K. B "Power electronics", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2001.

Reference Books

1. Ned Mohan, Tore M. Undeland and William P. Robbins, “Power Electronics Converters, Applications, and Design”, John Willey & Sons, Inc., 2ndEdition, 1995.
2. Agrawal, J. P., "Power electronic systems: Theory and design" Addison Wesley Longman (Singapore) Pte. Ltd. New Delhi, 2001
3. Boylestad R. and Nashelsky L., “Electronic Devices and Circuit Theory”, 9th Ed., Prentice Hall of India Private Limited. 2008
4. Gayakward R. A., “ OP-AMPs and Linear Integrated Circuit Technology ” , 4th Ed., Pearson Education. 2008
5. Dubey G. K., Doradla S. R., Joshi A. and Sinha R. M. K., Thyristorised Power Controllers”, New Age International Private Limited. 2008

Web Resource

nptel.ac.in/downloads/108105066/

ज्ञानेन प्रकाशते जगत् INDUS UNIVERSITY	INDUS INSTITUTE OF TECHNOLOGY& ENGINEERING Constituent Institute of Indus University

Subject: Programming for Scientific Computing								
Program: B. Tech CE/CS/IT				Subject Code: CE0525			Semester: V	
Teaching Scheme (Hours per week)				Examination Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	2	4	40	40	60	60	200

Course Objectives:

1. Importance of Python as scientific computing tool which directly leads to employability.
2. To learn how to design and develop Python applications.
3. Skill development to apply mutable and immutable types.
4. To learn how to design object-oriented concepts in python.
5. Development of GUI based applications for entrepreneurship.
6. To learn how to build and package Python modules for reusability.

CONTENTS

UNIT-I

[12 hours]

Basic elements of Python, Branching, looping, Strings and Input, Iteration, Functions, Recursion, Global variables, Modules, Files, Structured Objects, Mutability: Strings, Tuples, Lists, Sets, Dictionaries, Functions as Objects, Mutability and Higher-Order Functions.

UNIT-II

[12 hours]

Object-Oriented Programming, Abstract Data Types and Classes, Encapsulation and Information Hiding, Simple Algorithms and Data structures, Regular Expressions – REs, Networking, Multithreading in Python.

UNIT-III

[12 hours]

Array computing and curve plotting, vectors and higher-dimensional arrays, matrices, numPy, sciPy and Matplotlib, Plotting using PyLab, Chat Application, Graphics and GUI Programming – Drawing using Turtle, Tkinter.

UNIT-IV

[12 hours]

Python Pandas - Data alignment, aggregation, summarization, computation and analysis with Pandas. Scientific computation using Python - Statistical data analysis, image processing, Basics of web development (Introduction to frameworks flask, Tensorflow).

Course Outcomes:

At the end of this subject, students should be able to:

1. Work with the Python standard libraries.
2. Implement mutability for various elements of Python.
3. Develop GUI based projects.
4. Design Networking configuration for chatting applications.
5. Implement Scientific Computing.
6. Solve real world problems using Python programming.

Text Books:

1. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India
2. Hans Petter Langtangen, A Primer on Scientific Programming with Python

Reference Books:

1. Claus Fuhrer, Jan Erik Solem, Olivier Verdier, Scientific Computing with Python 3,Packt Publishing Limited
2. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education R. Nageswara Rao, "Core Python Programming", dreamtech
3. Wesley J. Chun. "Core Python Programming - Second Edition", Prentice Hall
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley
5. Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication

Web Resources:

1) http:// https://www.edx.org/course/introduction-to-computer-science-and-programming-using-python-2
2) http://www.openculture.com/2017/05/learn-python-with-a-free-online-course-from-mit.html
3) https://www.edx.org/course/introduction-to-python-absolute-beginner-3

LIST OF EXPERIMENTS

Experiment. No.	Title	Learning Outcomes

1.1	Write a Python program to print the calendar of a given month and year.	CO1
1.2	Write a Python program to calculate number of days between two dates.	CO1
1.3	Write a Python program to check whether a specified value is contained in a group of values. *Test Data* : 3 -> [1, 5, 8, 3] : True -1 -> [1, 5, 8, 3] : False	CO1
1.4	Write a Python program to get OS name, platform and release information.	CO1
2.	**Mutable and Immutable types**	
2.1	Write a Python program which accepts a sequence of comma-separated numbers from user and generate a list and a tuple with those numbers.	CO2
2.2	Write a Python program to display the first and last colors from the following list.[orange, purple, red,yellow,blue]	CO2
2.3.	Write a Python program to concatenate all elements in a list into a string and return it.	
2.4	Write a Python program to print out a set containing all the colors from color_list_1 which are not present in color_list_2. *Test Data* : color_list_1 = set(["White", "Black", "Red"]) color_list_2 = set(["Red", "Green"]) *Expected Output* : {'Black', 'White'}	CO2
2.5	Write a Python script to print a dictionary where the keys are numbers between 1 and 15 (both included) and the values are square of keys. Sample Dictionary {1: 1, 2: 4, 3: 9, 4: 16, 5: 25, 6: 36, 7: 49, 8: 64, 9: 81, 10: 100, 11: 121, 12: 144, 13: 169, 14: 196, 15: 225}	CO2
2.6	Write a Python program to print all unique values in a dictionary. Sample Data : [{"V":"S001"}, {"V": "S002"}, {"VI": "S001"}, {"VI": "S005"}, {"VII":"S005"}, {"V":"S009"},{"VIII":"S007"}] Expected Output : Unique Values: {'S005', 'S002', 'S007', 'S001', 'S009'}	CO2
3.	**Data Structures, RE and Plots**	
3.1	Develop programs for data structure algorithms using python – searching, sorting and hash tables.	CO6
3.2	Write a Python Program that searches a string to see if it starts with "The" and ends with "Indus".	CO1
3.3	Write a Python Program that returns a match where the string contains a white space character.	CO1
3.4	Write a Python program that matches a string that has an a followed by three 'b'.	CO1
3.5	Develop chat room application using multithreading.	CO4

3.6	Perform basic plotting using the randomly generated data to plot graph using series and matplotlib.	CO1
3.7	Generate different types of bar plot and Pie plot to understand behavior of given data.	CO1
4	**Tkinter, turtle, flask**	
4.1	Create (1) Registration form (2) Quiz form using tkinter.	CO3
4.2	Draw (1) Square (2) Rectangle (3) Star patterns using Turtle.	CO3
4.3	Basics of Flask.	CO3
4.4	Basics of Tensor flow.	CO3
5.	**Numpy**	
5.1	Practicals based on Numpy statistical analysis.	CO5
6.	**Pandas**	
6.1	Practicals based on Pandas	CO1

Subject: Renewable Energy Sources								
Program: B.Tech. Electrical Engineering				Subject Code: EL0520				Semester: V
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	1	0	4	40	0	60	0	100

Perquisites:

xiii) Knowledge of Conventional Sources of Energy

xiv) Knowledge of Basic Structure of Energy Flow in Power Network

Course Objective:

(xxx) To Study the Available Renewable Sources

(xxxi) To Study the Energy Generation the Solar Cells and Plants

(xxxii) To Study the concepts of wind power conversion

(xxxiii) To study the energy conversion from ocean energy

Course Outcome:

After studying this subject, Student will able to,

vii) Identify the potential energy sources available in world

viii) Understand the concept of conversion of Geothermal energy

ix) Understand the concept of conversion of Solar energy

x) Understand the concept of conversion of Wind energy

xi) Understand the concept of conversion of Ocean energy

xii) Understand the concept of conversion of Tidal energy

SYLLABUS

UNIT-I **[13]**

Introduction to Non-Conventional Energy Resources

Overview, Different Forms of Energy, Classification of Energy Resources, Availability of Conventional Energy Sources, Classification of Non-Conventional Energy Resources, Recent Technologies Developed

Geothermal Energy

Different Parts of Internal Structure of Earth, Geothermal Energy, Thermal Gradient, Resources of Geothermal Energy, Vapour Dominated Power Plant, Liquid Dominated Systems, Merits, Demerits and Application of Geothermal Power Generation

UNIT-II **[10]**

Solar Cell

Overview, Semiconductor Materials, P-N Junction, Theory of Solar Cells, V-I Characteristics of Solar Cell, Solar Cell Materials, Performance Analysis, Different Types of Solar Cell, Solar Cell Power Plants, Solar Modules and Solar Arrays, Solar Collectors- Flat Plate and Concentrating Collectors, Solar Power Towers

UNIT-III **[11]**

Wind Energy

Overview, Wind Power, Power Extracted by Wind Turbine (Momentum Theory), Optimization of Turbine Power, Aerodynamic Consideration in Design, The Wind Resources and Its Variation with Height, Types of Wind Turbine, Parts of Wind Turbine, Control System of the Wind Turbine, Power Generation Method, Operational Characteristics, Turbine Siting, Applications, Advantages and Disadvantages of Wind Energy

UNIT-IV **[11]**

Ocean Thermal Energy Conversion

Introduction, Working Principle of Ocean Thermal Energy Conversion (OTEC) Plant, Location of OTEC System, Various OTEC Systems – Open Cycle, Closed Cycle, Hybrid Cycle, Advantages, Disadvantages, Limitations and Environmental Impacts of OTEC System

Tidal Energy

Working Principle of Tidal Plants, Tidal Energy Conversion Scheme, Advantages and disadvantages of Tidal Plants, Economic and Environmental Considerations, Site Selection of Tidal Plant

Text Books

vii) Non-Conventional Energy Resources, S. Hasan Saeed and D.K. Sharma, 4th Edition, Katson Books, 2017 .

viii) Non-Conventional Energy Resources, S.K. Dubey and S.K. Bhargava, 2nd Edition, Dhanpat Rai & Co., 2014.

Reference Book

i) Wind and Solar Power Systems, Mukund R. Patel, CRC Press, 1999.

ii) Energy Technology, S. Rao. & S. Parulekar, Khanna publishers, Fourth edition, 2005.

iii) Non- Conventional Resources of Energy, G.D. Rai, Khanna Publishers, Fourth edition, 2010.

iv) Renewable Energy Sources and Conversion Techniques, N.K. Bansal, Kleeman and Melissa, Tata McGraw Hill, 1990.

Web Resource

v) Renewable Energy Source, Science Direct

Link:

https://www.sciencedirect.com/topics/earth-and-planetary-sciences/renewable-energy-source

vi) What Is a Renewable Energy Source? - Definition & Example

Link:

https://study.com/academy/lesson/what-is-a-renewable-energy-source-definition-example-quiz.html

MOOCS:

i) Energy Principles and Renewable Energy, edX, The University of Queensland, Australia

Link: https://www.edx.org/course/energy-principles-and-renewable-energy-2

Subject: Power System-II								
Program: B.Tech. Electrical Engineering				**Subject Code: EL0516**			**Semester: V**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	60	60	40	40	200

Perquisites:

xv) Basics Electrical Engineering

xvi) Fundamentals of optimization techniques.

Course Objective

i) Understand the basic concept of Per Unit System.

ii) Understand the basic concept of load flow analysis

iii) Understand the Concept of designing transmission line parameters

Course Outcome:

i) To study short circuit symmetrical and unsymmetrical condition.

ii) An ability to calculate power flow Analysis using different mathematical methods.

iii) Illustrate the concept of steady state and transient stability

iv) An ability to Analysis of unsymmetrical fault

v) An ability to Analysis of symmetrical fault

vi) An ability to Analysis of power system using symmetrical components transformation.

SYLLABUS

UNIT-I

[10]

Representation of Power System Components

Introduction, single phase solution of balanced three phase networks, the one line diagram and the impedance or reactance diagram, per-unit (pu) system, complex power, synchronous machine, representation of loads.

Characteristics and Performance of Power Transmission Lines

Short and medium transmission lines, Line performance, effect of capacitance, charging currents, short and medium lines, calculation by nominal-T, nominal- π and

end- condenser method, regulation and efficiency, Concept of ABCD constants, the long transmission line-rigorous solution, evaluationof ABCD constants, interpretation of long line equation, surge impedance and surge impedance loading, the equivalent circuit of a long transmission line, power flow through a transmission line, circle diagrams, Ferranti effect.

