DEPARTMENT OF ELECTRICAL ENGINEERING

Syllabus Scheme for Batch 2018 onwards (3rd - 8th semester)

BACHELOR OF TECHNOLOGY IN ELECTRICAL ENGINEERING

SEMESTER - 3RD											
S. No.	Course Category	Course Code	Course Title	Theory/Practical	Hours per week			Internal Marks	External Marks	Total	Credits
					L	T	P				
1.	Basic Science	BSEE-101	Engineering Mathematics-III (Probability and Statistics)	Theory	3	0	0	40	60	100	3
2.	Humanities/ Social Sciences/ Management	HSMEE-101	Education, Technology and Society	Theory	3	0	0	40	60	100	3
3.	Professional Core	PCEE-101	Electrical Circuit Analysis	Theory	3	1	0	40	60	100	4
4.	Professional Core	PCEE-102	Analog Electronics	Theory	3	1	0	40	60	100	4
5.	Professional Core	PCEE-103	Electrical Machines-I (Transformer & DC Machines)	Theory	3	1	0	40	60	100	4
6.	Professional Core	PCEE-104	Electromagnetic Fields	Theory	3	0	0	40	60	100	3
7.	Professional Core	LPCEE-101	Analog Electronics Laboratory	Practical	0	0	2	30	20	50	1
8.	Professional Core	LPCEE-102	Electrical Machines Laboratory-I	Practical	0	0	2	30	20	50	1
9.	Training*	TR-101	Training-I	Practical	-	-	-	60	40	100	1
TOTAL					**18**	**3**	**4+1#**	**360**	**440**	**800**	**24**

NOTE:

* Institutional/Industrial Training of Four weeks shall be held in summer vacation after 2nd semester and marks/credit shall be awarded in 3rd semester itself.

\# There will be one period per week for Mentoring and Professional Development, final evaluation of this course will be done based on the combined assessment of Odd and Even semester of respective year of study

SEMESTER - 4TH											
S. No.	**Course Category**	**Course Code**	**Course Title**	**Theory/Practical**	**Hours per week**			**Internal Marks**	**External Marks**	**Total**	**Credits**
					L	**T**	**P**				
1.	Professional Core	PCEE-105	Digital Electronics	Theory	3	1	0	40	60	100	4
2.	Professional Core	PCEE-106	Electrical Machines-II (Asynchronous & Synchronous Machines)	Theory	3	1	0	40	60	100	4
3.	Professional Core	PCEE-107	Power Electronics	Theory	3	1	0	40	60	100	4
4.	Professional Core	PCEE-108	Signals and Systems	Theory	3	1	0	40	60	100	4
5.	Professional Core	LPCEE-103	Digital Electronics Laboratory	Practical	0	0	2	30	20	50	1
6.	Professional Core	LPCEE-104	Electrical Machines Laboratory-II	Practical	0	0	2	30	20	50	1
7.	Professional Core	LPCEE-105	Power Electronics Laboratory	Practical	0	0	2	30	20	50	1
8.	Seminar	PREE-101	Seminar and Technical Report Writing	Practical	0	0	2	50	0	50	1
9.	Mandatory Theory Course (Non-Credit)$	MCEE-101	Environmental Science	Theory	2	0	0	50	0	50	S/US
10.	Mentoring	MPD-102	Mentoring & Professional Development	Practical	0	0	1	100	0	100	1
TOTAL					**14**	**4**	**9**	**450**	**300**	**750**	**21**

NOTE:

$ Marks of non-credit courses are excluded from total and minimum 40% score required to pass.

SEMESTER - 5TH											
S. No.	**Course Category**	**Course Code**	**Course Title**	**Theory/Practical**	**Hours per week**			**Internal Marks**	**External Marks**	**Total**	**Credits**
					L	**T**	**P**				
1.	Professional Core	PCEE-109	Power Systems – I (Apparatus & Modelling)	Theory	3	1	0	40	60	100	4
2.	Professional Core	PCEE-110	Control Systems	Theory	3	1	0	40	60	100	4
3.	Professional Core	PCEE-111	Microprocessors & Microcontrollers	Theory	3	1	0	40	60	100	4
4.	Professional Core	PCEE-112	Measurements and Instrumentation	Theory	3	1	0	40	60	100	4
5.	Professional Core	PCEE-113	Electric Generation and Economics	Theory	3	1	0	40	60	100	4
6.	Professional Core	LPCEE-106	Power Systems Laboratory-I	Practical	0	0	2	30	20	50	1
7.	Professional Core	LPCEE-107	Control and Instrumentation Laboratory	Practical	0	0	2	30	20	50	1
8.	Professional Core	LPCEE-108	Microprocessors & Microcontrollers Laboratory	Practical	0	0	2	30	20	50	1
9.	Training*	TR-102	Training-II	Practical	-	-	-	60	40	100	1
10.	Mandatory Theory Course (Non-Credit)$	MCI-10X@	Open-Elective	Theory	2	0	0	50	0	50	S/US
TOTAL					**17**	**5**	**6+1#**	**400**	**400**	**800**	**24**

NOTE:

* Industrial/Institutional Training of Four weeks shall be held in summer vacation after 4th semester and marks/credit shall be awarded in 5th semester itself.

$ Marks of non-credit courses are excluded from total and minimum 40% score required to pass.

There will be one period per week for Mentoring and Professional Development, final evaluation of this course will be done based on the combined assessment of Odd and Even semester of respective year of study. @MCI-102 Constitution of India/ MCI-103 Organisational Behavior

SEMESTER - 6TH											
S. No.	**Course Category**	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours per week**			**Internal Marks**	**External Marks**	**Total**	**Credits**
					L	**T**	**P**				
1.	Professional Core	PCEE-114	Power Systems – II (Operation and Control)	Theory	3	1	0	40	60	100	4
2.	Professional Core	PCEE-115	PLC and Industrial Drives	Theory	3	0	0	40	60	100	3
3.	Professional Elective	PEEE-XXX	Elective-I	Theory	3	1	0	40	60	100	4
4.	Professional Elective	PEEE-XXX	Elective-II	Theory	3	1	0	40	60	100	4
5.	Open Elective	OEXX-XXX	Open Elective-I	Theory	3	0	0	40	60	100	3
6.	Professional Core	LPCEE-109	Power Systems Laboratory-II	Practical	0	0	2	30	20	50	1
7.	Professional Core	LPCEE-110	PLC and Automation Laboratory	Practical	0	0	2	30	20	50	1
8.	Professional Core	LPCEE-111	Industrial Drives Laboratory	Practical	0	0	2	30	20	50	1
9.	Project	PREE-102	Minor Project	Practical	0	0	2	60	40	100	1
10.	Mentoring	MPD-103	Mentoring & Professional Development	Practical	0	0	1	100	0	100	1
TOTAL					**15**	**3**	**9**	**450**	**400**	**850**	**23**

CHOICE-I (For those students who are opting for one semester Industrial Training (TR-104) during the 7th Semester)

SEMESTER-7TH							
S. No.	**Course Category**	**Course Code**	**Course Title**	**Internal Marks**	**External Marks**	**Total**	**Credits**
1.	Industrial/Institution Training*	TR-103	Training-III	60	40	100	1
2.	Industrial/Institution Training	TR-104	Industrial Training	350	150	500	15
TOTAL				**410**	**190**	**600**	**16**

NOTE:

* Industrial/Institution Training of Four weeks shall be held in summer vacation after 6th semester and marks/credit shall be awarded in 7th semester itself.

SEMESTER - 8TH											
S. No.	**Course Category**	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours per week**			**Internal Marks**	**External Marks**	**Total**	**Credits**
					L	**T**	**P**				
1.	Professional Elective	PEEE-XXX	Elective-III	Theory	3	1	0	40	60	100	4
2.	Professional Elective	PEEE-XXX	Elective-IV	Theory	3	1	0	40	60	100	4
3.	Open Elective	OEXX-XXX	Open Elective-II	Theory	3	0	0	40	60	100	3
4.	Seminar/ Project	PREE-103	Major Project	Practical	0	0	6	120	80	200	3
5.	Mentoring	MPD-104	Mentoring & Professional Development	Practical	0	0	1	100	0	100	1
TOTAL					**9**	**2**	**7**	**340**	**260**	**600**	**15**

CHOICE-I (For those students who are opting for one semester Industrial Training (TR-104) during the 7th Semester)

List of Professional Elective Courses (TRACK-I)

ENERGY CONVERSION & POWER SYSTEMS			
S. No.	**Professional Elective Course**	**Course code**	**Course Name**
1.	**Elective –I**	PEEE-101	Renewable Energy Sources
2.		PEEE-103	Solar and Wind Energy
3.	**Elective –II**	PEEE-105	Energy Efficient Machines
4.		PEEE-107	Computer Aided Electrical Machine Design
5.	**Elective –III**	PEEE-117	High Voltage Engineering
6.		PEEE-119	High Voltage Transmission Systems
7.	**Elective –IV**	PEEE-121	Power Quality Improvement
8.		PEEE-123	Digital Protection of Power System

List of Professional Elective Courses (TRACK-II)

INSTRUMENTATION & CONTROL SYSTEMS			
S. No.	**Professional Elective Course**	**Course code**	**Course Name**
1.	**Elective –I**	PEEE-102	Embedded Systems& PLC
2.		PEEE-104	Automatic Control & Robotics
3.	**Elective –II**	PEEE-106	Digital Control System
4.		PEEE-108	Process Dynamics and Control
5.	**Elective –III**	PEEE-118	SCADA & Distributed Control System
6.		PEEE-120	Data Communication and Networking
7.	**Elective –IV**	PEEE-122	Virtual Instrumentation
8.		PEEE-124	Fuzzy Expert Systems

CHOICE-II (For those students who are opting for one semester Industrial Training (TR-104) during the 8th Semester)

SEMESTER - 7TH											
S. No.	Course Category	Course Code	Course Title	Subject Type	Hours per week			Internal Marks	External Marks	Total	Credits
					L	T	P				
1.	Professional Elective	PEEE-XXX	Elective-III	Theory	3	1	0	40	60	100	4
2.	Professional Elective	PEEE-XXX	Elective-IV	Theory	3	1	0	40	60	100	4
3.	Open Elective	OEXX-XXX	Open Elective-II	Theory	3	0	0	40	60	100	3
4.	Seminar/ Project	PREE-103	Major Project	Practical	0	0	6	120	80	200	3
5.	Industrial/Institution Training*	TR-103	Training-III	Practical	-	-	-	60	40	100	1
TOTAL					**9**	**2**	**6+1#**	**300**	**300**	**600**	**15**

NOTE:

* Industrial/Institutional Training of Four weeks shall be held in summer vacation after 6th semester and marks/credit shall be awarded in 7th semester itself.