UNIT-II

[13]

Review of Symmetrical Components and Its Application to Power System

Symmetrical component transformation, phase shift in star-delta transformers, sequence impedance of transmission lines, sequence impedance and sequence network of power system, sequence impedance and network of synchronous machine, sequence impedance of transmission lines, sequence impedance and networks of transformers, construction of sequence networks of power systems.

Symmetrical Fault Analysis

Introduction, transient on a transmission line, short circuit of a synchronous machine on no load, short circuit of a loaded synchronous machine, balanced three phase fault, short circuit capacity, fault analysis using bus impedance matrix, selection of protective equipments.

UNIT-III

[13]

Unsymmetrical Fault Analysis

Symmetrical component analysis of unsymmetrical faults, single line to ground (LG) fault, line to line (LL) fault, double line to ground (LLG) fault, open conductor faults, bus impedance matrix method for analysis of unsymmetrical faults.

UNIT-IV

[10]

Power System Transients

Types of system transients, factors affecting transients, reflection and refraction of traveling waves at different line termination, surge impedance, transient over voltages due to lightning, theory of ground wires, direct stroke to a tower, capacitive switching, kilometric fault, ferro- resonance, protection of power systems against transients and insulation coordination.

Text Books

1. G.W. Stagg & A. H. EI-Abaid, “Computer methods in Power System

Analysis", McGraw Hill, New York.
2. W. D. Stevenson , "Element of Power System Analysis", Mc Graw Hill, 1982.
3. Nagrath & kothari, " Power System Engineering", TMH publishing Company Ltd.

Reference Book

1. C.L.Wadhwa, "Electric Power System", New Age International Ltd.
2. C. S. Indulkar and D P Kothari, "Power System Transients, A Statistical Approach", Prentice Hall of India Pvt Ltd., New Delhi.
3. N. G. Hingorani, J Gyugi, "Understanding FACTS", IEEE Press.
4. K. Bhattacharya, MHT Bollern and J. C. Doolder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, USA, 2001.

Web Resource

i) https://www.smartzworld.com/notes/power-system-ii-ps-ii/
ii) https://www.eee.hku.hk
iii) http://www.srmuniv.ac.in

MOOCS:

i) nptel.ac.in/downloads/108101040/

www.edx.org

ज्ञानेन प्रकाशते जगत् INDUS UNIVERSITY	**INDUS INSTITUTE OF TECHNOLOGY& ENGINEERING** **Constituent Institute of Indus University**

Subject: Data Preparation & Analysis

Program: B. Tech CS	**Subject Code: CS0602**	**Semester: VI**

Teaching Scheme (Hours per week)				**Examination Evaluation Scheme (Marks)**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	**0**	**0**	**4**	**40**	**0**	**60**	**0**	**100**

Course Objectives:

1. To learn how to gather and analyze large sets of data to gain useful business understanding and how to produce a quantitative analysis report/memo with the necessary information to make decisions.
2. To survey industrial and scientific applications of Data Analytics, with case studies to develop entrepreneurship skill.
3. To prepare data for analytics and perform exploratory data analysis.
4. To develop meaningful data visualizations to empower skills of students in data analytics field.
5. To perform cleaning and reformatting real world data for analysis.
6. To apply summary statistics techniques over datasets.

CONTENTS

UNIT-I

[12 hours]

Introduction to Data Analysis

Defining data analysis problems: Knowing the client, Understanding the questions; Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues

UNIT-II

[12 hours]

Exploratory Analysis

Data Cleaning: Consistency Checking, Heterogeneous and Missing data, Data Transformation and Segmentation; Exploratory Analysis: Descriptive and Comparative analysis, Clustering and Association, Hypothesis Generation

UNIT-III

[12 hours]

Visualization

Designing Visualizations, Time Series, Geolocated Data, Correlations and Connections, Hierarchies and Networks, Interactivity

UNIT-IV

[12 hours]

Ethics in the Profession
Cases in Computing, Statistics and Communication, Professional ethics codes: ACM, IEEE, AM Stat. Assoc.

Course Outcomes:

At the end of this subject, students should be able to:

1. Apply clean and format real time data pertaining to real time data science applications
2. Visualize data in multiple dimensions as per the application requirement
3. Draw a comparative analysis of the different format of data
4. Analyze descriptive data with different technique.
5. Obtain results by applying statistic techniques over datasets
6. Students able to understand ethics profession of different codes.

Text Books:

1. Making Sense of Data: A Practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

Reference Books:

1. Data Preparation for Data Mining by Dorian Pyle – Morgan Kaufmann Series
2. Data Preparation in the Big Data by Federico Castanedo – O'Reilly
3. Data Analytics by Anil Maheshwari – McGraw Hill

ज्ञानेन प्रकाशते जगत् INDUS UNIVERSITY	**INDUS INSTITUTE OF TECHNOLOGY& ENGINEERING** **Constituent Institute of Indus University**

Subject: Data Science

Program: B. Tech CE/CSE/IT	**Subject Code: CE0630**	**Semester: VI**

Teaching Scheme (Hours per week)				**Examination Evaluation Scheme (Marks)**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	**0**	**2**	**4**	**40**	**40**	**60**	**60**	**200**

Course Outcome:

1. Learn the fundamentals of data analytics and the data science pipeline
2. Learn how to scope the resources required for a data science project
3. Apply principles of Data Science to the analysis of business problems.
4. Skill development in data mining software to solve real-world problems.
5. Increase in employability in cutting edge tools and technologies to analyze Big Data.

CONTENTS

UNIT-I

[12 Hours]

Introduction to data science:

Defining Data Science, what do data science people do? Data Science in Business, Use Cases for Data Science, Data science and Big data, Data science and Machine learning Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modeling – Presentation.

UNIT-II

[12 Hours]

Introduction to statistics:

What is statistics, Descriptive Statistics: Introduction, Population and sample, Types of variables, Measures of central tendency, Measures of variability, Coefficient of variance, Skewness and Kurtosis

Inferential Statistics:

Normal distribution, Test hypotheses, Central limit theorem, Confidence interval, T-test, Type I and II errors

UNIT-III

[12 Hours]

Machine Learning Introduction and Concepts:

Machine learning – Modeling Process – Training model – Validating model – Predicting new observations

Important machine learning terminologies, Types of machine learning algorithms, Supervised learning algorithms: Types of supervised learning algorithms, Regression: Linear Regression, Classification algorithms
Unsupervised learning algorithms: Clustering algorithms

UNIT-IV

[12 Hours]

Introduction to data visualization – Data visualization options – Filters – Python libraries for visualization – Matplotlib- seaborn
Data Science Ethics – Doing good data science – Owners of the data - Valuing different aspects of privacy - Getting informed consent - The Five Cs – Diversity – Inclusion – Future Trends.

Course Outcome:

After completion of the course students will be able to:

1) Demonstrate knowledge of big data analytics.
2) Demonstrate the ability to think critically in making decisions based on data
3) Interpret data, extract meaningful information, and assess findings.
4) Identify and analyze social, legal, and ethical issues in data science.
5) Choose and apply tools and methodologies to solve data science tasks.
6) Explore future trends in data.

Text Books:

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016

2. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

3. Ethics and Data Science, D J Patil, Hilary Mason, Mike Loukides, O' Reilly, 1st edition, 2018

Reference Books:

1. Machine Learning: A Probabilistic Perspective. Kevin P. Murphy.

LIST OF EXPERIMENTS

Sr. No.	Title	Learning Outcome
1	Getting Started with Skills Network Labs	To know functionality and usage of Skill Network Labs environment
2	Getting Started with Jupyter Notebooks	To know functionality and usage of Jupyter Notebook platform

3	Getting Started with Apache Zeppelin Notebooks	To know functionality and usage of Apache Zeppelin Notebook
4	Getting Started with RStudio IDE	Introduction to Rstudio and its usage in Machine Learning
5	Data Analysis with Python Import data sets Clean and prepare data for analysis Manipulate pandas Data Frame Summarize data Build machine learning models using scikit-learn Build data pipelines	To understand the concept of machine learning, data preparation, pandas and scikit-learn with model building.
6	Data Visualization with Python Introduction to Visualization Tools Basic Visualization Tools Specialized Visualization Tools Creating Maps and Visualizing Geospatial Data	To understand about the field of data visualization and tools used for visualization.
7	Advanced Visualization Tools	Study and understanding about functionalities of advanced visualization tools.

Subject: Electrical Drives & Control								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0617**			**Semester: VI**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Prerequisites:

iv) Basics of Electrical dc, ac Machines

v) Basics of Power Electronics

vi) Basics of control systems

Course Objectives:

(ix) To Learn Adjustable speed drive (ASD) or variable-speed drive (VSD) equipment used to control the speed of machinery.

(x) To understand detailed concept of drives, their transients and stability.

(xi) To focus on the concepts of DC drive, AC drive and their power electronic control strategies.

(xii) To know the construction, working and performance of synchronous motor drives and learn industrial applications of drives.

Course Outcome:

Students will be:

i) Able to understand detailed concept of drives, their structure and control methods.

ii) Able to measure & analyze the drive steady state and dynamic parameters, understand load equalization techniques.

iii) Able to understand concepts of DC drive, AC drive and their power electronic control techniques.

iv) Able to understand adjustable speed drive (ASD) or variable-speed drive (VSD).

v) Able to know different synchronous motor drives and their performance.

vi) Able to learn and implement industrial applications of drives.

SYLLABUS

UNIT-I

[12]

Fundamentals of Electric Drives: Electrical drives - introduction:, advantages of electrical drives, parts of electrical drives, choice of electrical drives, status of ac and dc drives.

Dynamics Of Electrical Drives: Fundamental torque equation, speed-torque convention and multi quadrant operation, dynamics of motor load combination, types of load, load with translational motion, load with rotational motion, load torque that vary with time, Speed Sensing and current Sensing, components of load torque, nature and classification of load torque, measurement of moment of inertia, calculation of time and energy loss in transient operation, load equalization, steady state stability of electrical drives, selection of Motor Power Rating.

UNIT-II

[11]

Dc Drives: Review of DC Motors and its performance, starting, braking, speed control, Controlled rectifier fed DC drives with continuous and discontinuous mode of operation- 1-ph and 3-ph fully controlled rectifier fed separately excited dc motor, multi-quadrant operation of dc motor, Supply Harmonics, Power Factor and ripple in motor current, Chopper Controlled DC Drives, Sources current harmonics in chopper, Converter Ratings and closed loop control

UNIT-III

[12]

AC Drives: Review of Three phase Induction Motor and its performance, starting, braking, speed control, Operation of I.M with unbalanced source voltages and single-phasing, with unbalanced rotor impedance, Analysis of I.M fed from non-sinusoidal voltage supply, Stator Voltage control , Variable Frequency Control, VVVF control, voltage source inverter, current source inverter, Cyclo-converter control, static rotor resistance control, slip power recovery control schemes.

UNIT-IV

[10]

Three Phase Synchronous Motors: Review of Three phase Synchronous Motor and its performance, Self controlled schemes, Variable frequency control of multiple synchronous motor, Permanent magnet AC motor drives, Brushless DC Motor Drives, Industrial Applications.

Text Books

1) Dubey G.K, “Fundamentals of Electrical Drives”, Narosa Publishing House, Second Edition, 2001.
2) Vedam Subrahmanyam, ‘Electric drives: concepts and applications’ , TMHE Publication
3) Pillai S.K., “A First Course on Electrical Drives”, New Age International, Second Edition, 2006.
4) Ned Mohan, ‘First Course on Power Electronics and Drives’, MNPERE, 2003 Edition.

Reference Books

1) De N.K., Sen P.K. “Electric Drives”, Prentice Hall of India, Second Edition , 2001.
2) Krishnan, R, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall of India, Second Edition , 2001.
3) Bimal K. Bose, ‘Modern Power Electronics and AC Drives’, PHI Publication
4) Ned Mohan et al, “Power Electronics: Converters, Applications, and Design”, John Wiley & Sons. Inc., 2nd Edition, 1995.
5) Werner Leonhard, “Control of electrical drives”, Springer, 1995.

Web resources

1) https://nptel.ac.in/courses/108102046/
2) https://nptel.ac.in/courses/108108077/
3) https://irimee.indianrailways.gov.in/instt/uploads/files/1455168405740-AC%20Motor%20Drives.pdf

MOOCs

xiii) https://www.edx.org/

xiv) https://www.nptel.ac.in/

xv) https://www.coursera.org/

Subject: **ENERGY AUDIT**								
Program:				Subject Code: EL0631			Semester: VI	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	40	-	60	-	100

SYLLABUS

UNIT-I **[11]**

Energy Audit Methodology and recent trends.