\# There will be one period per week for Mentoring and Professional Development, final evaluation of this course will be done based on the combined assessment of Odd and Even semester of respective year of study.

SEMESTER-8TH							
S. No.	Course Category	Course Code	Course Title	Internal Marks	External Marks	Total	Credits
1.	Industrial/Institution Training*	TR-104	Industrial Training	350	150	500	15
2.	Mentoring	MPD-104	Mentoring and Professional Development	100	0	100	1
TOTAL				**450**	**150**	**600**	**16**

CHOICE-II (For those students who are opting for one semester Industrial Training (TR-104) during the 8th Semester)

List of Professional Elective Courses (TRACK-I)

ENERGY CONVERSION& POWER SYSTEMS			
S. No.	**Professional Elective Course**	**Course code**	**Course Name**
1.	**Elective –I**	PEEE-101	Renewable Energy Sources
2.		PEEE-103	Solar and Wind Energy
3.	**Elective –II**	PEEE-105	Energy Efficient Machines
4.		PEEE-107	Computer Aided Electrical Machine Design
5.	**Elective –III**	PEEE-109	Power System Reliability
6.		PEEE-111	Power System Planning
7.	**Elective –IV**	PEEE-113	Sub-Station Automation
8.		PEEE-115	Smart Grids

List of Professional Elective Courses (TRACK-II)

INSTRUMENTATION & CONTROL SYSTEMS			
S. No.	**Professional Elective Course**	**Course code**	**Course Name**
1.	**Elective –I**	PEEE-102	Embedded Systems& PLC
2.		PEEE-104	Automatic Control & Robotics
3.	**Elective –II**	PEEE-106	Digital Control System
4.		PEEE-108	Process Dynamics and Control
5.	**Elective –III**	PEEE-110	Optimization Techniques
6.		PEEE-112	Artificial Intelligence Techniques
7.	**Elective –IV**	PEEE-114	Digital Signal Processing
8.		PEEE-116	Biomedical Signals &Instrumentation

CHOICE-III (For those students who are opting for course work during 7th and 8th semesters)

SEMESTER - 7TH											
S. No.	Course Category	Course Code	Course Title	Theory/ Practical	Hours per week			Internal Marks	External Marks	Total	Credits
					L	T	P				
1.	Professional Elective	PEEE-XXX	Elective-III	Theory	3	1	0	40	60	100	4
2.	Professional Elective	PEEE-XXX	Elective-IV	Theory	3	1	0	40	60	100	4
3.	Open Elective	OEXX-XXX	Open Elective-II	Theory	3	0	0	40	60	100	3
4.	Seminar/ Project	PREE-104	Project-I	Practical	0	0	6	120	80	200	3
5.	Training*	TR-103	Training-III	Practical	-	-	-	60	40	100	1
TOTAL					**9**	**2**	**6+1#**	**300**	**300**	**600**	**15**

NOTE:

* Institutional/Industrial Training of Six weeks shall be held in summer vacation after 6th semester and marks/credit shall be awarded in 7thsemester itself.

\# There will be one period per week for Mentoring and Professional Development, final evaluation of this course will be done based on the combined assessment of Odd and Even semester of respective year of study.

SEMESTER - 8TH											
S. No.	Course Category	Course Code	Course Title	Theory/ Practical	Hours per week			Internal Marks	External Marks	Total	Credits
					L	T	P				
1.	Professional Elective	PEEE-XXX	Elective-V	Theory	3	1	0	40	60	100	4
2.	Professional Elective	PEEE-XXX	Elective-VI	Theory	3	1	0	40	60	100	4
3.	Open Elective	OEXX-XXX	Open Elective-III	Theory	3	0	0	40	60	100	3
4.	Seminar/ Project	PREE-105	Project-II	Practical	0	0	6	120	80	200	3
5.	Seminar/ Project	PREE-106	Technical Seminar on Recent and Advanced Topics	Practical	0	0	2	50	0	50	1
6.	Mentoring	MPD-104	Mentoring & Professional Development	Practical	0	0	1	100	0	100	1
TOTAL					**9**	**2**	**9**	**390**	**260**	**650**	**16**

CHOICE-III (For those students who are opting for course work during 7th and 8th semesters)

List of Professional Elective Courses (TRACK-I)

ENERGY CONVERSION & POWER SYSTEMS			
S. No.	**Professional Elective Course**	**Course code**	**Course Name**
1.	**Elective –I**	PEEE-101	Renewable Energy Sources
2.		PEEE-103	Solar and Wind Energy
3.	**Elective –II**	PEEE-105	Energy Efficient Machines
4.		PEEE-107	Computer Aided Electrical Machine Design
5.	**Elective –III**	PEEE-109	Power System Reliability
6.		PEEE-111	Power System Planning
7.	**Elective –IV**	PEEE-113	Sub-Station Automation
8.		PEEE-115	Smart Grids
9.	**Elective –V**	PEEE-117	High Voltage Engineering
10.		PEEE-119	High Voltage Transmission Systems
11.	**Elective –VI**	PEEE-121	Power Quality Improvement
12.		PEEE-123	Digital Protection of Power system

List of Professional Elective Courses (TRACK-II)

INSTRUMENTATION & CONTROL SYSTEMS			
S. No.	**Professional Elective Course**	**Course code**	**Course Name**
1.	**Elective –I**	PEEE-102	Embedded Systems & PLC
2.		PEEE-104	Automatic Control & Robotics
3.	**Elective –II**	PEEE-106	Digital Control System
4.		PEEE-108	Process Dynamics and Control
5.	**Elective –III**	PEEE-110	Optimization Techniques
6.		PEEE-112	Artificial Intelligence Techniques
7.	**Elective –IV**	PEEE-114	Digital Signal Processing
8.		PEEE-116	Biomedical Signals & Instrumentation
9.	**Elective –V**	PEEE-118	SCADA & Distributed Control System
10.		PEEE-120	Data Communication and Networking
11.	**Elective –VI**	PEEE-122	Virtual Instrumentation
12.		PEEE-124	Fuzzy Expert Systems

List of Open Elective subjects offered by Electrical Engineering Department to all other Departments

S. No.	Open Elective Course	Course code	Course Name
1.	**Open Elective –I**	OEEE-101	Energy Auditing and Management
2.		OEEE-102	Elements of Power System
3.		OEEE-103	Biomedical Engineering
4.	**Open Elective –II** (To be offered in 7th Sem for Choices II & III)	OEEE-104	Automation Control and Robotics
5.		OEEE-105	Soft Optimization Techniques
6.		OEEE-106	Energy Efficient Machines
7.	**Open Elective –II** (To be offered in 8th Sem for Choice I)	OEEE-107	Generation of Electric Power
8.		OEEE-108	Reliability Engineering
9.		OEEE-109	Electric Vehicles
10.	**Open Elective –III** (To be offered in 8th Sem for Choices III)	OEEE-107	Generation of Electric Power
11.		OEEE-108	Reliability Engineering
12.		OEEE-109	Electric Vehicles

Minor Specialization Course for Electrical Engineering

S. No.	Course code	Course Name	Hours Per week			Internal awards	External Awards	Total	Credits
			L	T	P				
1.	MnPCEE-101	Electrical Machines*	2	0	0	40	60	100	2
2.	MnPCEE-102	Electrical Measurement & Instrumentation#	3	0	0	40	60	100	3
3.	MnPCEE-103	Power Generation, Transmission & Utilization #	3	0	0	40	60	100	3
4.	MnPEEE-101	Renewable Energy Systems*	3	0	0	40	60	100	3
5.	MnLPCEE-101	Electrical Machines Laboratory*	0	0	2	30	20	50	1

*** To be offered in even semester**
 # To be offered in odd semester

Subject Code: BSEE-101

Subject Name:*ENGINEERING MATHEMATICS-III (PROBABILITY AND STATISTICS)*

Programme: B.Tech (EE)	**L: 3 T: 0 P: 0**
Semester: 3	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:** 3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**80%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Knowledge of Integration, Differential Calculus

Additional Material allowed in ESE:Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Apply probability theory via Bayes' Rule
2.	To determine expected value of discrete random variables
3.	Formulate the marginal and conditional distributions of bivariate random variables
4.	Verify the predicted data sets using Binomial, Poisson and normal distribution
5.	Predict the linear regression parameters and correlation coefficient
6.	Select a critical value from a normal and chi - square distribution

DETAILED CONTENTS

PART-A

BASIC PROBABILITY ***(12 Hours)***

Probability spaces, theorems of Probability, addition multiplication and Baye's theorem, conditional probability, independence; Discrete random variables, Independent random variables, Poisson approximation to the binomial distribution, sums of independent random variables; Expectation of Discrete Random Variables, Variance.