General Philosophy, need of Energy Audit and Management, EC Act, Definition and Objective of Energy Management, General Principles of Energy Management. Energy Management Skills, Energy Management Strategy. Economics of implementation of energy optimization projects, it's constraints, barriers and limitations, Financial Analysis: Simple Payback, IRR, NPV, Discounted Cashflow;

Report-writing, preparations and presentations of energy audit reports, Post monitoring of energy conservation projects, MIS, Case-studies / Report studies of Energy Audits. Guidelines for writing energy audit report, data presentation in report, findings recommendations, impact of renewable energy on energy audit recommendations. Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy. Case studies of implemented energy cost

optimization projects in electrical utilities as well as thermal utilities.

UNIT-II **[11]**

Electrical Distribution and Utilization: Electrical Systems, Transformers loss reductions, parallel operations, T & D losses, P.F. improvements, Demand Side

management (DSM), Load Management, Harmonics & its improvements, Energy efficient motors and Soft starters, Automatic power factor Controllers, Variable speed drivers, Electronic Lighting ballasts for Lighting, LED Lighting, Trends and Approaches. Study of 4 to 6 cases of Electrical Energy audit and management (Power factor improvement, Electric motors, Fans and blowers,

Cooling Towers, Industrial/Commercial Lighting system, etc.)

UNIT-III **[10]**

Thermal Systems: Boilers- performance evaluation, Loss analysis, Water treatment and its impact on boiler losses, integration of different systems in boiler operation. Advances in boiler technologies, FBC and PFBC boilers, Heat recovery Boilers- it's limitations and constraints. Furnaces- Types and classifications, applications, economics and quality aspects, heat distributions, draft controls, waste heat recovering options, Furnaces refractory- types and sections. Thermic Fluid heaters, need and applications, Heat recovery and its limitations. Insulators- Hot and Cold applications, Economic thickness of insulation, Heat saving and application criteria. Steam Utilization Properties, steam distribution and losses, steam trapping, Condensate, Flash steam recovery

UNIT-IV **[10]**

System Audit of Mechanical Utilities: Pumps, types and application, unit's assessment, improvement option, parallel and series operating pump performance. Energy Saving in Pumps & Pumping Systems. Bloomers (Blowers) types & application, its performance assessment, series & parallel operation applications & advantages. Energy Saving in Blowers Compressors, types & applications, specific power consumption, compressed air system,& economic of system changes. Energy Saving in Compressors & Compressed Air Systems Cooling towers, its types and performance assessment & limitations, water loss in cooling tower. Energy Saving in Cooling Towers .Study of 4 to 6 cases of Energy Audit & Management in Industries (Boilers, Steam System, Furnaces, Insulation and Refractory, Refrigeration and Air conditioning, Cogeneration, Waste Heat recovery etc.)Study of Energy Audit reports forvarious Industries and Organizations

Reference Book

1. Energy Audit and Management, Volume-I, IECC Press
2. Energy Efficiency in Electrical Systems, Volume-II, IECC Press
3. Energy Management: W.R.Murphy, G.Mckay, Butterworths Scientific
4. Energy Management Principles, C.B.Smith, Pergamon Press
5. Industrial Energy Conservation, D.A. Reay, Pergammon Press
6. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience
7. Industrial Energy Management and Utilization, L.C. Witte, P.S. Schmidt, D.R. Brown, Hemisphere Publication, Washington, 1988

Hand Book of Energy Audits, Albert Thumann, P.E., C.E.M. William J. Younger, C.E.M., CRC Press

Subject: Energy Management								
Program: B.Tech. Electrical Engineering				Subject Code: EL0620				Semester: VI
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	40	0	60	0	100

Perquisites:

xvii) Knowledge of Different Sources of Energy

xviii) Knowledge of Basic Structure of Energy Flow in Power Network

Course Objective:

(xxxiv) To Study the Current Energy Scenario in India and World

(xxxv) To Study the Time-wise Cost of Energy

(xxxvi) To Study the Energy Conservation Opportunities in Industries

(xxxvii) To Study about the Load Management

Course Outcome:

After studying this subject, Student will able to,

xiii) Understand the Energy Scenario in India and World

xiv) Understand and Develop Energy Management Program

xv) Calculate the Time Value for Energy

xvi) Calculate the Energy Bills for Different Utilities

xvii) Identify the Energy Conservation Opportunities in Industrial Sector

xviii) Understand the Load Management Program in Different Situations

SYLLABUS

UNIT-I **[11]**

Organizing for Energy Management

Concept of Energy Management, Types of Energy Sources, Organizing EM Program, Surveying Energy Usage and Losses, The Six Equipment Audit Categories, Energy Conservation Opportunities, Energy Monitoring and Forecasting, Employee Participation

Energy Scenario and Conservation Programs in India

An Energy Summary in India, National Energy Plan, Energy Policy of India, Energy Conservation in India, Progress Made in Energy Conservation in India, National Institutes Promoting Energy Conservation

UNIT-II **[11]**

Translating Energy into Cost

Important Concepts in an Economic Analysis, Economic Models- Their Applications and Limitations, Time Value of Money- Concept and Examples, Utility Rate Structures, Calculating the Cost of Electricity, Loss Evaluation

UNIT-III **[16]**

Energy Management in Industrial Sector

Industrial Energy Efficiency, Energy Conservation in Indian Industrial Sector, Energy Saving Potential in Industries equipments (Boiler, Furnaces, Air Compressors, Refrigeration System, Heat Exchanger, Heat Pump, Turbines, Electrical Drives, Pumps, Cooling Towers, Fans and Blowers), Energy Saving Techniques/ Processes (Fluidized Bed Combustion Technology, Waste Heat Recovery, Microwave Heating, Laser Beam Welding, Electron Beam Welding, Process Automation)

UNIT-IV **[07]**

Load Management

Definition of Load Management, Demand Control Techniques, Utility Monitoring and Control System, HVAC and Energy Management, Economic Justification of Load Management System

Text Books

ix) IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.

x) Energy Management, Dr. Sanjeev Singh, Umesh Rathore, 2nd Edition, Katson Books, 2017.

Reference Book

v) Energy Efficiency for Engineers and Technologists, Eastop T.D, Croft D.R, Logman Scientific & Technical, 1990.

vi) Industrial Energy Conservation, Reay D. A. , 1st Edition, Pergamon Press, 1977.

Web Resource

vii) Manual on Energy Management by Bureau of Energy Efficiency

Link: https://beeindia.gov.in/

MOOCS:

Subject: **ELECTRIC ENERGY STORAGE SYSTEM**								
Program: **B.Tech Electrical Engineering**				Subject Code: EL0630			Semester: VI	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	40	-	60	-	100

Course Outcomes:

1. analyze the characteristics of energy from various sources and need for storage
2. classify various types of energy storage and various devices used for the purpose
3. Identify various real time applications.
4. Understand need of energy storage systems
5. Acquire knowledge pertaining to various ways to store energy, its analysis and use
6. Focus and develop hydrogen storage and fuel cell systems though research

SYLLABUS

UNIT-I

Electrical Energy Storage Technologies:Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

UNIT-II

Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy, different types of energy storage, mechanical, chemical, electrical, electrochemical, biological, magnetic, electromagnetic, thermal, comparison of energy storage technologies

UNIT-III

Energy Storage Systems: Thermal Energy storage, sensible and latent heat, phase change materials, Energy and exergy analysis of thermal energy storage, Electrical

Energy storage-super-capacitors, Magnetic Energy storage-Superconducting systems, Mechanical-Pumped hydro, flywheels and pressurized air energy storage, Chemical-Hydrogen production and storage, Principle of direct energy conversion using fuel cells, thermodynamics of fuel cells, Types of fuel cells, AFC, PEMFC, MCFC, SOFC, Microbial fuel cell, Fuel cell performance, Electrochemical Energy Storage- Battery, primary, secondary and flow batteries,

UNIT-IV

Design and Applications of Energy Storage: Renewable energy storage-Battery sizing and stand-alone applications, stationary (Power Grid application), Small scale application-Portable storage systems and medical devices, Mobile storage Applications- Electric vehicles (EVs), types of EVs, batteries and fuel cells, future technologies, hybrid systems for energy storage.

Test/References:

1. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech.
2. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York,
3. Handbook of battery materials by C. Daniel, J. O. Besenhard,Wiley VCH Verlag GmbH & Co. KgaA
4. Electric & Hybrid Vehicles by G. Pistoia, Elsevier B. V.
5. Thermal energy storage: Systems and Applications by Dincer I. and Rosen M. A., Wiley pub.
6. Energy Storage: Fundmentals, Materials and Applications, by Huggins R. A., Springer
7. Fuel cell Fundamentals by R. O'Hayre, S. Cha, W. Colella and F. B. Prinz, Wiley Pub.
8. Chemical and Electrochemical Energy System by R. Narayan and B. Viswanathan, University Press.
9. Battery Systems Engineering by C. D. Rahn and C. Wang, Wiley Pub.
10. Electrochemical Energy Storage for Renewable sources and grid balancing by P. T. Moseley and J. Garche, Elsevier Science

Compressed air energy storage by F. P. Miller, A. F. Vandome, M. B. John, VDM publishing.

Subject: Electrical Power Utilization and Control								
Program: B.Tech. Electrical Engineering				Subject Code:EL0618			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	40	0	60	0	100

Prerequisites:

xix) Knowledge of Power Generation, Transmission and Distribution Network

xx) Knowledge of Electrical Machines and Drives

Course Objective:

(xxxviii) To Study about the operating characteristics of electric drive

(xxxix) To Study Various Industrial Heating Methods

(xl) To Study the Concept of Electric Traction

(xli) To Study the Concept of Electric and Hybrid Vehicles

Course Outcome:

After studying this subject, Student will able to,

xix) Understand the operating characteristics of electric drive

xx) Calculate the Flywheel Calculations and Load Equalization

xxi) Understand the Concept and Working Principle of Various Electric Heating Methods

xxii) Understand the principle of Electric Traction System

xxiii) Understand the Power Supply Network for Traction System

xxiv) Understand the Concept of Electric and Hybrid Vehicles

SYLLABUS

UNIT-I **[12]**

Electric Drive

Introduction, Factors Governing Selection of Electric Motors, Types of Drive, Starting and Running Characteristics of Electric Motor, Mechanical Consideration of Electric Motor, Braking of Motors – Plugging, Rheostatic and Regenerative Braking, Load Equalization, Temperature Rise Calculations.

UNIT-II **[10]**

Electric Heating

Introduction, Domestic and Industrial Application, Advantages, Classification, Resistance Heating and its types, Design of Heating Element, Temperature Control of Resistance Furnace, Causes of Failure of Heating Element, Induction Heating and its types, Arc Furnace, Condition of Maximum Output, Eddy Current Heating, Dielectric Heating

UNIT-III **[16]**

Electric Traction

Traction System, Types of Traction System, Speed-Time Curve – Trapezoidal, Quadrilateral, Mechanics of Train Movement, specific energy consumption.

Power Supply for Electric Traction

Overview, Current Collection System, Current Collector for Overhead System, Transmission System for Traction Substation, Substations and Location of Substations, Block Diagram of an AC Electric Locomotive

UNIT-IV **[07]**

Introduction to Electric and Hybrid Vehicles:

Configuration and Performance of Electric Vehicles, Traction Motor Characteristics, Tractive Effort, Transmission Requirement, Vehicle Performance and Energy Consumption.

Text Books

i) Utilization of Electrical Energy, E. Open Shaw Taylor, Orient Longman Publication.

ii) Utilization of Electrical Power & Electric Traction, J. B. Gupta, S. K. Kataria Publications

Reference Book

i) 'Modern Electric Traction', H.Partab, DhanpatRai Publications

ii) A Course in Electrical Power, Soni, Gupta and Bhatnagar, DhanpatRai & Sons

iii) Utilisation of Electric Power & Electric Traction, G. C. Garg, Khanna Publishers

Web Resource

i) https://nptel.ac.in/courses/108102046/3

ii) http://www.rknec.edu/FirstYearContents/2017-18/Electrical%20heating.pdf

iii) http://www.darshan.ac.in/Upload/DIET/Documents/EE/UEET_2160907_CH_7_27012018_042415AM.pdf

iv) https://rdso.indianrailways.gov.in/works/uploads/File/STC-TrD-01.pdf

MOOCS:

xvi) https://www.edx.org/

xvii) https://www.nptel.ac.in/

xviii) https://www.coursera.org/

Subject: **HIGH SPEED TRAIN SAFETY AND CONTROL (OE)**								
Program: B.Tech Electrical Engineering				Subject Code: EL0629			Semester: VI	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	40	-	60	-	100

Course Outcome

1. Understanding the systems and technologies involved in a High Speed Rail System
2. Understanding the parallel monitoring technique.
3. Analyze the causes of failure of high speed trains
4. Evaluate Different safety analysis technique
5. Understand the operating procedure of high speed rail
6. Understand the monitoring of high speed trains

SYLLABUS

UNIT-I

System science and train operation safety, the critical control items of train safety, the architecture of train safety control system, the key technology of train safety, principle of system level “Fail Safe”, application of system level “Fail Safe” in high speed trains**.**

UNIT-II

Concept of parallel monitoring technology, Speed parallel monitoring relying on board and ground ATP equipment, TSR parallel monitoring, Data sharing of train control system, the fusion of train control data, avoid common cause errors.

UNIT-III

Operation Behavior monitoring, monitoring of the signaling system and human factors for a closed loop, Intelligent train operation control, failure causing factors of a high speed railway signaling system, risk control methods for train control system

UNIT-IV

Safety analysis methods, qualitative and quantitative methods, basic principle of system safety evaluation, phase of a system safety evaluation, system safety assessment.

Reference Book

1. The Second Age of Rail: A History of High-Speed Trains, Murray Hughesis, The History Press Ltd; UK ed. edition (6 July 2015)

2. Design of High-Speed Railway Turnouts: Theory and Applications, Ping Wang, Academic Press; 1st edition (27 April 2015)

3. Handbook on High Speed Rail, Edited by Yoshitsugu Hayashi, KE Seetha Ram, and Shreyas Bharule, Asian Development Bank Institute, 2020

Safety Theory and Control Technology of High-Speed Train Operatio, Junfeng Wang, Elsevier Science, 2017

Subject: Electric and Hybrid Vehicles								
Program: B.Tech.				Subject Code: EL0625				Semester: VI
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	40	-	60	-	100

Perquisites:

xxi) Electrical Machines

xxii) Electrical Power Utilization and Traction

xxiii) Power Electronics

Course Objective:

(xlii) To understand concept of hybrid vehicle.

(xliii) To understand concept of hybrid traction.

(xliv) To understand concept of hybrid drive train topology.

(xlv) To understand fuel efficiency analysis.

(xlvi) To understand configuration and control of electric drives.

(xlvii) To understand hybrid system design.

Course Outcome:

xxv) Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.

xxvi) Able to apply mathematical models to describe vehicle performance.

xxvii) Able to apply Power flow control in hybrid drive-train topologies.

xxviii) Able to apply different configuration and control of electric drives.

xxix) Able to design Hybrid system.

SYLLABUS

UNIT-I

[10]

Introduction to EV

History of hybrid and electric vehicles.Social and environmental importance of hybrid and electric vehicles.Impact of modern drive-trains on energy supplies.Basics of vehicle performance.Vehicle power source characterization. Transmission characteristics. Mathematical models to describe vehicle performance.

UNIT-II

[10]

Hybrid traction

Basic concept of hybrid traction. Introduction to various hybrid drive-train topologies. Power flow control in hybrid drive-train topologies. Fuel efficiency analysis Basic concepts of electric traction. Introduction to various electric drive-train topologies. Power flow control in hybrid drive-train topologies. Fuel efficiency analysis

UNIT-III

[15]

EV and Hybrid configuration control

Introduction to electric components used in hybrid and electric vehicles. Configuration and control of DC Motor drives. Configuration and control of Introduction Motor drives. Configuration and control of Permanent Magnet Motor drives. Configuration and control of Switch Reluctance Motor drives. Drive system efficiency

UNIT-IV

[10]

Hybrid Systems Design

Matching the electric machine and the internal combustion engine (ICE). Sizing the propulsion motor. Sizing the power electronics. Selecting the energy storage technology. Communications. Supporting subsystems

Text Books

1. Sira -Ramirez, R. Silva Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, “Sliding mode control of switching Power Converters”

Web Resource

1. https://nptel.ac.in/downloads/108103009/
2. https://pluginbc.ca/wp/wp-content/uploads/2014/07/EV-Beginners-Guide_Final_Sept2_2014.pdf

MOOCS:

xiii) https://www.edx.org/

xiv) https://www.nptel.ac.in/

xv) https://www.coursera.org/

ज्ञानेन प्रकाशते जगत् INDUS UNIVERSITY	**INDUS INSTITUTE OF TECHNOLOGY& ENGINEERIN** **Constituent Institute of Indus Universit**

Subject: Internet of Things								
Program: B. Tech CE/CS/IT				**Subject Code: CE0622**			**Semester: VI**	
Teaching Scheme (Hours per week)				**Examination Evaluation Scheme (Marks)**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	**0**	**2**	**4**	**40**	**40**	**60**	**60**	**200**

Course Objectives

1. Introduce evolution of internet technology and need for IoT.
2. Train the students to build IoT systems using sensors, single board computers and open source IoT platforms that help in skill development.
3. To identify the design, development and security challenges in IoT Systems.
4. To study IoT Applications in Different Domains and be able to measure their performance that enhances the employability skills of students.
5. To implement basic IoT Applications on Embedded Platforms to enhance entrepreneurship skills in students.

CONTENTS

UNIT-I

[12 hours]

Introduction to IoT

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs, Machine to Machine, IoT versus Machine to Machine, Challenges in IoT: Design challenges, Development challenges, Security challenges

Application of IoT: Home automation, Industry applications, Surveillance applications

UNIT-II

[12 hours]

IoT Reference Architecture- Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment.

Constraints affecting design in IoT world- Introduction, Technical design Constraints.

Web Infrastructure for managing IoT Resources: Introduction, Open IoT Architecture for IoT/Cloud Convergence, Scheduling Process and IoT Service Lifecycle, Device/Cloud
Collaboration Framework

UNIT-III

[12 hours]

Internet of Things Privacy, Security and Governance: Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities and Security.

UNIT-IV

[12 hours]

PREPARING IOT PROJECTS: Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.

Course Outcomes

At the end of this subject, students should be able to:

1. Explain the Principles of Internet of Things
2. Design and develop IoT based sensor systems.
3. Employ IoT Solutions to Real Time Engineering Problems
4. Familiar with the Data Management Techniques, Architectures and various key enablers to enable practical IoT systems
5. Identify the Challenges and Research Scope in Communication Protocols used in IoT Applications.
6. Solve IoT security problems using light weight cryptography

Text Books:

1. Internet of Things Principles and Paradigms, Edited By Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufmann, ELSEVIER
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, “From Machine to Machine to Internet of Things”, Elsevier Publications, 2014

Reference Books:

1. Fundamentals of Wireless Sensors Networks Theory and Practice, Waltenegus Dargie and Christian Poellabauer, WILEY Series
2. Rethinking the Internet of Things A Scalable approach to connecting everything, Francis daCosta, Apress Open

3. Arduino Cookbook, Michael Margolis, O'Reilly
4. Internet of Things – From Research and Innovation to Market Deployment, Edited By Ovidiu Vermesan and Peter Friess, River Publishers

Web Resources:

1. NPTEL Lecture: https://nptel.ac.in/courses/106105166/

LIST OF EXPERIMENTS

Experiment. No.	Title	Learning Outcomes
1	Familiarization with Arduino/Raspberry Pi and perform necessary software installation.	CO-1
2	To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.	CO-2,3
3	Interface analog sensor (PIR Sensor, temperature sensor LM35, Ultrasonic Sensor) with - Arduino	CO-2
4	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from a smart phone using Bluetooth.	CO-2,3
5	To install MySQL database on Raspberry Pi and perform basic SQL queries.	CO-3,4
6	Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.	CO-1,3
7	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.	CO-3,4
8	Write a program to create a TCP server on Arduino/Raspberry Pi and respond with humidity data to the TCP client when requested.	CO-4,5
9	Creating a webpage and display the values available through Arduino	CO-4,5
10	Open Ended Experiment-Mini Project: Working on any IOT Application	CO-5,6

Subject: Power System Operation & Control								
Program: B.Tech. Electrical Engineering				Subject Code: EL0616				Semester: VI
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	2	4	40	40	60	60	200

Perquisites:

xxiv) Power System I

xxv) Power System II

xxvi) Switchgear and Protection

Course Objective:

(xlviii) To understand concept of Load flow Analysis.

(xlix) To learn the concept Economic Load dispatch

(l) To learn the concept of Unit Commitment.

(li) To understand steady state and transient stability

(lii) To understand the concept of load frequency control.

(liii) To understand the concept of power system security

Course Outcome:

xxx) Able to analyze load flow study.

xxxi) Able to apply economic load diapatch.

xxxii) Able to apply unit commitment.

xxxiii) Able to understand steady state stability condition.

xxxiv) Able to understand transient stability condition.

xxxv) Able to apply Load frequency control.

SYLLABUS

UNIT-I

[09]

Load Flow Studies

Network model formulation, Bus Incidence matrix, formation of Y bus, Y Bus Algorithm, power flow problem, different types of buses, approximate power flow,

Gauss Seidel method, Algorithm, Flow chart, Newton-Raphson method, NR algorithm, Jacobian Matrix, FDLF.

UNIT-II

[10]

Economic Load Dispatch

Economic dispatch of thermal units and methods of solution, Transmission losses, B matrix loss formula, Composite generation production cost function-solution by gradient search techniques, Nonlinear function optimization

Unit Commitment

Constraints in Unit commitment, Spinning reserve, Thermal and hydro constraints, Unit commitment solution methods-Priority list methods, Dynamic programming solution.

UNIT-III

[09]

Automatic Generation Control

Governor characteristic for single area and parallel operated unit, Turbine speed governing system, Single area load frequency control, speed governing system and characteristics, Tie line load frequency control, cascade tripping and restoration process.

Reactive Power and Voltage Control

Reactive power and its relation to voltage control, location of voltage control equipment, methods of voltage control, excitation control, voltage regulators, tap changing transformers, booster transformers, reactive power injection and voltage control by synchronous condenser.

UNIT-IV

[12]

Power System Stability

Introduction, dynamics of a synchronous machine, power angle equation-swing equation, power angle curve, simple systems, steady state stability, condition of steady state stability, transient stability, equal area criteria- Sudden change in Mechanical input, effect of clearing time on stability, sudden loss of one of parallel lines, sudden short circuit on one of parallel lines, numerical solution of swing equation, some factors affecting transient stability.

Power System Security

Factors affecting power system security, Contingency analysis: Detection of network

problems, Correcting the generation approach: Sensitivity factors.

Text Book

1. A. J. Wood and B.F. Wollenberg, “Power Generation Operation and Control”, John Wiley & Sons, ICN., 2nd Edition.

Reference Book

2. A. K.Mahalanabis, “Computer Aided Power system analysis and control”, Tata McGraw Hill 1991
3. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill, 2nd Edition, 1982,Dec
4. Stevenson J V, William D, “Elements of Power System Analysis”, McGraw Hill, 1988.
5. I. J. Nagrath & D.P. Kothari, “Modern Power System Analysis”, Tata McGraw Hill,1989

Web Resource

nptel.ac.in/downloads/108101040/

MOOCS:

xvi) https://www.edx.org/

xvii) https://www.nptel.ac.in/

https://www.coursera.org/

Subject: Testing & Commissioning of Electrical Equipment								
Program: B.Tech. Electrical Engineering				Subject Code:EL0624			Semester: VI	
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	60			40	100

Perquisites:

xxvii) Electrical Power System I

xxviii) Electrical Machine -1

xxix) Electrical Machine -2

Course Objectives:

(liv) To understand different types of testing of transformers

(lv) To provide knowledge of installation of transformers.

(lvi) To understand the types of testing of Induction Motors

(lvii) To understand the Maintenance and service of substation equipments.