CONTINUOUS PROBABILITY AND BIVARIATE DISTRIBUTIONS ***(8 Hours)***

Continuous random variables and their properties, distribution functions and densities, normal, exponential densities. Bivariate distributions and their properties, distribution of sums and quotients.

PART-B

BASIC STATISTICS ***(8 Hours)***

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal-evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

APPLIED STATISTICS ***(8 Hours)***

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations

SMALL SAMPLES ***(4 Hours)***

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Text / References:

1 E. Kreyszig, *"Advanced Engineering Mathematics",* John Wiley & Sons, 2006.

2 P. G. Hoel, S. C. Port and C. J. Stone, *"Introduction to Probability Theory"*, Universal Book Stall, 2003.

3 S. Ross, *"A First Course in Probability"*, Pearson Education India, 2002.

4 W. Feller, *"An Introduction to Probability Theory and its Applications"*, Vol. 1, Wiley, 1968.

5 N.P. Bali and M. Goyal, *"A text book of Engineering Mathematics",*Laxmi Publications, 2010.

6 B.S. Grewal, *"Higher Engineering Mathematics",* Khanna Publishers, 2000.

7 T. Veerarajan, *"Engineering Mathematics",* Tata McGraw-Hill, New Delhi, 2010.

E-Books and online learning material:

1 Convex Optimization by Boyd and Vandenberghehttp://stanford.edu/~boyd/cvxbook/bv_cvxslides.pdf

2 Probability and Statistics by PrasannaSahoohttp://www.math.louisville.edu/~pksaho01/teaching/Math662TB-09S.pdf

Online Courses and Video Lectures:

1 Probability and Statistics by nptel hrd http://nptel.ac.in/courses/111105041/

2 Probability and statistics by nptel hrd http://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PLbMVogVj5nJQrzbAweTVynH6-vG5A4aN5

Subject Code: HSMEE-101
Subject Name: *EDUCATION, TECHNOLOGY AND SOCIETY*

Programme: B.Tech (EE)	**L: 3 T: 0 P: 0**
Semester: 3	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:**3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 0%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites:NIL

Additional Material allowed in ESE: NIL

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

CO#	Course Outcomes (CO)
1.	Integrate technical education for betterment of Society as well get motivated to lead a good human life
2.	Analyze different learning domains and Educational Transition
3.	Acknowledge recent advancements in Electrical Technology
4.	Use sustainable developments to address environmental issues
5.	Estimate the Power scenario in the Urban and Rural sector
6.	Follow ethical practices in technical fields

DETAILED CONTENTS

PART-A

INTRODUCTION TO EDUCATION AND SOCIETY ***(7Hours)***

Necessity of Education for Human Life, role of education in Technology advancement, Implications of Electrical engineering on Society and mankind, role of Central Electricity Authority(CEA).

EDUCATIONAL TRANSITION-ICTDRIVEN ***(7Hours)***

Nature and scope of education (Gurukul to ICT driven), Emotional Intelligence Domains of learning, Approaches to learning, learning outcomes, Relevance of ICT (Information and communications technology) in Electrical Engineering education.

ADVANCEMENT IN ELECTRICAL TECHNOLOGY ***(7 Hours)***

Introduction to the concept of Micro-grids,Energy Conservation Building Code, High Efficiency Photovoltaic Cells,Green Energy Electrical Power Converters, Hybrid energy Systems and Hybrid Vehicles.

PART B

ENVIRONMENTAL ISSUES AND HEALTH HAZARDS ***(9Hours)***

Health hazards caused due to lack of awareness and education, promoting the use of Renewable Energy Resources for Sustainable development, Electrical Safety Precautions at commercial places, Safety Alerts, reduction of pollutants caused due to power generation.

ETHICS IN POWER UTILITY ***(10Hours)***

Menace of power Theft, Technical and Commercial Losses, Power Scenario in Rural India, future of Indian Power sector. Anecdotes of Power Theft Detection, Tampering of security seals, Power Theft control methods. Power theft in Electro-mechanical Meters.Significance and planning structure of Indian Electricity Grid Code (IEGC).

Text / References:

1 Jan L Harrington, *"Technology and Society",* Jones and BartlettPublishers, 2009

2 Bower and Hilgard, *"Theories of learning",* Prentice Hall Publisher, 1998

3 G.Sreenivasan, *"Power Theft"*, PHI Learning Pvt. Ltd Delhi, 2014

4 A.K Thereja, *"A textbook of Electrical Technology",*S.Chand, 1994

5 B H Khan, *"Non-Conventional energy Resources",* Tata McGraw-Hill Education Private Ltd.New Delhi, 2009.

E-books and online learning material:

1 Technology and Society By Jan L Harrington
https://books.google.co.in/books?id=3y4LW3lAf9kC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

2 Non-Conventional energy Resources by B H Khan
https://books.google.co.in/books?id=YVyv4WyA5QUC&printsec=frontcover&dq=Non-Conventional+energy+Resources+by+B+H+KHAN&hl=en&sa=X&ved=0ahUKEwin9_iHgebiAhVKfysKHVhtBQIQ6AEIKDAA#v=onepage&q&f=false

Online Courses and Video Lectures:

1 https://www.youtube.com/watch?v=fTNnsZGlV28

Subject Code: PCEE-101
Subject Name:*ELECTRICAL CIRCUIT ANALYSIS*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 3	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 50%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering.

Additional Material allowed in ESE:Scientific Calculator

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

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

DETAILED CONTENTS

PART-A

NETWORK THEOREMS ***(10 Hours)***

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources, Node and Mesh Analysis, .Concept of duality and dual networks.

SOLUTION OF FIRST AND SECOND ORDER NETWORKS ***(10 Hours)***

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

PART-B

SINUSOIDAL STEADY STATE ANALYSIS ***(7 Hours)***

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits, Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS ***(7 Hours)***

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

TWO PORT NETWORK AND NETWORK FUNCTIONS ***(6 Hours)***

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks, synthesis of network using Foster and Cauer Forms.

Text / References:

1 M. E. Van Valkenburg, *"Network Analysis",* Prentice Hall, 2006.
2 D. Roy Choudhury, *"Networks and Systems",* New Age International Publications, 1998.
3 W. H. Hayt and J. E. Kemmerly, *"Engineering Circuit Analysis",* McGraw Hill Education, 2013.

4 C. K. Alexander and M. N. O. Sadiku, *"Electric Circuits",* McGraw Hill Education, 2004.
5 K. V. V. Murthy and M. S. Kamath, *"Basic Circuit Analysis",*Jaico Publishers, 1999.

E-Books and online learning material:

1 Electrical Circuit Theory and Technology John Bird http://s1.nonlinear.ir/epublish/book/Electrical_Circuit_Theory_and_Technology_0415662869.pdf

2 Network Analysis and Synthesis by SmarajitGhoshhttps://books.google.co.in/books?id=4P6tFSv7HswC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

3 Fundamentals of Electric Circuits Charles K. Alexander and Matthew N. O. Sadikuhttp://omega.altervista.org/extra/Fundamentals%20of%20Electric%20Circuits%20(Alexander%20and%20Sadiku),%204th%20Edition.pdf

Online Courses and Video Lectures:

1 https://nptel.ac.in/courses/108102042/9

2 https://nptel.ac.in/courses/108102042/10

3 https://nptel.ac.in/courses/108102042/21

4 https://nptel.ac.in/courses/108102042/24

5 https://nptel.ac.in/courses/108102042/26

6 https://nptel.ac.in/courses/108102042/42

7 https://nptel.ac.in/courses/108102042/43

Subject Code: PCEE-102
Subject Name:*ANALOG ELECTRONICS*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 3	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

Additional Material allowed in ESE:Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Analyze basic diode circuits.
2.	Understand the characteristics of transistors.
3.	Understand the characteristics of MOSFET.
4.	Understand mathematical models of electronic devices.
5.	Understand the functioning of OP-AMP and design OP-AMP based circuits.
6.	Design and analyze various rectifier and amplifier circuits.

DETAILED CONTENTS

PART-A

DIODE CIRCUITS ***(4 Hours)***

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

BJT CIRCUITS ***(8 Hours)***

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

MOSFET CIRCUITS ***(9 Hours)***

MOSFET structure and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

PART-B

DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS ***(8 Hours)***

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

LINEAR AND NONLINEAR APPLICATIONS OF OP-AMP ***(13 Hours)***

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators.Precision rectifier, peak detector.

Text/References:

1 A.S. Sedra and K. C. Smith, *"Microelectronic Circuits",* New York, Oxford University Press, 1998.

2 J. V. Wait, L. P. Huelsman and G. A. Korn, *"Introduction to Operational Amplifier theory and applications",* McGraw Hill U. S., 1992.

3 J. Millman and A. Grabel, *"Microelectronics",* McGraw Hill Education, 1988.

4 P. Horowitz and W. Hill, *"The Art of Electronics",* Cambridge University Press, 1989.

5 P.R. Gray, R.G. Meyer and S. Lewis, *"Analysis and Design of Analog Integrated Circuits",* John Wiley & Sons, 2001.

E-books and online learning material:

1 Integrated Electronics: Analog and Digital circuits and systems by Jacob Milliman and Christos C Halkiashttp://www.introni.it/pdf/Millman%20Halkias%20-%20Integrated%20Electronics.pdf

2 Principles of Analog Electronics by Giovanni Saggiohttps://books.google.co.in/books?id=eosAAgAACAAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

3 Analog Electronics by Hayrettin Köymenhttp://www.electronics.teipir.gr/personalpages/papageorgas/download/2/shmeiwseis/ELECTRONIC_COMPONENTS/varistor/Analog_Electronics.pdf

4 Analog Electronics Raymond E. Frey Physics Department University of Oregon https://pages.uoregon.edu/rayfrey/AnalogNotes.pdf

5 Foundations of Analog and Digital Electronic Circuits anantagarwal and jeffrey h. langhttps://neurophysics.ucsd.edu/courses/physics_120/Agarwal%20and%20Lang%20(2005)%20Foundations%20of%20Analog%20and%20Digital.pdf

Online Courses and Video Lectures:

1 https://nptel.ac.in/courses/108102095/1

2 https://nptel.ac.in/courses/108102095/2

3 https://nptel.ac.in/courses/108102095/3

4 https://nptel.ac.in/courses/108102095/5

5 https://nptel.ac.in/courses/108102095/10

6 https://nptel.ac.in/courses/108102095/20

7 https://nptel.ac.in/courses/108102095/41

Subject Code: PCEE-103
Subject Name:*ELECTRICAL MACHINES-I (TRANSFORMER AND DC MACHINES)*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 3	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:**4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Understand the concepts of magnetic circuits
2.	Understand the operation of dc generator
3.	Analyze the performance characteristics of DC Generator and Motor for different operating conditions
4.	Understand the concept of torque in rotating machines
5.	Testing of single phase transformer and evaluate efficiency and voltage regulation
6.	Understand the concept of three phase and auto transformers

DETAILED CONTENTS

PART-A

MAGNETIC FIELDS AND MAGNETIC CIRCUITS ***(6 Hours)***

Review of magnetic circuits - MMF, flux, reluctance, inductance; Flux-linkage vs current characteristic of magnetic circuits; choice of flux density in distribution and power transformers, and effect of saturation; harmonics in magnetization current, influence of highly permeable materials on themagnetic flux.

DC GENERATOR ***(6 Hours)***

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

DC MOTOR ***(8 Hours)***

Working principle, characteristics, starters (3-point, 4-point and soft starters), speed control methods (field and armature control). Braking: plugging, dynamic and regenerative braking.Estimation of losses and efficiency by Swinburn's test and Hopkinson test.Introduction to brushless direct current (BLDC) machines.

PART-B

SINGLE PHASE TRANSFORMERS ***(9 Hours)***

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

THREE PHASE TRANSFORMERS AND AUTOTRANSFORMER ***(11 Hours)***

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

Text / References:

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

2 A. E. Clayton and N. N. Hancock, *"Performance and design of DC machines",* CBS Publishers, 2004.
3 M. G. Say, *"Performance and design of AC machines",* CBS Publishers, 2002.
4 P. S. Bimbhra, *"Electrical Machinery",*Khanna Publishers, 2011.
5 I. J. Nagrath and D. P. Kothari, *"Electric Machines",* McGraw Hill Education, 2010.

E-books and online learning material:

1 https://nptel.ac.in/courses/108106071/

2 https://drive.google.com/file/d/0B_jwSWRUH7bwbV83ZVpOd3dvdjA/view

3 https://drive.google.com/file/d/0B_jwSWRUH7bwZGxaREwyTWVzN1k/view

4 https://drive.google.com/file/d/0B_jwSWRUH7bwLUVRNk40X040RjQ/view

5 https://drive.google.com/file/d/0B_jwSWRUH7bwR0xHMFRKelRTZGs/view

Online Courses and Video Lectures:

1 https://nptel.ac.in/courses/108105017/2

2 https://nptel.ac.in/courses/108105017/4

3 https://nptel.ac.in/courses/108105017/10

4 https://nptel.ac.in/courses/108105017/11

5 https://nptel.ac.in/courses/108105017/17

6 https://nptel.ac.in/courses/108105017/21

7 https://nptel.ac.in/courses/108105017/24

Subject Code: PCEE-104
Subject Name:*ELECTROMAGNETIC FIELDS*

Programme: B.Tech (EE)	**L: 3 T: 0 P: 0**
Semester: 3	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:**3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic knowledge of Coordinate systems, Electric and Magnetic fields

Additional Material allowed in ESE:Scientific Calculator

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

CO #	Course Outcomes (CO)
1.	Understand the basic laws of electromagnetism
2.	Understand various coordinate systems and transformations
3.	Obtain the electric and magnetic fields for simple configurations under static conditions
4.	Analyze time varying electric and magnetic fields
5.	Understand Maxwell's equation in different forms and different media
6.	Understand the propagation of EM waves

DETAILED CONTENTS

PART-A

REVIEW OF VECTOR CALCULUS ***(6 Hours)***

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl, integraltheorems of vectors. Conversion of a vector from one coordinate system to another.

STATIC ELECTRIC FIELD CONDUCTORS, DIELECTRICS AND CAPACITANCE ***(12 Hours)***

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density, Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

PART-B

STATIC MAGNETIC FIELDs, FORCES, MATERIALS AND INDUCTANCE*(10Hours)*

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

TIME VARYING FIELDS AND MAXWELL'S EQUATIONS ***(6 Hours)***

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces, Boundary Conditions.

ELECTROMAGNETIC WAVES ***(6 Hours)***

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text / References:

1 M. N. O. Sadiku, *"Elements of Electromagnetics",* Oxford University Publication, 2014.
2 A. Pramanik, *"Electromagnetism - Theory and applications",* PHI Learning Pvt. Ltd, New Delhi, 2009.
3 A. Pramanik, *"Electromagnetism-Problems with solution",* Prentice Hall India, 2012.
4 G.W. Carter, *"The electromagnetic field in its engineering aspects",* Longmans, 1954.
5 W.J. Duffin, *"Electricity and Magnetism",* McGraw Hill Publication, 1980.
6 W.J. Duffin, *"Advanced Electricity and Magnetism",* McGraw Hill, 1968.
7 E.G. Cullwick, *"The Fundamentals of Electromagnetism",* Cambridge University Press, 1966.
8 B. D. Popovic, *"Introductory Engineering Electromagnetics",* Addison-Wesley Educational Publishers, International Edition, 1971.
9 W. Hayt, *"Engineering Electromagnetics"*, McGraw Hill Education, 2012.

E-books and online learning material:

1 Engineering Electromagnetics Sixth Edition William H. Hayt, Jr. John A. Buck
http://alumni.media.mit.edu/~aggelos/papers/EM_Hayt_6th.pdf

2 Electromagnetic Field Theory BO THIDE
https://physics.bgu.ac.il/~gedalin/Teaching/Mater/EMFT_Book.pdf

Online Courses and Video Lectures:

Introduction to vector by Dr. HarishankarRamchandran

1 https://nptel.ac.in/courses/108106073/

2 https://nptel.ac.in/courses/108106073/10

3 https://nptel.ac.in/courses/108106073/39

4 https://nptel.ac.in/courses/108106073/16

Subject Code: LPCEE-101
Subject Name:*ANALOG ELECTRONICS LABORATORY*

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester: 3	**Teaching Hours**: 26
Theory/Practical: Theory	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

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

CO#	Course Outcomes (CO)
1.	Make circuits on bread-board and understand the use and importance of various types of equipment's used in the laboratory
2.	Analyze, take measurements to understand circuit behavior and performance under different conditions
3.	Troubleshoot electronic circuits meant for different applications
4.	Design and create various electronic circuits
5.	Acquire experience in creating and troubleshooting simple projects employing semiconductor devices
6.	Evaluate the performance electronic circuits and working small projects employing semiconductor devices

S.No	Name of Practical
1	Design a full wave and half wave rectifier and observe the waveforms with and without filters (RC).
2	To design a voltage regulator using Zener diode and also see the effect of line and load regulation
3	To design various clippers and clampers using diodes.
4	To study the transistor characteristics in common emitter characteristics and also determine the h-parameters from the characteristics.
5	To design, study and compare various transistor biasing techniques and also see the effect on operating point (Q-point) when using various transistors at different temperatures.
6	Design different transistor biasing circuits and compare them.
7	Working of a transistor as current mirror and switch.
8	To plot the VI characteristics of FET.
9	Voltage follower circuit.
10	Op-Amp as an inverting and non-inverting amplifier.
11	Op-Amp as a summing and difference amplifier.
12	Op-Amp as a zero crossing detector.
13	Op-Amp as a Schmitt trigger.
14	Op-Amp as an integrator and differentiator.
15	RC phase shift oscillator using Op-Amp.
16	Wein bridge oscillator using Op-Amp.
17	To examine the operation of a PLL and to determine the free running frequency, the capture range and the lock in range of PLL.

Reference Material

Manual Available in lab

Subject Code: LPCEE-102
Subject Name:*ELECTRICAL MACHINES-I LABORATORY*

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester: 3	**Teaching Hours**: 26
Theory/Practical: Theory	**Credits:**1
Internal marks:30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

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

CO #	Course Outcomes (CO)
1.	Evaluation of equivalent circuit parameters, efficiency and voltage regulation by performing various tests on transformer
2.	Analyze three-phase transformer connections and parallel operation of transformers
3.	Analyze performance characteristics of DC generators
4.	Evaluate various speed controls and starting methods of DC motor
5.	Construct and analyze torque slip characteristics of DC motor
6.	Troubleshoot and perform various tests on electrical machines

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

Reference Material

Manual Available in lab

Subject Code: PCEE-105
Subject Name:*DIGITAL ELECTRONICS*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 4	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Knowledge of Basic Electronics

Additional Material allowed in ESE:Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Understand working of logic families and logic gates
2.	Design and implement Combinational logic circuits
3.	Design and implement Sequential logic circuits
4.	Understand the process of Analog to Digital conversion and Digital to Analog conversion
5.	Be able to use PLDs to implement the given logical problem
6.	Design simple digital electronics based working projects

DETAILED CONTENTS

PART-A

FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES ***(7Hours)***

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples ofICgates, number systems-binary, signed binary, octal hexadecimal number, binaryarithmetic,one's and two's complements arithmetic, codes, error detecting and correctingcodes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

COMBINATIONAL DIGITAL CIRCUITS ***(7Hours)***

Standard representation for logic functions, K-map representation, simplification oflogicfunctions using K-map, minimization of logical functions. Don't care conditions, Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder,serialadder, ALU, elementary ALU design, popular MSI chips, digital comparator,paritychecker/generator, code converters, priority encoders, decoders/drivers for display devices,Q-M method of function realization.