(lviii) Analysis of different types of cables and conductors of transmission line.

(lix) To understand the Sizing and requirement of substation.

Course Outcome:

After the end of the course the students will be able to

xxxvi) Service & Maintenance of Transformers

xxxvii) Commissioning of Substation and Its Equipments

xxxviii) Calculate the cable sizing , Operation & Maintenance of Transmission Line

xxxix) Commissioning & Testing of large scale motors.

xl) Service & Maintenance of Different types of Power Apparatus.

xli) Commissioning and installation of Earthing System.

SYLLABUS

UNIT-I

[09]

Transformer

Testing procedure for HV testing ,Phase shifting/ phase group , Radio interference, Ratio Test , Load loss ,Separate source voltage testing ,Induced voltage testing , Impulse & Surge testing , Noise level & vibration testing , Short circuit withstand

test ,Tan Delta test , Core insulation voltage test, Measurement of impedance ,Testing of auxiliaries & safety device , Oil testing , Classification of testing methods , Testing of bushing. DC & AC Resistance measurement, Temp. Rise test, Short circuit test, Dielectric test, Partial discharge, Insulation resistance testing. Polarity testing, Short time current rating, Impulse & surge testing, Determination of error & accuracy class, Power frequency voltage withstand test, over voltage inter-turn test. Determination of polarization index for transformer. Drying out procedure for transformer. Commissioning steps for transformer, Purification & Filtration Procedure for Transformer oil. Troubleshooting & Maintenance of transformer.

UNIT-II

[12]

Induction Motor Testing (3-phase & 1-phase)

Hammer test, Testing against variation of voltage/current/frequency, Load test, NL & BR test, DC & AC, Resistance measurement, Insulation measurement, Starting test, Temp. Rise test, Slip measurement, HV test, Testing on auxiliaries, Vibration Test, Noise level test. Drying out methods / Polarization Index / Hot Temperature measurement Degree of protection (IP Grade) Commissioning steps for Induction motor, Heat Run Test. Commissioning of Induction Generator. Troubleshooting & maintenance of induction motor.

DC Machines

Testing Voltage drop test or bar to bar test, Load test, Open circuit & magnetizing test, Insulation resistance, Starting performance, Dielectric test. Swinburne ' s test, Hopkinson's test, Field test, Separation of losses in DC shunt machine. Temp. rise test & Heat run test Drying out process Commissioning steps for DC machines Troubleshooting & maintenance.

UNIT-III

[12]

Substation Equipments

Bus bar Temp. Rise test, Rated short time current test, HV test, Power frequency voltage withstand test, Impulse / surge testing, Vibration. Earthing Earthing resistance measurement, Substation grid Earthing, Soil resistivity measurement. Isolator Testing Temp. Resistance test, Short circuit test, Charging current making & breaking test, Inductive current making & breaking test.

Circuit breaker: Testing of HV/LV circuit breaker

No load Mechanical Operation, Mechanical endurance test, Temp. Rise test, Impulse & surge testing, short time current test. Short circuit making & breaking test, Line Charging current making & breaking test, Cable charging & capacitor bank making & breaking test, Out of phase switching, Short line fault test, and Electrical & Mechanical endurance test for LT switch gear like MCB / MCCB /ELCB etc. C.T. & P.T. Testing, Relay testing, Coupling capacitors, Station Batteries for D.C. Supply, Fire Shifting Equipments. Testing & Commissioning of Lightning Arrestor, Substation Commissioning by Thermograph. Troubleshooting & maintenance of circuit breakers.

UNIT-IV

[12]

Synchronous machine: Testing

OC & SC test, Characteristics, Loss measurement, Temp. rise test , Over speed test , HV testing , Insulation resistance wave form interference , DC & AC Resistance of armature & field winding measurement , Dielectric testing on armature & field winding , Mechanical balance , Magnetic balance , Current balance , Phase sequence.

Commissioning of transmission line & Cable

Derating of cable capacity, HV test, AC & DC Resistance check, Insulation resistance, Impedance measurement, Location finding technique for fault in underground cables (Murray loop test & Warley loop test), Testing of open circuit faults in cables. Line charging, loading & Dropping.

Text Books

1. Testing, Commissioning & maintenance of electrical equipment By S. S. Rao, khanna publications

Reference Book

1. The commissioning of Electrical Plant by RCH Richardson (Chapman & Hall)

Web Resource

MOOCS:

xviii) https://www.edx.org/

xix) https://www.nptel.ac.in/

xx) https://www.coursera.org/

Subject: Advanced Control Theory								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0623**			**Semester:VI**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Prerequisites:

vii) Laplace transform

viii) Linear Algebra

ix) Differential Equations

x) Control System basics

xi) Matrix Algebra

Course Objectives:

(xiii) To Learn various methodology of modelling in state space,

(xiv) State transition matrix and solution in state equation, controllability and observability will be studied.

(xv) Stability analysis issues of linear and nonlinear system in state space will be discussed.

(xvi) To know the concepts of controller design and observer design.

Course Outcome:

Students will be able to:

vii) Understand the basic concepts of state space representation and state transformation techniques.

viii) Able to learn state transition matrix, its properties and solution of state equations.

ix) Understand and apply controllability and observability concepts in control systems.

x) Understand the different types of nonlinear systems and stability conditions for them.

xi) Learn and apply Liapunov Stability Analysis conditions for control systems.

xii) Design and Analyze pole placement technique and state observer designs.

SYLLABUS

UNIT-I

[11]

State Space Analysis of Control Systems: State Variables; State-Space Representation of Electrical, Mechanical and Electromechanical Systems; State Space Representation of nth Order Linear Differential Equation; Transformation to Phase Variable Canonical Form; Relationship Between State Equations and Transfer Functions; Characteristic Equation; Eigen Values and Eigen Vectors; Transformation to Diagonal Canonical Form; Jordan Canonical Form; Controllability Canonical Form; Observability Canonical Form; Decomposition of Transfer Function-Direct, Cascade and Parallel Decomposition;

UNIT-II

[11]

State Diagram; Solution of the Time Invariant State Equation; State Transition Matrix and its Properties; Transfer Matrix; Transfer Matrix of Closed Loop Systems.

Controllability and Observability: Concept of Controllability and Observability; Kalman's Theorems on Controllability and Observability, Alternative Tests (Gilbert's Method) of Controllability and Observability; Principle of Duality; Relationship among Controllability, Observability and Transfer Function.

UNIT-III

[12]

Introduction to nonlinear systems, Types of common nonlinearities, Stability of nonlinear systems, describing functions analysis, limit cycles.

Liapunov Stability Analysis: Stability of Equilibrium State in the Sense of Liapunov, Graphical

representation of Stability Asymptotic Stability and Instability, Sign-Definiteness of Scalar Function.

UNIT-IV

[11]

Pole placement Design & State Observers:

Stability improvement state feedback control, Pole Placement Design, State Regulator Design, Observer Design, State Feedback with Integral Control, Design of Full order state Observer, Design of reduced order state observer

Text Books

iii) M. Gopal, "Digital control and state variable methods", 2nd Ed, TMH Publication.

iv) Katsuhiko Ogata, "Modern Control Engineering", 4th Ed, Prentice Hall of India.

v) Benjamin C. Kuo, "Automatic Control Systems", PHI Learning Private Limited, 2010.

Reference Books

iii) Norman S Nise, "Control system engineering", 4th Ed., Wiley-India Edition.

iv) A. Tewari, Modern Control Design: with MATLAB and SIMULINK, Wiley, 2002.

v) I. J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers, Fifth Edition, 2007.

vi) D. R. Choudhuary, "Modern Control Engineering, PHI, 2005.

vii) Stefani et. al., Design of Feedback Control Systems, Oxford, Fourth edition, 2002.

Web resources

i) https://nptel.ac.in/courses/101108047/32.

ii) https://nptel.ac.in/courses/101108047/module9/Lecture%2022.pdf

MOOCs

xix) https://www.edx.org/

xx) https://www.nptel.ac.in/

xxi) https://www.coursera.org/

Subject: Digital Signal Processing								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0622**			**Semester: VI**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Course Outcome

By the end of this course, the student will be able to:

1. Formulate engineering problems in terms of DSP tasks 2
2. Analyse digital and analog signals and systems
3. Analyze discrete time signals in frequency domain
4. Design digital filters
5. Change sampling rate of the signal
6. Conceptualize the need of adaptive filters in communication applications.
7. Understand the key Architectural features of Digital Signal Processor
8. Apply digital signal processing algorithms to various areas

SYLLABUS

UNIT-I

[10]

Introduction to DSP: Overview: Signals, systems and signal processing, classification of signals, elements of digital signal processing system, concept of frequency in continuous and discrete time signals, Periodic Sampling, Frequency domain representation of sampling, Reconstructions of band limited signals from its samples

Discrete-Time Signals and Systems (Frequency Domain analysis): Z-transform & Inverse z-transform, Linear convolution and its properties, Linear Constant Coefficient Difference equations, Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT), Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform Theorems.

UNIT-II

[10]

Analysis of Linear Time Invariant System: Analysis of LTI systems in time domain and stability considerations. 8 15 Frequency response of LTI system, System functions

for systems with linear constant-coefficient Difference equations, Freq. response of rational system functions relationship between magnitude & phase, All pass systems, inverse systems, Minimum/Maximum phase systems, systems with linear phase.

UNIT-III

[15]

Structures for Discrete Time Systems: Block Diagram and signal flow diagram representations of Linear Constant-Coefficient Difference equations, Basic Structures of IIR Systems, lattice and lattice-ladder structures, Transposed forms, Direct and cascade form Structures for FIR Systems, Linear Phase FIR structure, Effects of Co-efficient quantization.: Block Diagram and signal flow diagram representations of Linear Constant-Coefficient Difference equations, Basic Structures of IIR Systems, lattice and lattice-ladder structures, Transposed forms, Direct and cascade form Structures for FIR Systems, Linear Phase FIR structure, Effects of Co-efficient quantization.

Filter Design Techniques: Design of Discrete-Time IIR filters from Continuous-Time filters Approximation by derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques..

UNIT-IV

[10]

Discrete-Fourier Transform & Fast Fourier Transform: Representation of Periodic sequences: The discrete Fourier Series and its Properties Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform, Properties of DFT, Linear Convolution using DFT. FFT-Efficient Computation of DFT, Goertzel Algorithm, radix2 Decimation-in-Time and Decimationin-Frequency FFT Algorithms.

Text Books:

1. “Digital Signal Processing: Principles, Algorithm & Application”, 4th edition, Proakis, Manolakis, Pearson

2. “Discrete Time Signal Processing”:Oppeheim, Schafer, Buck Pearson education publication, 2nd Edition, 2003.

3. Digital Signal Processing fundamentals and Applications,Li Tan , Jean Jiang, Academic Press,2nd edition,2013

Reference Books:

1. Digital Signal Processing – A computer based Approach, S.K.Mitra, Tata McGraw Hill,3rd edition,2006

2. Fundamentals of digital Signal Processing –Lonnie c.Ludeman, Wiley

3. Digital Signal processing-A Practical Approach,second edition, Emmanuel I. feacher, and BarrieW..Jervis, Pearson Education

4. Digital Signal Processing, S.Salivahanan, A.Vallavaraj, C.Gnapriya TMH 8. Digital Signal Processors, Architecture, programming and applications by B. Venkatramani, M Bhaskar, Mc-Graw Hill

Subject: Advance Micro controller								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0721**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Perquisites:

i) Microprocessor

ii) Microcontroller

iii) Digital Logic Design

Course Objectives:

i) To know application of 8051 microcontroller and its interfacing.

ii) To understand the Architecture of PIC microcontroller.

iii) To learn the RISC architecture and ARM7 controller and Its application

iv) To know programming of DSP Processor.

Course Outcome:

i) Able to do advance programming using 8051 with other peripheral.

ii) Learn the PIC18F microcontroller architecture.

iii) Able to interface peripheral of PIC18F and its applications

iv) Understand the ARM controller architecture

v) Learn DSP Processor ARCHITECTURE.

vi) Analyze advance microcontrollers difference, its features and application.

SYLLABUS

UNIT-I

[11]

8051 Microcontroller Advance:

SPI communication Protocol, I2C Communication Protocol, Interfacing of 8051 with SPI and I2C based devices like ADC, DAC and RTC(Real Time Clock), Programming of timers in different modes, programming of PCA timer in different modes, interfacing of 8051 with DC motor and stepper motor.

UNIT-II

[11]

PIC18F Family Microcontroller:

PIC Architecture: Overview of PIC series microcontrollers, block diagram, file register set, memory segmentation, hardware input/output ports, memory addresses, oscillator configuration, power management mode, Reset Features, 8x8 Hardware Multiplier.

PIC18F4550 Family Peripheral and programming:

Interrupt, I/O Ports

UNIT-III

[12]

PIC18F4550 Family Peripheral and programming:

Timer Module - Capture & Compare Mode, ADC, Enhanced Universal Synchronous Asynchronous Receiver Transmitter (EUSART), SPI, PIC Series Microcontroller Applications: Various motor controls like DC, stepper and servo motor, temperature control application, analog sensor applications, interfacing with sensors.

UNIT-IV

[11]

Introduction to Arm:

Advanced RISC Machine-ARM architecture- architectural Inheritance Core and architectures- Registers- Pipeline- LPC 21XX peripheral introduction, Interrupts- ARM organization, General Purpose I/O Functionality: Pin multiplexing and general purpose I/O overview, Introduction to Multiplexing and general purpose I/O Control registers, General purpose I/O ports, General purpose I/O programming.

Digital Signal Processor:

Introduction to DSP Controller, Brief Introduction to Peripherals & Memory.

Text Books

iv) M. Mazidi and others, “The 8051 Microcontroller and Embedded Systems”, PRENTICE Hall Of India, 3rf edition.

v) Muhammad Ali Mazidi, Rolin. D. Muckinlay, Danny Caussey. “PIC Microcontroller And Embedded System Using Assembly and C For PIC18”

vi) John B Beatman. “Design with PIC Microcontrollers” prentice Hall.

vii) Steve Furber. “ARM System on Chip Architecture”. Addision wisely 2nd edition.

Reference Books

i) Dorgan Ibrahim. “Advanced PIC Microcontroller Projects in C”

ii) Martin P Bates, Programming 8-bit PIC Microcontrollers in C with Interactive Hardware Simulation, Newnes Publication.

iii) User guide of ARM controller

iv) User guide of DSP controller.

v) Han Way Huang, PIC Microcontroller: An Introduction to Software and Hardware Interfacing, Cengage Learning Publication.

Web resources

x) https://nptel.ac.in/courses/117104072/

xi) https://docplayer.net/61333140-Chapter-1-introduction-to-the-tmslf2407-dsp-controller.html

xii) http://bwrcs.eecs.berkeley.edu/Classes/CS252/Notes/Lec09-DSP.pdf

xiii) https://www.arm.com/files/word/Yiu_Ch1.pdf

MOOCs

xxii) https://www.edx.org/

xxiii) https://www.nptel.ac.in/

xxiv) https://www.coursera.org/

Subject: Advanced Power Electronics								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0718**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	40	0	60	0	100

Prerequisites:

(i) Basics of power electronics

Course Objectives:

(i) To learn working principle of cycloconverters and its types.

(ii) To learn basics of resonant converters and converters with zero voltage switching

(iii) To learn concept of multilevel converters and PWM controlling methods

(iv) To learn switch mode power supplies, UPS and its applications.

Course Outcome:

(i) Understand cycloconverter working principle , output voltage equation and its types

(ii) Learn resonant converter circuit, dc link and zero voltage switching of converters.

(iii) Understand multilevel inverter, PWM modulations techniques and its applications.

(iv) Understand carrier based control schemes and its features.

(v) Learn switch mode power conversion, its working principle, types and applications.

(vi) Understand uninterruptible power supplies and static switches.

SYLLABUS

UNIT-1 **[12]**

Cycloconverters and Multipulse Converters:

Introduction-Working principle, 1-ph to 1-ph – step up cycloconverter, midpoint, bridge type cycloconverter, 1-ph to 1-ph – step down cycloconverters, midpoint, bridge type cycloconverters, Three phase half wave cycloconverters - 3-ph to 1-ph cycloconverters, 3-ph to 3-ph cy**clocon**verters, output voltage equation for a cycloconverter, load commutated cycloconverter.

Multi-pulse converters : Concept of multi-pulse, Multipulse Diode and SCR Rectifiers- review of 6 pulse, 12 pulse and 18 pulse rectifiers, multi level VSC.

UNIT-2 **[12]**

Resonant Converters

Introduction, Classification of resonant converters, basic resonant circuit concepts, load resonant converters, resonant switch converters, zero-voltage switching, clamped voltage topologies, resonant dc link inverters with zero voltage switching, high-frequency-link integral-half-cycle converters.

UNIT-3 **[11]**

Multi level Inverters

Need for multi-level inverters, Concept of multi-level Cascaded Multi-level Inverter, Operation with equal and unequal DC sources, Carrier based PWM Control Strategy Diode Clamped multi-level inverter, configurations, Space Vector Modulation, Even Order Harmonic Elimination, Effect on Neutral Point Voltage Regulation of Neutral Point Voltage, Carrier Based Control Schemes ; Other Multilevel Inverter Configurations like Flying Capacitor, NPC-Hybrid etc. Features and relative comparison of these configurations and Applications

UNIT-4

[10]

Switch mode DC power supplies

Application of Switch mode DC power supplies, review of non-isolated dc-dc converters, need of isolation, classification of transformer based-isolated DC-DC converters, Fly-back converter, forward converter, full-bridge converter, half-bridge and push-pull converter, practical considerations.

Uninterruptible power supplies-online, offline UPS, static switches-single phase ac switches, dc switches, solid state relays - DC solid state relays, AC solid state relays.

Text Books:

1. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics, Converter, Application and Design", Third Edition, John Willey & Sons, 2004
2. M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Pearson, 2002, India.
3. K. Billings, "Switch Mode Power Supply Handbook", McGraw-Hill, 1999, Boston

Reference Books:

1. B. K. Bose, "Power Electronics and Variable Frequency Drive", Standard Publishers Distributors, 2000.
2. Bin Wu, "High-Power Converters and AC Drives", IEEE Press, A John Wiley & Sons, Inc Publication , New York, 2006.

Web resources

1. https://nptel.ac.in/syllabus/syllabus_pdf/108102006.pdf
2. http://www.nitc.ac.in/electrical/ipg/pegcres/presentations/3%20Dr.%20Rijil%20Ramachand/01_Introduction%20to%20Multilevel%20Inverters.pdf
3. http://webfiles.portal.chalmers.se/et/MSc/DerakhshanfarMSc.pdf
4. http://shodhganga.inflibnet.ac.in/bitstream/10603/16448/7/07_chapter%202.pdf

MOOCs

xxv) https://www.edx.org/

xxvi) https://www.nptel.ac.in/

xxvii) https://www.coursera.org/

ज्ञानेन प्रकाशते जगत् INDUS UNIVERSITY	**INDUS INSTITUTE OF TECHNOLOGY& ENGINEERING** **Constituent Institute of Indus University**

Subject: Artificial Intelligence

Program: B. Tech IT	**Subject Code: IT0701**	**Semester: VII**

Teaching Scheme (Hours per week)				**Examination Evaluation Scheme (Marks)**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	**0**	**2**	**4**	**40**	**40**	**60**	**60**	**200**

Course Objectives:

1. Understand AI Problems and Apply Various Techniques for Engineering Problem Solving and skill development.
2. Solve Game Playing Problems
3. Understand how Expert System is designed and how Knowledge Engineering works to provide employability.
4. Apply Fuzzy Logic for Problem Solving.
5. Apply Semantic Rules for reasoning and inference.
6. Apply Various Algorithms like Breadth First Search, Depth First Search, A* and Heuristic Search for various Applications

CONTENTS

UNIT-I

[12 hours]

Artificial Intelligence: Its Roots and Scope

Introduction, history/early work in AI, Overview of AI Application Areas , Turing Test.AI Problems, The Underlying Assumption, What Is An AI Techniques, The Level Of The Model, Criteria For Success,

Problem Solving by Searching

Defining the problems as a state space search, production systems, production characteristics, production system characteristics, Issues in designing search programs. Uninformed and Informed Search Strategies, Searching with Partial Information, Heuristic Functions,

UNIT-II

[12 hours]

Search Techniques:

Generate and test, Hill climbing, Breadth first search, Depth first search, Hill climbing, Best first search, A* algorithm, AO* Algorithm, Iterative Deepening Search, IDA*, Recursive Best First Search, Constraint Satisfaction and Heuristic Repair, Applications, Problem Solving Agents, Searching for Solutions, Real World Problems, Constraint Satisfaction Search, Local Search Algorithms and Optimization Problems, Online Search Agents and Unknown Environments

UNIT-III

[12 hours]

Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation
Using Predicate Logic: Representation Simple Facts in Logic, Representing Instance and ISA Relationships, Computable Functions and Predicates and Resolution.
Representing Knowledge Using Rules: Procedural versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.
Symbolic Reasoning Under Uncertainty: Introduction to Non monotonic Reasoning, Logics for Non-monotonic Reasoning.
Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory, Fuzzy Logic. Semantic Nets, Frames.

UNIT-IV

[12 hours]

Game Playing : Games, Optimal Decisions in Games, Min max method , Perfect and imperfect decisions, Overview, Min Max, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques.
Learning: Overview of different forms of learning, Learning Decision Trees, Neural Networks.

Course Outcomes:

After learning the course the students should be able to:

1. Understand AI Problems and Apply Various Techniques for Engineering Problem Solving.
2. Solve Game Playing Problems.
3. Understand how Expert System is designed and how Knowledge Engineering works.
4. Apply Fuzzy Logic for Problem Solving.
5. Apply Semantic Rules for reasoning and inference.
6. Apply Various Algorithms like Breadth First Search, Depth First Search, A*, Heuristic Search for various Applications

Text Books:

1. "Artificial Intelligence" -By Elaine Rich And Kevin Knight (2nd Edition) Tata Mcgraw-Hill
2. N. J. Nilsson, "Artificial Intelligence: A New Synthesis", Harcourt Publishers.

Reference Books:

1. "Artificial Intelligence: A Modern Approach", Stuart Russel, Peter Norvig, PHI
2. "Introduction to Prolog Programming " by Carl Townsend.
3. "PROLOG Programming For Artificial Intelligence" -by Ivan Bratko(Addison-Wesley)

4. “Programming with PROLOG” –by Klocksin and Mellish.

Web Resources:

1) www.nptel.ac.in
2) http://www.inf.ed.ac.uk/teaching/courses/aipp/material/aipp_coursenotes.pdf

LAB PLAN

LIST OF EXPERIMENTS

Experiment. No.	Title	Learning Outcomes
1	A) Write a PROLOG program that list four addresses in a label form, each address should list a name, one-line address, city, state &ZIP code. B) WAP to Create Database for Hobbies of Different Person	Basic knowledge of PROLOG
2	A) Write a PROLOG program for diagnosis the childhood diseases. B) Write a PROLOG program for Family Relationship.	Basic knowledge of PROLOG
3	A) Write a PROLOG program To implement Breadth first search (BFS) B) Write a PROLOG program To implement Depth first search (DFS)	Basic knowledge of BFS & DFS
4	Write a PROLOG program Checking for Password. A) Give an opportunity to user to re-enter the password ‘n’ no. Of Times, on entering wrong password. B) Give an opportunity to user to re-enter the password three (03) Times, on entering wrong password.	Basic knowledge of PROLOG
5	Write a PROLOG program to implement Tower Of Hanoi Problem.	Basic knowledge of Tower Of Hanoi Problem.
6	Write a PROLOG program to calculate the roots of quadratic equation Consider all possibilities real, equal, imaginary.	Basic knowledge of PROLOG operators.
7	Write a PROLOG program for finding the average salary of an employee and for adding and deleting employees from the database.	Basic knowledge of PROLOG operators
8	Write a PROLOG program to solve Water-Jug Problem.	Basic knowledge of Water-Jug Problem
9	Write a PROLOG program to demonstrate the effective use of Cut and Fail.	Basic knowledge of cut & fail in prolog.
10	Write a PROLOG program for Traveling Salesman Problem.	Basic knowledge of Traveling Salesman Problem.
11	Write a PROLOG program for Monkey Banana Problem.	Basic knowledge of Monkey Banana Problem
12	Write a PROLOG program N-QUEEN problem	Basic knowledge of N-QUEEN problem.