SEQUENTIAL CIRCUITS AND SYSTEMS ***(7Hours)***

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T andD-typesflipflops,applicationsofflipflops,shiftregisters,applicationsofshiftregisters,serialtoparallel converter, parallel to serial converter, ring counter, sequence generator,ripple(Asynchronous) counters, synchronous counters, counters design using flip flops,specialcounter IC's, asynchronous sequential counters, applications ofcounters.

PART-B

A/D AND D/A CONVERTERS ***(10Hours)***

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/Aconverter,specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit,analog to digital converters: quantization and encoding, parallel comparator A/Dconverter,successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES ***(9Hours)***

Memory organization and operation, expanding memory size, classification andcharacteristicsof memories, sequential memory, read only memory (ROM), read and write memory(RAM), content

addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text/References:

1 R. P. Jain, *"Modern Digital Electronics"*, McGraw Hill Education, 2009.

2 M. M. Mano, *"Digital logic and Computer design"*, Pearson Education India, 2016.

3 A. Kumar, *"Fundamentals of Digital Circuits"*, Prentice Hall India, 2016.

E-books and online learning material:

1 Digital electronics by Atul P. Godse& Deepali A. Godse https://books.google.co.in/books?id=bftp5ZG8v5kC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

2 Digital electronics by D. K. Kaushikhttps://www.researchgate.net/publication/264005171_Digital_Electronics

3 https://nptel.ac.in/courses/117103064/11

Online Courses and Video Lectures:

1 https://nptel.ac.in/courses/108105113/1

2 https://nptel.ac.in/courses/108105113/26

3 https://nptel.ac.in/courses/108105113/31

4 https://nptel.ac.in/courses/108105113/32

Subject Code: PCEE-106

Subject Name:*ELECTRICAL MACHINES – II*(ASYNCHRONOUS & SYNCHRONOUS MACHINES)

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 4	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 60%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering, Electrical Machines-I

Additional Material allowed in ESE:Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Understand the concepts of AC machine windings
2.	Analyze performance characteristics of Three Phase Induction motor
3.	Analyze performance characteristics of Induction Generator
4.	Apprehend performance characteristics of Single Phase Induction Motor
5.	Understand the concepts of Synchronous machines
6.	Understand parallel operation of alternators with infinite bus with study of load sharing

DETAILED CONTENTS

PART-A

FUNDAMENTALS OF AC MACHINE WINDINGS ***(5 Hours)***

Introduction to salient pole and cylindrical Rotors, full-pitch windings, concentrated winding, distributed winding, sinusoidally distributed winding, winding distribution factor.

THREE PHASE INDUCTION MOTORS ***(8 Hours)***

Analogy between induction motor and transformer, constructional features, concept of slip, rotor frequency, current and power, Development of circuit model (equivalent circuit), phasor diagram, torque-slip characteristics, effect of rotor circuit resistance, starting torque, crawling and cogging, High torque cage motors: double cage and deep bar motor.

INDUCTION GENERATOR AND SINGLE PHASE INDUCTION MOTOR ***(7 Hours)***

Induction generator operation: Isolated and Grid mode, method of excitation, application of induction generator in wind mills and micro hydel power plants. Single Phase Induction Motor: Double revolving field theory, types of single phase motors, characteristics. Shaded pole motor: working principle and characteristics.

PART-B

SYNCHRONOUS MACHINES ***(12 Hours)***

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation,EMF Method, MMF Method, Zero Power Factor (Z.P.F)Method, Operating characteristics of synchronous machines, V-curves. Salient pole machine-two reaction theory, power angle characteristics, Transients in Synchronous Machines.

PARALLEL OPERATION OF ALTERNATORS ***(8 Hours)***

Conditions for Proper Synchronizing for Single Phase and Three Phase Alternators, Conditions for Parallel Operation, Synchronizing Power, Current and Torque, Effect of Increasing Excitation of one of the Alternators, Effect of Change of Speed of one of the Alternators, Effect of unequal Voltages, Load Sharing.

Text/References:

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

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

3 P. S. Bimbhra, *"Electrical Machinery",* Khanna Publishers, 2011.

4 I. J. Nagrath and D. P. Kothari, *"Electric Machines",* McGraw Hill Education, 2010.

5 A. S. Langsdorf, *"Alternating current machines",* McGraw Hill Education, 1984.
6 P. C. Sen, *"Principles of Electric Machines and Power Electronics",* John Wiley & Sons, 2007.

E-books and online learning material:

1 https://gndec.ac.in/~librarian/web%20courses/IIT-MADRAS/Elec_Mach2/SynchronousMachines.pdf
2 https://nptel.ac.in/courses/108106072/

Online Courses and Video Lectures:

1 https://www.youtube.com/watch?v=fbwZkhaF0dk

2 https://www.youtube.com/watch?v=RX5Xj1keQIc&list=PLPpCFgQP7QKFrkYIYaZt0idq7ocZq9AYU

Subject Code: PCEE-107
Subject Name:*POWER ELECTRONICS*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 4	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic fundamentals of Analog and Semiconductor Electronics

Additional Material allowed in ESE:Scientific Calculator

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

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

DETAILED CONTENTS

PART-A

THYRISTORS, CHARACTERISTICS AND COMMUTATION TECHNIQUES ***(11 Hours)***

Introduction to Thyristor Family, V-I Characteristics of SCR, SUS, GTO, LASCR, DIAC, TRIAC, Principle of Operation of SCR, Turn on Methods of a Thyristor, Switching Characteristics of Thyristors during Turn-on and Turn-off, Gate Characteristics, Firing of Thyristors, Series and Parallel Operation of SCR, Protection of SCR from Over Voltage and Over Current. Load Commutation (Class A), Resonant-Pulse Commutation (Class B), Complementary Commutation (Class C), Impulse Commutation (Class D), External Pulse Commutation (Class E), Line commutation (Class F).

PHASE CONTROLLED TECHNIQUES ***(9 Hours)***

Introduction to Phase angle Control, Single Phase Half Wave Controlled Rectifiers, Single Phase Half Controlled and Full Controlled Bridge Rectifiers with RL Load, Three Phase Full Controlled Bridge Rectifiers with R and RL Load. Basic Circuit and Principle of Operation of Dual Converter with Circulating and Non-Circulating Current mode of operation, Applications of Rectifiers and Dual Converters to Control the Speed of DC Motors.

PART-B

CHOPPERS ***(8 Hours)***

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

CYCLOCONVERTERS ***(5 Hours)***

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

INVERTERS ***(7 Hours)***

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

Text/References:

1 M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2 N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.

3 R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4 L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

E-books and online learning material:

1 Power Electronics Handbook By Muhammad H. Rashid
http://site.iugaza.edu.ps/malramlawi/files/RASHID_Power_Electronics_Handbook.pdf

2 Power Electronics Principles & applications by Joseph vithayathilhttps://books.google.co.in/books?id=LX5GKpQz2CgC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

3 https://nptel.ac.in/courses/108105066/4

4 https://nptel.ac.in/courses/108105066/5

Online Courses and Video Lectures:

1 https://nptel.ac.in/courses/108108077/
2 https://nptel.ac.in/courses/108101038/

Subject Code: PCEE-108
Subject Name:*SIGNALS AND SYSTEMS*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 4	**Teaching Hours**: 40
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 60%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

Additional Material allowed in ESE:Scientific Calculator

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

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

DETAILED CONTENTS

PART-A

INTRODUCTION TO SIGNALS AND SYSTEMS ***(9 Hours)***

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

BEHAVIOR OF CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS ***(10 Hours)***

Impulse response and step response, convolution, input-output behavior with a periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems.System representation through differential equations and difference equations.State-space Representation of systems.State-Space Analysis, Multi-input, multi-output representation.State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

PART-B

FOURIER TRANSFORMS ***(7Hours)***

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

LAPLACE AND Z-TRANSFORMS ***(6 Hours)***

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

SAMPLING AND RECONSTRUCTION ***(8 Hours)***

The Sampling Theorem and its implications.Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects.Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text/References:

1 A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
2 J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3 H. P. Hsu, "Signals and systems",Schaum's series, McGraw Hill Education, 2010.
4 S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
5 A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
6 M. J. Robert,"Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
7 B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

E-books and online learning material:

1 Signals and Systems by Richard Baraniukhttp://www.eng.ucy.ac.cy/cpitris/courses/ece623/notes/SignalsAndSystems.pdf
2 Signals and Systemsby Alan V. Oppenheim, S. Hamid Nawabhttps://web.itu.edu.tr/hulyayalcin/Signal_Processing_Books/Oppenheim_Signals_and_Systems.pdf

Online Courses and Video Lectures:

1 Review of Signal and system by S. C. Dutta Roy, EE Deptt IIT Delhi https://nptel.ac.in/courses/108102042/

Subject Code: LPCEE-103
Subject Name:*DIGITAL ELECTRONICS LABORATORY*

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester: 4	**Teaching Hours**: 26
Theory/Practical: Theory	**Credits:**1
Internal marks:30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks: 50	**Elective Status:** Compulsory

Prerequisites:

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

CO#	Course Outcomes (CO)
1.	Identify different types of digital IC's, read their specification sheets and the way to handle these
2.	Verify the truth tables of various gates and different laws and rules of Boolean Algebra
3.	Design and test different types of combinational and sequential circuits
4.	Analyze different types of DAC, ADC and memory devices
5.	Create and troubleshoot working projects using digital logic
6.	Design and create digital electronics based working projects

Sr. No.	Name of Practical
1	Verification of the truth tables of TTL gates viz: 7400, 7402, 7404, 7408, 7432, 7486.
2	Design and realization of all gates using NAND/NOR gates.
3	Verification of theorems and laws using gates.
4	Design and verification of the truth tables of Half-Adder using different gates and Full Adder circuit using 7483 IC.
5	Design and verification of the truth table of four bit subtractor using 7483 and 7486 IC's.
6	Design and verification of binary to gray code converter or vice-versa.
7	Verification of truth table of Multiplexer (74150)/Demultiplexer(74154).
8	Design, fabrication and testing ofMon-stable multivibrator of t = 0.1ms approx. using 74121/123IC.Testing for both positive and negative edge triggering, variation in pulse width and retriggering.
9	Design and test S-R flip-flop using NOR/NAND gates.
10	Design, fabricate and test a switch debouncer using 7400.
11	Verify the truth table of a JK flip flop using IC 7476.
12	Verify the truth table of a D flip flop using IC 7474 and study its operation in the toggle and asynchronous mode.
13	Operate the counters 7490, 7493 and 74193(Up/Down counting mode). Verify the frequency division at each stage. Using a frequency clock (say 1 Hz) display the count of LED's.
14	Verify the truth table of decoder driver7447/7448. Hence operate a 7 segment LED display through a counter using a low frequency clock. Repeat the above with the BCD to Decimal decoder 7442.

Reference Material

Manual Available in lab

Subject Code: LPCEE-104

Subject Name:*ELECTRICAL MACHINES LABORATORY-II*

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester: 4	**Teaching Hours**: 26
Theory/Practical: Practical	**Credits:**1
Internal marks:30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

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

CO#	Course Outcomes (CO)
1.	Construct equivalent circuits for single phase and three phase induction motor by performing no-load and blocked rotor test
2.	Comprehend the requirement of starting and speed control methods of induction motors in the various applications of industry
3.	Construct equivalent circuits of synchronous generator and motor
4.	Construct characteristic curves for induction motors
5.	Construct characteristic curves of synchronous machines
6.	Compare various methods of parallel operation of three phase alternators

Sr. No.	Name of Practical
1	To perform no-load and blocked–rotor test on three-phase induction motor and to obtain equivalent circuit parameters.
2	To perform load-test on three-phase induction motor and to plot torque versus speed characteristics.
3	To perform no-load and blocked–rotor test on single-phase induction motor and to determine the parameters of equivalent circuit.
4	To perform load–test on single-phase induction motor and to plot torque–speed characteristics.
5	To perform the speed control methods of three-phase induction motor by a) Kramer's method b) Cascading method.
6	To start the three-phase induction motor using star- delta and DOL starters.
7	To perform no load and short circuit test on three-phase alternator and to draw open circuit & short circuit characteristics.
8	To analyze the effect of variation of field current on the stator current and power factor with synchronous motor running at no load and to draw V-curves & inverted Vcurves.
9	To perform parallel operation of three phase alternators using dark lamp method, two-bright and one dark lamp method.
10	To perform parallel operation of three-phase alternators using synchroscope.
11	Application of MATLAB software for solution of problems regarding induction motors and synchronous machines.

Reference Material

Manual Available in lab

Subject Code: LPCEE-105
Subject Name:*POWER ELECTRONICS LABORATORY*

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester: 4	**Teaching Hours**: 26
Theory/Practical: Practical	**Credits:**1
Internal marks:30	**Percentage of Numerical/Design/ Programming Problems:** 100%
External Marks:20	**Duration of End Semester exam (ESE):** 1.5hr
Total marks: 50	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

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

CO#	Course Outcomes (CO)
1.	Understand the properties and characteristics of thyristors
2.	Evaluate and analyze the use of thyristors for different applications like phase control, speed control circuits
3.	Acquire fault finding skills in thyristor based circuits
4.	Develop thyristor based circuits for industrial use like understanding speed control of motors
5.	Understand the different types of waveforms of inverter
6.	Understand waveforms of chopper circuits

Sr. No.	Name of Practical
1	To plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2	To draw V-I characteristics of an UJT and to use UJT as relaxation oscillator.
3	To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load.
4	To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.
5	To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.
6	Study of Jones chopper or any chopper circuit to check the performance.
7	Thyristorised speed control of a D.C. Motor.
8	Speed Control of induction motor using thyristors.
9	Demonstration of series inverter circuit.
10	Demonstration of commutation circuit.
11	Study of a single-phase cycloconverter.

Reference Material

Manual Available in lab

Subject Code: PREE-101

Subject Name: *SEMINAR AND TECHNICAL REPORT WRITING*

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester: 4	**Teaching Hours**: 26
Theory/Practical: Practical	**Credits:**1
Internal marks:50	**Percentage of Numerical/Design/ Programming Problems:** 100%
External Marks:NIL	**Duration of End Semester exam (ESE):**NA
Total marks: 50	**Elective Status:** Compulsory

Prerequisites: Basic writing skills

Additional Material Allowed in ESE: NIL

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

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

DETAILED CONTENTS

PART-A

INTRODUCTION ***(4 Hours)***

Structure of technical Report, Presentation, Planning the report, Writing the first draft, Revising the first draft, Diagrams, graphs, tables and mathematics, The report layout, Headings, References to diagrams, graphs, tables and equations, Originality and plagiarism, Finalising the report and proofreading, The Summary, Proofreading.

PRESENTATION SKILLS ***(4Hours)***

Different ways to fight anxiety, If you don't have anything to say, If something goes wrong, If you forget something, If you make a mistake. Voice: Voice and eye contact, Perfect vs Passionate, Tempo and Time, Gestures, Contact: Facial Expression, asking questions, Things not to do, Computer does not start, working with slides. Q&A: Recap, Filtering questions, Tough questions, you're uncomfortable with the answer, Difficult situations.

LaTeX and Text Formatting ***(6 Hours)***

TeX, LaTeX, Terms regarding TeX, Custom installation with TeX Live, Tables and graphics tools, Automatic installation, Manual installation, Checking package status, External resources, The LaTeX syntax, Compilation.Spacing, Hyphenation, Quote-marks, Diacritics and accents, Margin misalignment and interword spacing, Ligatures, Slash marks, Fonts, Formatting macros, Text mode superscript and subscript, Text figures ("old style"numerals), Dashes and hyphens, Ellipsis (…), Readymade strings

PART B

PARAGRAPH AND FONTS ***(6 Hours)***

Formatting Paragraph alignment, Paragraph indent and break, \paragraph line break, Line spacing, Manual breaks, Special paragraphs. Introduction to Font families, Available LaTeX Fonts, emphasizing text, Font encoding, Font styles, Local font selection, arbitrary font size, finding fonts, Using arbitrary system fonts, PDF fonts and properties, List Structures

TABLES, FLOATS, FIGURES AND CAPTIONS ***(6 Hours)***

The tabular environment, Row specification, Spanning, controlling table size, Colors, Width and stretching, Table across several pages, Partial vertical lines, vertically centered images, Footnotes in tables, Professional tables, Sideways tables, Table with legend, the eqparbox package, Floating with table, Floats, keeping floats in their place, Captions, lists of figures and tables, Labels and crossreferencing, Wrapping text around figures, Subfloats, Wide figures in two-column documents, Custom floats, Labels in the figures, Footnotes and Margin Notes

Text/References:

1 Van Emden J., "Effective communication for Science and Technology", Palgrave 2001.
2 Van Emden J., "A Handbook of Writing for Engineers",2nd ed. Macmillan 1998.
3 Van Emden J. and Easteal J., "Technical Writing and Speaking, an Introduction", McGraw-Hill 1996.
4 Pfeiffer W.S., "Pocket Guide to Technical Writing", Prentice Hall 1998.
5 Eisenberg A., "Effective Technical Communication", McGraw-Hill 1992.
6 Presentation skills: Effective Presentation Delivery (Coursera).
7 Frank Mittelbach , Michel Goossens, Johannes Braams,David Carlisle, Chris Rowley, "The LaTeX Companion (Tools and Techniques for Computer Typesetting)", 2nd Edition,Addison-Wesley,2005
8 Stefan Kottwitz, "LaTeX Beginner's Guide",1st Edition PACKT, 2011.
9 Davies J.W., "Communication for Engineering Students", Longman, 1996.
10 AH Basson & TW von Backström, "Guide for Writing Technical Reports", 3rd Edition, Stellenbosch University",2007.

E-Books and online learning material:

1 http://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/techreport writing.
2 "Introduction to LaTex", http://home.iitk.ac.in/~kalpant/docs/intro_latex.pdf.
3 LaTeX, Wikibook , http://en.wikibooks.org/wiki/LaTeX ,en.wikibooks.org, 2016,

Online Courses and Video Lectures:

1 "Technical Report Writing for engineers", https://www.futurelearn.com/courses/technicalreport-writing-for-engineers
2 "Academic and Research Report Writing", https://swayam.gov.in/courses/4635-academic-andresearch-report-writing

Subject Code: MCEE-101

Subject Name: *ENVIRONMENTAL SCIENCE*

Programme: B.Tech (EE)	**L: 2 T: 0 P: 0**
Semester: 4	**Teaching Hours**: 26
Theory/Practical: Theory	**Credits:** NIL
Internal marks:50	**Percentage of Numerical/Design/ Programming Problems:** 100%
External Marks:NIL	**Duration of End Semester exam (ESE):**NA
Total marks: 50	**Elective Status:** Compulsory

Prerequisites: Basic of Environment

Additional Material Allowed in ESE: NIL

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

CO#	Course Outcomes (CO)
1.	Measure environmental variables and interpret results
2.	Evaluate local, regional and global environmental topics related to resource use and management
3.	Propose solutions to environmental problems related to resource use and management
4.	Interpret the results of scientific studies of environmental problems
5.	Describe threats to global biodiversity, their implications and potential solutions
6.	Understand concept of sustainable development

DETAILED CONTENTS

PART-A

NATURAL RESOURCES AND RELATIONAL MODEL ***(6 Hours)***

Renewable and non renewable resources: Natural resources and associated problems: Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people. Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems, Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, case studies, Land Resources: Land as a resource, land degradation, man induces landslides, soil erosion, and desertification.