13	Write a PROLOG program based on list:- A) To find the length of a list. B) To find whether given element is a member of a list. C) To Append the list. D) To Reverse the list. E) To find the last element of a list. F) To delete the first occurrence of an element from a list.	Basic knowledge of list in PROLOG.
14	17. Write a PROLOG program for Arithmetic Operations. C) To add the member of a given list. D) To check if a given year is a Leap Year or not. E) To find the Greatest Common Divisor. F) To find the Least Common Divisor. G) To find the factorial of a given number. H) To generate the Fibonacci series of a given number. I) To convert an integer number into a string of equivalents binary	Basic knowledge of Arithmetic Operations.

Subject: Biomedical Instrumentation								
Program: **B.Tech. EC Engineering**				Subject Code: EL0731			Semester: VII	
Teaching Scheme (Hours per week)				**Examination Evaluation Scheme (Marks)**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	40	00	60	00	100

COURSE OUTCOMES

i. Learn about biomedical instruments used in hospital
ii. Learn about Calibration of biomedical instruments used in hospital
iii. Understanding the testing of different biomedical instruments used in hospital
iv. Analyze different bio signals / potentials

SYLLABUS

UNIT-I **[12]**

Fundamentals of medical instrumentation. Sources of biomedical signals, Generalized medical instrumentation block diagram. Medical electrodes - ECG,EEG,EMG, Defibrillator, Medical transducers: Body temperature, Blood pressure, respiration rate, Classification of Medical instruments based on: Application - (diagnostic, therapeutic, Imaging, analytical) Physiological parameter and biopotential Biological system Different departments in the hospital.

UNIT-II **[11]**

Electrocardiograph(ECG) machine, ECG block diagram, Bipolar and unipolar leads Phono-cardiograph, Electroencephalograph (EEG). Electrode placement system, EEG readout device, Electro-myograph (EMG) machine. Bio-feedback Instrumentation

UNIT-III **[10]**

X-ray machine. CT-Scan machine. Properties of ultrasound Ultrasonic foetal monitors. Echoencephalography. Echo-cardiograph. Colour Doppler ultrasound machine.

UNIT-IV **[10]**

Electro-surgery machine (cautery), Hemo-dialysis machine, Muscle stimulators, Defibrilator Machine, Bio chemistry analyzer. 5.4 Auto analyzer. 5.5 Blood gas analyzer.

Reference Books

1. Handbook of biomedical instrumentation, R. S. Khandpur, Tata McGraw Hill, New Delhi.
2. Introduction to biomedical equipment technology, Carr Joseph J.,Brown J.M, Pearson education, New Delhi
3. Biomedical instrumentation measurements, Lesli P Cromwell, Fred J. Weibell, Erich A. Pfeiffer, PHI Learning, New Delhi
4. Medical instrumentation application & design, John G. Webster, Editor, John Wiley and Sons, New Delhi

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1.

Subject: Electrical Machine Design								
Program: B.Tech.				**Subject Code: EL0717**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	60	40	60	40	200

Unit 1 **[09]**

Design of DC Machines: Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.

Unit 2 **[10]**

Design of Transformers: Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.

Unit 3 **[10]**

Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.

Unit 4 **[16]**

Design of Three Phase Synchronous Machines: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.

Test Book

1. A COURCE IN Electrical Machine Design, A K Sawney, Dhanpat Rai and Sons.

Reference Book

2. Electrical machine Design- R K Agarwal, S K kataria & Sons.

Subject: Industrial Automation								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0722**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Perquisites:

i) Digital Logic Design

ii) Control Theory

iii) Analog Electronics

Course Objectives:

(xvii) To understand the process control and its characteristics in Automation

(xviii) To understand operation of different controller mode and its application

(xix) To know Basic PLC and its programming.

(xx) To learn PLC, DCS and SCADA interface and its application.

Course Outcome:

After successful completion of the course, student will able to:

i) Students have good knowledge of types of automation.

ii) Students know concept process control and importance of automation.

iii) The student can understand the application of different controller.

iv) Analyze the limitation and advantages of different control mode

v) Apply the Ladder programming of PLC in Automation application.

vi) Apply the knowledge of DCS and SCADA application.

SYLLABUS

UNIT-I

[10]

General Concepts:

General concepts of the industrial production. Concepts of production systems and production processes, Automation production systems and their classification.

Process Control Loop and its Characteristic:

Controlled variable, controlling parameters, process equation load, transient, process, lag, self-regulation, control lag, variable range, dead time, cycling, Realizing control using analog electronics

UNIT-II

[10]

Control Algorithms:

Characteristic of different discontinuous controller mode, two position mode, multi position mode, floating control mode, introduction of different continuous controller mode, proportional, integral, derivative, PI, PID controller mode.

UNIT-III

[12]

Programmable Logic Controller (PLC):

Architecture by block diagram, I/O modules, Memory and storage, Scan Cycle, programming language- ladder diagram, FBD approach, Introduction to analog signal processing, interlocking, permissive, realization of Logic gates, Automation application.

UNIT-IV

[12]

Programmable Logic Controller (PLC):

Timer and counter operation of PLC and it's application.

Distributed Control System:

Evaluation of DCS, system architecture-hierarchical of DCS at function levels, Database organization, system implementation concepts System elements- fields, station, intermediate station, central computer system, Monitoring and communication facilities, data communication link transfer of process data, SCADA.

Text Books

i) Johnson, C. D., "Process Control Instrumentation Technology", Prentice Hall.

ii) Webb, J. W., and Reis, R. A., "Programmable Logic Controllers: Principles & Applications", Prentice Hall, (2002).

iii) Liptak, B. G., "Instrument Engineers – Handbook", (Vol. – II), CRC Press.

iv) Morriss, S. B., "Programmable Logic Controllers", Prentice hall.

Reference Books

i) Shinskey, F. G., "Process Control Systems: Application, Design and Tuning", McGraw-Hill Professional, (1996).

ii) Thomas E. Marlin, “Process Control: Designing Processes and Control for Dynamic Performance”, McGraw – Hill, International Edition

iii) Dale E. Seborg, Thomas F. Edger, Duncan A. Mellichamp, “Process Dynamics and Control”, Wiley India.

iv) Surekha Bhanot, “Process Control: Principles and Applications”, Oxford University Press.

v) Peter Harriot, “Process Control”, Tata - McGraw Hill. Patranabis, “Principles of Process Control”, Tata - McGraw Hill.

Web resources

xiv) http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Industrial%20Automation%20control/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf

xv) http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Industrial%20Automation%20control/pdf/L-39(SM)%20(IA&C)%20((EE)NPTEL).pdf

xvi) http://gpdlpune.ac.in/mainEN/IAM/DCS.pdf

xvii) http://www.nptel.ac.in/courses/108106022/12

xviii) http://www.nptel.ac.in/courses/108106022/8

MOOCs

xxviii) https://www.edx.org/

xxix) https://www.nptel.ac.in/

xxx) https://www.coursera.org/

Subject: Power System Planning								
Program: B.Tech. Electrical Engineering				Subject Code: EL0720				Semester: VII
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	0	3	40	0	60	0	100

Perquisites:

xxx) Basic Electrical Engineering

xxxi) Knowledge of Electrical Power System

xxxii) Knowledge of optimization techniques

Course Objective:

i) To analyze and evaluate an electric power system for generation planning and load forecasting, and

ii) To execute production costing analysis and long term generation expansion plans in power system

Course Outcome:

xlii) Learn the different types of planning methods

xliii) Learn economic aspects in planning.

xliv) Learn about substation planning

xlv) Learn about generation expansion planning

xlvi) Learn about reactive power planning

xlvii) Learn about power system planning under uncertainties.

SYLLABUS

UNIT-I

Power System Planning, Basic Principles

Power System Elements, Power System Structure, Power System Studies, a Time-horizon Perspective, Power System Planning Issues, Static Versus Dynamic Planning, Transmission Versus Distribution Planning, Long-term Versus Short-term Planning, Basic Issues in Transmission Planning.

Economic Principles

Definitions of Terms, Cash-flow Concept-Time Value of Money, Economic Terms. Economic Analys- Present Worth Method, Annual Cost Method, Rate of Return Method, Examples.

UNIT-II

Load Forecasting

Load Characteristics, Load Driving Parameters, Spatial Load Forecasting, Long Term Load Forecasting Methods, Trend Analysis, Econometric Modeling, End-use Analysis, Combined Analysis, Load Forecasting for a Regional Utility, Load Forecasting of a Large Scale Utility.

Single-bus Generation Expansion Planning

Problem Definition, Problem Description, Mathematical Development, Objective Functions, Constraints, WASP, a GEP Package, Calculation of Costs, Description of WASP-IV Modules.

Multi-bus Generation Expansion Planning

Problem Description, A Linear Programming (LP) Based GEP, Basic Principles, Mathematical Formulation, A Genetic Algorithm (GA) Based GEP.

UNIT-III

Substation Expansion Planning.

Problem Definition, Basic Case. Problem Description, Typical Results for a Simple Case, Mathematical View, Objective Function, Constraints, Problem Formulation, Required Data, An Advanced Case, General Formulation, Solution Algorithm, System Under Study, Load Model, Downward Grid, Upward Grid, Transmission Substation, Results for BILP Algorithm, Results for GA.

Network Expansion Planning.

Problem Definition, Problem Description, Problem Formulation, Objective Function, Constraints, Solution Methodologies, Enumeration Method, Heuristic Methods, Numerical Results, Garver Test System, A Large Test System.

Unit-IV

Reactive Power Planning

Voltage Performance of a System, Voltage Profile, Voltage Stability, Voltage Performance Control Parameters, Static Versus Dynamic Reactive Power Resources, Problem Description, Reactive Power Planning (RPP) for a System, Static Reactive

Resource Allocation and Sizing, Dynamic Reactive Resource Allocation and Sizing, Solution Procedure, Numerical Results, Small Test System, Large Test System

Power System Planning in the Presence of Uncertainties

Power System De-regulating, Power System Uncertainties, Uncertainties in a Regulated Environment, Uncertainties in a De-regulated Environment, Practical Issues of Power System Planning in a De-regulated Environment, How to Deal with Uncertainties in Power System Planning, Expected Cost Criterion, Min-max Regret Criterion, Laplace Criterion, The Van Neuman–Morgenstern (VNM) Criterion, Hurwicz Criterion.

Text Book

1. Electric Power System Planning: Issues, Algorithms and Solutions, Hossein Seifi, Mohammad Sadegh Sepasian, Springer, 2011.
2. Power System Planning Technologies and Applications: Concepts, Solutions and management, Elkarmi, Fawwaz, Engineering Science Reference, 2012

Reference Book

1. Power System Engineering: Planning, Design, and Operation of Power Systems and equipments, Juergen Schlabbach, Karl-Heinz Rofalsk, Wiley VCH, 2014
2. Probabilistic Transmission System Planning, Wenyuan Li, Wiley, IEEE Press, 2011
3.

Web Resource

viii) https://slideplayer.com/slide/5291948/
ix) https://www.youtube.com/watch?v=eVmXBXO-w-8
x) https://www.youtube.com/watch?v=gqMyAzAvzqM

MOOCS:

xxi) https://www.edx.org/
xxii) https://www.nptel.ac.in/
https://www.coursera.org/

Subject: Power System Design								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0719**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	60		40		100

Perquisites:

Power System I

Power System II

High Voltage Engineering

Course Objectives:

(lx) To understand different types of Transmission lines

(lxi) To provide knowledge of transmission line parameters.

(lxii) To understand the Concept of HVDC system

(lxiii) To understand the concept of EHV transmission line design.

(lxiv) To understand the Sizing and requirement of substation.

(lxv) To understand different configuration of cables for Distribution System

Course Outcome:

After the end of the course the students will be able to

xlviii) Design 3 phase Transmission line and related parameters

xlix) Design HVDC System.

l) Design the substation and different bus-bar schemes.

li) Analysis of electrical and mechanical design parameters

lii) Calculate the cable sizing , feeder sizing and Voltage regulation for Distribution

System design

liii) Design EHV line based on bundle conductors and Design of EHV towers

SYLLABUS

UNIT-I

[09]

Design of HVDC Transmission Lines:

Introduction, Limitations of high voltage a.c. transmission, Advantaged and limitations of HVDC transmission, Principle of control of HVDC transmission, Applications of HVDC system.