ECO SYSTEMS AND ENVIRONMENTAL POLLUTION ***(6 Hours)***

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers, decomposers, Energy flow in the ecosystems, Ecological succession, Food chains, food webs and ecological pyramids. Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards.

PART-B

IMPACT OF INFORMATION TECHNOLOGY ON ENVIRONMENT AND SUSTAINABLE DEVELOPMENT ***(4 Hours)***

Positive and Negative Impacts of IT for Environment, Mobile Phones and Cell Towers, SAR Levels, Effects of Mobile Radiations, Management and Control, IT Impact in Education-Health-Entertainment-EnvironmentBusiness-Society, National Management Information System, Environmental Information System, Geographical Information System, Functions of Remote Sensing, Human Health and Safety.

SOCIAL ISSUES AND THE ENVIRONMENT ***(5 Hours)***

Form unsustainable to sustainable development, Water conservation, rain water harvesting, water shed management, Resettlement and rehabilitation of people; its problems and concerns, case studies,

Environmental ethics: issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies, Environment protection Act, Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act, Wildlife protection act, Forest conservation act.

E-WASTAGE AND GREEN COMPUTING ***(5 Hours)***

Impacts of E-Waste on the Environment, Harmful Effects caused by Improper Computer & Electronic Waste Recycling, Global Trade Issues, Information Security, Recycling, Repair, Electronic Waste Substances, Holistic Approaches and Techniques for Green Computing, Impacts of Green Computing, Green Awareness, Green Initiatives in Information Technology, Green Computing Certifications, Issues & Challenges Ahead.

Text / References:

1 Cunninghan, W.P,"Principle of Environment Science",Springer, 2009.
2 Joseph, "Essentials of Environment Science",W. H Freeman and Company, 2006.
3 Kaushik, A., "Perspectives in Environmental Studies",New Age International Publishers, 2008.
4 Meenakshi, "Elements of Environment Science & Engineering", PHI Publishers,2012.
5 Duggal, "Elements of Environment Engineering", S. Chand2007
6 Erach Bharucha,"Textbook of Environmental studies",UGC,2017
7 Weblink: https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf.
8 D D Mishra,"Fundamental concepts in Environmental Studies", S Chand & Co Ltd, 2018
9 Agarwal, K. c, "Environment Biology", Nidi Publ. Ltd. Bikaner, 2001

Subject Code: PCEE-109
Subject Name: Power Systems – I(Apparatus and Modeling)

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester:5	**Teaching Hours**: 36L+12T = 48 Hours
Theory/Practical: Theory	**Credits:**4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: BasicElectrical Engineering, Electric Circuit Analysis
Additional Material allowed in ESE:Scientific Calculator
On Completion ofthe course, the student will have the ability to:

CO #	Course Outcomes (CO)
1.	Calculate and justify the economical size of conductor to be used in power system
2.	Distinguish the types of overhead transmission lines, line parameters of transmission lines and judge its effects on efficiency of transmission line
3.	Evaluate surge impedance loading and string efficiency of insulators
4.	Compare the different types of underground cables
5.	Acquire knowledge about different types of fault analysis as well as protection of power system
6.	Understand the concept of DC transmission line

DETAILED CONTENTS

PART-A

BASIC CONCEPTS (8L+3 T = 11 Hours)

Evolution of Power Systems, Present-Day Scenario, Structure of a power system, Bulk Power Grids and Micro-grids, Conventional and Renewable Energy Sources, Distributed Energy Resources, Energy Storage, Transmission and Distribution Systems, Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems), Synchronous Grids and Asynchronous (DC) interconnections, Review of Three-phase systems, Analysis of simple three-phase circuits, Power Transfer in AC circuits and Reactive Power.

OVERHEAD TRANSMISSION LINE (7L+2T =9 Hours)

Electrical and magnetic fields around conductors, Corona, Parameters of transmission lines, Capacitance and Inductance calculations for simple configurations, Use of bundled conductor, transpositioning of power lines, Travelling-wave Equations, Sinusoidal Steady state representation of short, medium and long lines,ABCD parameters, power transfer, Voltage profile and Reactive Power, Surge Impedance Loading, Series and Shunt Compensation of transmission lines, Per-unit System and per-unit calculations.

UNDERGROUND CABLES (3L +1T = 4 Hours)

Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, testing of cables, heating effect, Maximum current carrying capacity, causes of failure, comparison with overhead transmission lines.

PART-B

FAULT ANALYSIS (6L+2T = 08 Hours)

Method of Symmetrical Components (positive, negative and zero sequences), Balanced and Unbalanced Faults, Representation of generators, lines and transformers in sequence networks, Computation of Fault Currents, Neutral Grounding,

SWITCHGEAR AND PROTECTION SCHEMES (6L+2T=08 Hours)

Types of Circuit Breakers, Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their applications.

INTRODUCTION TO DC TRANSMISSION (6L+2T = 08 Hours)

DC Transmission Systems, Line-Commutated Converters (LCC) and Voltage Source Converters (VSC), LCC and VSC based dc link, Real Power Flow control in a dc link, Comparison of ac and dc transmission.

Text/References:

1 J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education,1994.
2 O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3 A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4 I. J. Nagrath and Kothari , “Modern Power System Analysis”, McGraw HillEducation, 2003.
5 B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

Subject Code: PCEE-110

Subject Name: Control Systems

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester:5	**Teaching Hours**: 36L+12T = 48 Hours
Theory/Practical: Theory	**Credits:**4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**60%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Electric Circuit Analysis, Signals and Systems

Additional Material allowed in ESE:Scientific Calculator

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

CO #	Course Outcomes (CO)
1.	Understand the modeling of linear-time-invariant systems using transfer function and state-space representations
2.	Design specifications for second order systems based on time response
3.	Interpret the concept of stability and its assessment for linear-time invariant systems using various methods
4.	Determine the stability of a system in the time domain and the frequency domain
5.	Design controllers in time and frequency domain
6.	Evaluate controllability and observability using state space analysis

DETAILED CONTENTS

PART-A

INTRODUCTION TO CONTROL PROBLEM (4L +1T = 5 Hours)

Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems, Feedback Control, Open-Loop and Closed-loop systems, Benefits of Feedback, Block diagram reduction techniques,Industrial Control examples.

TIME RESPONSE ANALYSIS (10L +3T = 13 Hours)

Standard test signals, Time response of first and second order systems for standard test inputs, study of poles and zeros, s-plane, Application of initial and final value theorem, Design specifications for second-order systems based on the time-response, Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique, Construction of Root-loci.

FREQUENCY-RESPONSE ANALYSIS (4L+ 2T = 6Hours)

Relationship between time and frequency response, Polar plots, Bode plots, Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin, Closed-loop frequency response.

PART-B

INTRODUCTION TO CONTROLLER DESIGN (10L+ 3T =13Hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Zero order hold, Root-loci method of feedback controller design, Design specifications and methods in frequency-domain, Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs, Analog and Digital implementation of controllers.

STATE VARIABLE ANALYSIS (8L+ 3T= 11Hours)

Concepts of state variables, State space model, Diagonalization of State Matrix, Solution of state equations, Eigenvalues and Stability Analysis, Concept of controllability and observability, Pole-placement by state feedback, Discrete-time systems, Difference Equations, State-space models and stability of linear discrete-time systems.

Text / References:

1 M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2 B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3 K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.

4 I. J. Nagrath and M.Gopal, “Control Systems Engineering”, New Age International,
5 MOOCS course on Control Systems
6 Related papers from reputed journals

Subject Code:PCEE-111
Subject Name: Microprocessors and Microcontrollers

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester:5	**Teaching Hours**: 36L+12T = 48 Hours
Theory/Practical: Theory	**Credits:**4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:6**0%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Digital Electronics
Additional Material allowed in ESE:Scientific Calculator
On Completion ofthe course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Study of 8085 microprocessor and 8051 microcontroller
2.	Comprehend the importance of 8051 microprocessor and 8051 microcontroller and understand their internal architecture
3.	Acquire programming skills in assembly and C using 8051 microcontroller
4.	Acquire skill to do arithmetic and logical operations
5.	Comprehend the use of timers, serial communication, interrupts and RTC in 8051 microcontroller
6.	Interfacing 8051 with real world and acquire skills to make live projects

DETAILED CONTENTS

PART-A

FUNDAMENTALS OF MICROPROCESSORS (4L+1T = 5Hours)

Digital Computers: General architecture, Inside the computer: Some important terminology, internal working of the computer. Microprocessor and their comparison with microcontroller. Generic microprocessor/microcontroller instruction set and computer languages.8-bit microprocessor and microcontroller architecture.

THE 8051 ARCHITECTURE (6L+2T =8Hours)

The 8051 Architecture: Introduction, 8051 micro-controller hardware, input/output, pins, ports and circuits. Stack and stack pointer, Memory structures. 8051 Hardware connection: The 8051 pin diagram header circuit and INTEL Hex file.

MECHANICS OF PROGRAMMING AND ARITHMETIC, LOGIC INSTRUCTIONS (8L+3T =11Hours)

Assembly language programming: Inside 8051, assembly language programming, assembly and running the program, program counter, 8051 data types and directives, flag bits and PSW register, jump loop and call instructions and 8051 addressing modes. Arithmetic instructions, signed number concepts and arithmetic operations, logic and compare instructions, rotate instructions and data serialization, BCD, ASCII and other application programs.