Design of Substation:

Substation layout, selection of sizes and locations of sub stations, Substation equipments specifications ratings and its operation from design view point, selection of size and location of generating stations, Interconnection.

UNIT-II

[12]

Power System Earthing:

Objectives, Definitions, Tolerable limits of body currents, Soil resistivity, Earth resistance, Tolerable step and touch voltage , Actual Touch and step voltages, Design of earthing grid, Tower footing resistance, Measurement of soil resistivity and earth resistance, Impulse behavior of earthing Systems, Neutral earthing.

UNIT-III

[12]

Design of Distribution System:

Types of distribution systems, arrangements, selection and size of feeders using Kelvin's law, design of cables in distribution systems considering ampere capacity, voltage drop during starting and running load, primary distribution design, secondary distribution design, Distribution substation, Calculation of distributor size and its examples, calculation of voltage drops and size of distributor, Voltage regulation and lamp flicker, Design of rural distribution, Planning and design of town electrification scheme, Design of industrial distribution system. Economics Of Distribution System**:** Comparison of overhead-transmission and distribution system, Effect of voltage, Selection of equipment, Economic size of power apparatus, Economic selection of distribution system, Power transmission and distribution cost, Energy losses in distribution system.

UNIT-IV

[12]

Transmission Line Design:

Electrical design of transmission line, Design philosophy, voltage level selection and choice of conductors, spacing of conductor and corona, insulators and SIL, design problem. Mechanical design of transmission line Considerations, loading on conductors, span, sag and tension clearance, stringing, problems. Transmission line tower design, Location of tower, Earth wires, Reduction of tower footing resistance, examples.EHV Transmission Line Design Considerations, selection, spacing of conductors, corona and radio interference, shunt and series compensation, tuned power lines, insulation coordination and different types of EHV towers, EHV systems in India.

Text Book

xi) Electrical Power System Design :M. V. Deshpande, TMH publication

xii) Electrical Power System Design :B. R. Gupta, S. CHAND

Reference Book

1. A course in Electrical Power: Soni,Gupta and Bhatnagar, Dhanpat Rai & Sons
2. Substation Design: Satnam & Gupta, DhanpatRai and Co.
3. Electrical Power System Planning A. S. Pabla, TMH publication

Web Resource

https://www.vssut.ac.in/lecture_notes/lecture1424265031.pdf

MOOCS:

xxiii) https://www.edx.org/

xxiv) https://www.nptel.ac.in/

xxv) https://www.coursera.org/

Subject: Soft computing Technique								
Program: B.Tech. Electrical Engineering				Subject Code:EL0723				Semester: VII
Teaching Scheme				Examination Evaluation Scheme				
Lecture	Tutorial	Practical	Credits	University Theory Examination	University Practical Examination	Continuous Internal Evaluation (CIE)- Theory	Continuous Internal Evaluation (CIE)- Practical	Total
3	0	2	4	40	40	60	60	200

Perquisites:

xxxiii) Digital Logic Design

xxxiv) Optimization Techniques

Course Objective:

(lxvi) To understand different soft computing techniques

(lxvii) To learn the concept of Genetic algorithm.

(lxviii) To learn the concept of fuzzy system.

(lxix) To understand application of Genetic algorithm and fuzzy system.

(lxx) To understand the concept of artificial neural network.

(lxxi) To understand application of artificial neural network.

Course Outcome:

liv) Able to apply concept of feedback neural networks.

lv) Able to apply the concept of fuzziness involved in various systems.

lvi) To expose the ideas about genetic algorithm

lvii) Able to utilize FL and NN toolbox

lviii) Analyze problems with artificial intelligence techniques.

SYLLABUS

UNIT-I

[12]

Genetic Algorithms

Introduction, GA terminology, selection methods, cross over methods, mutation methods, flow chart of genetic Algorithm, problems based on GA.

UNIT-II

[12]

Fuzzy Logic

Concepts of uncertainty and imprecision, sets, concepts, properties and operations on classical sets & fuzzy sets, classical & fuzzy relations, membership functions, fuzzy logic, fuzzification, fuzzy rule based systems, fuzzy propositions, and applications.

UNIT-III

[10]

Artificial Neural Networks I

Basics of ANN: Models of a Neuron, Topology, Multi Layer Feed Forward Network (MLFFN), Radial Basis Function Network (RBFN), Recurring Neural Network (RNN), learning processes: supervised and unsupervised learning. error-correction learning, Hebbian learning;

UNIT-IV

[11]

Artificial Neural Network II

Single layer perceptrons, multilayer perceptrons, least mean square algorithm, Mc-culloch pits neuron, linear separability concept, Hebb's rule, Perceptron network, learning rule, flow chart, Adaptive linear neuron, back propagation algorithm applications.

Text Books

1. Timothy J.Ross, Fuzzy Logic with Engineering Applicatios, McGraw-Hill

2. Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications by S. Rajasekaran, G. A. Vijayalakshmi Pai

3. J.M. Zurada, .Introduction to artificial neural systems., Jaico Publishers

Reference Book

4. H.J. Zimmermann, Fuzzy set theory and its applications., III Edition, Kluwer Academic Publishers, London.

5. Suran Goonatilake, Sukhdev Khebbal (Eds), .Intelligent hybrid systems., John Wiley & Sons, New York, 1995

6. Goldberg, D. E, Genetic algorithm in search, optimization and machine learning,Addison-Wesley, Reading Mass.

7. Kalyanmoy Deb, Optimization for Engineering Design – Algorithms and examples, PHI, New Delhi, ISBN-81-203-0943-x.

8. Simon Haykin, Neural Netwroks, PrenticeHall

Web Resource

1. https://lecturenotes.in/subject/124/soft-computing
2. users.du.se/~jwe/fuzzy/NFL/F9.PD

MOOCS:

xxvi) https://www.edx.org/

xxvii) https://www.nptel.ac.in/

https://www.coursera.org/

Subject: **SMART GRID**								
Program: B.Tech				Subject Code: EL0730			Semester: VII	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	0	3	40	-	60	-	100

Course Outcome

1. To understand the concepts and principles of Smart Grid, technology enabling, and demand participation.
2. To study the impact of information and communication technologies on distribution grids.
3. To assess various investment options (e.g. generation capacities, transmission, renewables, demand-side resources, etc) in electricity markets, and evaluate the energy efficiency of smart grid technologies and projects

SYLLABUS

UNIT-I

Basics of Power Systems: Load and Generation, Power Flow Analysis, Economic Dispatch and Unit Commitment Problems Smart Grid: Definition, Applications, Government and Industry, Standardization, Smart Grid Communications: Two-way Digital Communications Paradigm, Network Architectures, IP-based Systems, Power Line Communications, Advanced Metering Infrastructure

UNIT-II

Demand Response: Definition, Applications, and State-of-the Art, Pricing and Energy Consumption Scheduling, Controllable Load Models, Dynamics, and Challenges, Electric Vehicles and Vehicle-to-Grid Systems, Demand Side Ancillary Services, Renewable Generation and Resources: Carbon Footprint, Wind and Solar, Micro-grid Architecture, Tackling Intermittency, Stochastic Models and Forecasting, Distributed Storage and Reserves

UNIT-III

Wide Area Measurement: Sensor Networks, Phasor Measurement Units, Communications Infrastructure, Fault Detection and Self-Healing Systems,

Applications and Challenges, Security and Privacy: Cyber Security Challenges in Smart Grid, Load Altering Attacks, False Data Injection Attacks, Defense Mechanisms, Privacy Challenges

UNIT-IV

Economics and Market Operations: Energy and Reserve Markets, Market Power, Generation Firms, Locational Marginal Prices, Financial Transmission Rights

Reference Book

1. James Momoh, *Smart Grid: Fundamentals of Design and Analysis*, Wiley-IEEE Press
2. Buchholz, Bernd M., Styczynski, Zbigniew, *Smart Grids – Fundamentals and Technologies in Electricity Networks*, Springer Publishers
3. J. C. Stephens, E. J. Wilson, T. R. Peterson, *Smart Grid (R)Evolution*, Cambridge University Press
4. D. S. Kirschen and G. Strbac, *Fundamentals of Power System Economics*, John Wiley & Sons Ltd

Subject: Switchgear & Protection								
Program: B.Tech. Electrical Engineering				**Subject Code:EL0716**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	40	40	60	60	200

Prerequisites:

1. Electric power system – generation, transmission and distribution
2. Electrical machines
3. Electrical measurements and instrument transformers

Course Objectives:

1. To develop understanding for basic arc interruption theory.
2. To understand arc extinguishing process in various types of CB, their selection and application
3. To provide the understanding of basic requirements of protection systems.and understand the construction and working of various types of relays
4. To be able to calculate settings and implementation schemes for power system and electrical apparatus

Course Outcome:

After the end of the course the students will be able to

1. Understand the physic of arc interruption and will able to know concept of various CB mechanism and operating principles
2. Apply comparative study for selection of CB as per application area
3. Understand the necessity and requirements of Power system
4. Protection and importance of relay selection and factors affecting it.
5. Apply relay coordination of interconnected system and various electrical apparatus
6. Discriminate the between healthy and faulty condition of

SYLLABUS

UNIT-I **[08]**

Low end Switchgear and Neutral Grounding

Re-wirable fuses, HRC fuses, isolators and earthing switches, selection of fuses. Effectively grounded and ungrounded systems, resonant grounding Methods of neutral grounding.

Basic Principles and Ratings Of Circuit Breakers

Arc phenomenon, arc Interruption theories, arc control devices, recovery and restriking voltages, current chopping, Interruption of capacitive current, resistance switching, circuit breaker operating mechanism and control systems, making current, breaking current symmetrical and unsymmetrical, continuous current rating, MVA capacity.

UNIT-II **[09]**

Circuit Breakers

Arc controlled devices, ACB, ABCB, SF_6 circuit breaker, vacuum circuit breaker and DC circuit breakers, circuit breaker ratings, auto re-closer. Testing of circuit Breaker.

Functions of Protective Relaying

Fundamental characteristics of relays, standard definition of relay terminologies, relay classifications, operating principles of single and double actuating quantity type electromechanical relays, directional relay, reverse power relay

UNIT-III **[11]**

Transformer Protection

Protection of transformers, basic differential over current relays, restricted earth fault protection, gas relays, overall generator-transformer differential protection, magnetizing inrush protection

Generator & Motor Protection

Modern methods of protecting generators against faults in stator, rotor and prime movers and other abnormal conditions. Abnormal operating conditions, under voltage, phase and earthfault, overload and unbalanced voltage protections for motors.

UNIT-IV **[14]**

Busbar Protection: Protection of out door and indoor bus bar by current differential, voltage differential and directional comparison principles, linear coupler, high impedance schemes.

Transmission Line Protection: Operating characteristics of impedance, reactance relays on R-X diagram, overreach and memory action, ohm and mho types relays and their characteristics, relay response under power swings and effect of fault resistance, setting of distance relays, Carrier Current Protection-Phase comparison and directional comparison principles.

Text Books

1. M. A. Date, B.Oza, N.C. Nair, “Power System Protection”, Bharti Prakashan,2004 .
2. J. Lewis Blackburn, “Protective Relaying”, Marcel Dekker INC. 1997

Reference Books

1. Network Protection Application Guide, GE technical publication
2. J B Gupta, "Switch Gear and Protection", S K KATARIA & SONS-NEW DELHI 2013
3. Van. C. Warrington A.R., "Protective Relays Vol. 1 & 2", Chapman & Hall, 1998.
4. T S Madhav Rao, "Power system protection static relays with microprocessor Applications", Tata McGraw hill Publication, 1998.
5. Badri Ram, D N Vishwakarma, "Power System Protection and Switchgear", Tata Mc Graw Hill, 2005.
6. Anderson P M, "Power System Protection", IEEE publication, 1999.
7. Walter -Marcel Dekker, "Protective relaying theory and applications", 2ed, Elmore, 2004. Russel Mason, "Art and Science of Protection relaying
8. Network Protection Application Guide, GE technical publication

Web resources

nptel.ac.in/downloads/108101039/

MOOCs