PART-B

8051 PROGRAMMING IN C (4L+1T=5 Hours)

Data types and time delay in 8051C, I/O programming, Logic and data conversion programs in C, Accessing code ROM space and data serialization in C

TIMERS, SERIAL PORT AND INTERRUPTS PROGRAMMING IN C **(8L+3T =11 Hours)**

Programming 8051 Timers, counter programming, programming timer 0 and 1 in 8051 C. Basics of serial communication. 8051 connection to RS232, Serial port programming in C.8051 interrupts, programming timer, external hardware and serial communication interrupt. Interrupt programming in C.

LCD, K-BOARD, ADC, DAC, SENSOR INTERFACING AND DS12887 RTC INTERFACING **(6L+2T =8 Hours)**

LCD interfacing, keyboard interfacing, parallel and serial ADC, DAC interfacing, serial interfacing and signal conditioning. DS12887 RTC interfacing and programming in C.

Text/References:

1 Uffenbeck, John, "Microcomputers and Microprocessors" PHI/ 3rd Edition.
2 Ray, A.K. & Burchandi, K.M., "Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing" Tata Mc. Graw Hill.
3 Krishna Kant, "Microprocessors and Microcontrollers" PHI Learning.
4 Renu Singh & B.P.Singh, "Microprocessor and Interfacing and applications" New Age International 10. N. Senthil Kumar, "Microprocessors and Microcontroller", Oxford,University Press.
5 Kenneth J Ayala, The 8051 Micro Controller-Architecture, Programming and Application, Penram International Publication.
6 Mazidi M.A. and Mazidi J. G., The 8051 Microcontroller and Embedded Systems, Pearson Education.

E-books and online learning material:

1. https://books.google.co.in/books/about/Microprocessor_and_Microcontroller.html?id=Wcf-CwAAQBAJ&redir_esc=y

2. https://books.google.co.in/books/about/Microprocessors_and_Microcontroller.html?id=OVYGy4NhymMC

3. https://www.freebookcentre.net/Electronics/MicroProcessors-Books.html

4.https://books.google.co.in/books/about/MICROPROCESSORS_AND_MICROCONTROLLERS.html?id=viEaDAAAQBAJ&redir_esc=y

Online Courses and Video Lectures:

1.https://nptel.ac.in/courses/106/108/106108100/

2.https://nptel.ac.in/courses/108/105/108105102/

3. https://www.edx.org/learn/microcontrollers

4. https://edge.edx.org/courses/course-v1:BITSX+F241+2015-16_Semester_II/313201f255574e04b94a47c1fb845e87/

Subject Code: PCEE-112
Subject Name: Measurements and Instrumentation

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester:5	**Teaching Hours**: 36L+12T =48 Hours
Theory/Practical: Theory	**Credits:**4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**30%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering
Additional Material allowed in ESE:Scientific Calculator
On Completion of the course, the student will have the ability to:

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

DETAILED CONTENTS

PART-A

BASIC CONCEPTS OF MEASUREMENTS (10 L+3T = 13 Hours)

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

INTRODUCTION TO HIGH RANGEQUANTITIES MEASUREMENT (8L +2T = 11 Hours)

Measurement of high DC voltages, measurement of high AC voltages , electrostatic voltmeters , sphere gaps,DC Hall effect sensors, high current measurements, Study of Phasor Measurement Units (PMU), Current transformers and potential transformers:principle working, ratio and phase angle errors, numerical problems, Clamp on meters.

PART-B

MAGNETIC MEASURMENTS AND SENSORS (8L+ 3T = 11 Hours)

Measurement of flux and permeability, flux meter, hall effect Gaussmeter for BH curve and permeability measurement, hysteresis measurement, principle of ballistic galvanometer , determination of BH curve, hysteresis loop, Lloyd Fisher square for measurement of iron losses, Sensors for temperature, pressure, torque, flow Speed and Position Sensing, Measurement of rotational speed using proximity and optical sensors.

DC AND AC POTENTIOMETERS AND BRIDGES (6L+ 2T = 8 Hours)

General Principle, calibration of ammeter, voltmeter and wattmeter using potentiometer, AC Bridges, Maxwell's bridge, Schering bridge and Wien's bridge, Block diagram and principle of operation of general purpose CRO, vertical and horizontal deflection system , basic sweep generator , XY mode and Lissajous patterns , applications of CRO , dual trace oscilloscope, Digital Storage Oscilloscope.

INTRODUCTION TO TRANSDUCRESAND ITS APPLICATIONS (4L+1T = 5Hours)
Definition and classification , common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature ,basic principles and working of LVDT, electromagnetic and ultrasonic flow meters, piezo electric force transducer, load cell, bridge configuration for four strain gauges, RTD, Thermistors, thermocouple, Need for instrumentation system, data acquisition system.

Text / References:

1 H.frick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice-Hall of India, Reprint 1988.

2 B.E. Jones, "Instrumentation Measurement and Feedback", Tata McGraw-Hill, 1986.

3 E.W Golding, "Electrical Measurement and Measuring Instruments", 3rd Edition, Sir Issac Pitman and Sons, 1960.

4 H. Buckingham. and E.N Price,, "Principles of Electrical Measurements", 1961.

5 E.O Doebeling, "Measurement Systems Application and Design" McGraw Hill PublishingCompnay, 1990

6 A.S Mooris, Principle of Measurement and Instrumentation, Prentice Hall of India,1999

7 J.W Dalley., Riley, W.F. and Meconnel, K.G., Instrumentation for Engineering

8 Measurement, John Wiley & Sons, 1999

9 A.K.Sawhney, " A course in Electrical and Electronics Measurements and Instruments" DhanpatRai& Co. (Pvt.) Ltd. 2000

10 J. B. Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria&Sons

11 H. S Kalsi., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012

12 W.D Cooper, "Modern Electronics Instrumentation" Prentice Hall of India

13 P.Purkait, B.Biswas, S.Das and C. Koley, Electrical and Electronics Measurements andInstrumentation, McGraw Hill Education (India) Pvt. Ltd.,2013

Subject Code: PCEE-113
Subject Name: Electric Generation and Economics

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester:5	**Teaching Hours**: 36L+12T = 48 Hours
Theory/Practical: Theory	**Credits:**4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering
Additional Material allowed in ESE:Scientific Calculator
On Completion ofthe course, the student will have the ability to:

CO #	Course Outcomes (CO)
1.	Evaluate and compare the performance of conventional and non-conventional energy sources
2.	Understand the concept of cogeneration plants
3.	Analyze the load curves and related factors for determining power generation needs
4.	Carry out economic analysis of different electric energy generation techniques
5.	Plan optimal method of loading turbo generator
6.	Justify the need of hydro thermal coordination

DETAILED CONTENTS

PART-A

CONVENTIONAL AND NON-CONVENTIONALRESOURCES OF ELECTRIC ENERGY GENERATION (8L+3T = 11Hours)

Thermal, Nuclear, Hydro, Gas and Diesel power plants; their layout and components. Selection of power plants, site, number and capacity of units, Drawbacks of conventional energy resources, need and growth of non-conventional energy resources, New Energy Sources, Solar Power Plant, Wind energy System, MHD Generation, Base and Peak load plants, Environmental aspect of electric energy generation.

COGENERATION (4L + 1T = 5 Hours)

Definition and scope, Topping and Bottoming Cycles, Benefits, Cogeneration technologies.

LOADS AND LOAD CURVES (6L+2T = 8 Hours)

Types of loads, connected load, maximum demand, demand factor, group and peak diversity factors, chronological load curve, load duration curve, mass curve, load factor, capacity factor, utilization factor, load forecasting.

PART-B

ECONOMICS OF ELECTRIC ENERGY GENERATION (7L+ 2T= 9Hours)

Capital cost of power plants, annual fixed and operating costs, unit cost of electrical energy, and effect of load factor on unit cost, depreciation, objectives and types of electricity tariff, determination of most economic power factor.

ECONOMIC OPERATION OF STEAM POWER PLANTS AND HYDRO-THERMAL SCHEDULING (11L+4T = 15 Hours)

Methods of loading turbo-generators, Input- output curve, Heat rate curve, Incremental cost curves, Method of Lagrangian multiplier, Effect of transmission losses, Co-ordination equations, Iterative procedure to solve co-ordination equations, Advantages of combined operation of plants, Optimal scheduling of hydro-thermal system.

Text / References:

1 M.V.Deshpande, Power plant engineering, Tata McGraw Hill.

2 B.R.Gupta, , Generation of electric energy, S. Chand.

3 I.J. Nagrath, and D.P. Kothari, Power system engineering, Tata McGraw-Hill Education.

4 P.K Nag,. Power plant engineering, Tata McGraw-Hill Education.

5 A. J. Wood, and B. F. Woolenberg, Power Generation Operation & Control, Wiley India.

6 G. Boyle, Renewable energy-power for a sustainable future, Oxford University Press.

7 G.D.Rai, Non-conventional energy sources, Khanna Publishers.

Online Learning Matertial:

1. http://www.fayoum.edu.eg/stfsys/stfFiles//243//2512//Ch%204%20%20Principles%20of%20Power%20system.pdf – Accessed on 27/08/2020
2. https://byjus.com/physics/conventional-and-nonconventional-sources-of-energy/-Accessed on 27/08/2020
3. https://nptel.ac.in/courses/121/106/121106014/- Accessed on 27/08/2020
4. http://www.ignou.ac.in/upload/Unit-7-58- Accessed on 27/08/2020

Subject Code: LPCEE-106

Subject Name:*POWER SYSTEMS LABORATORY-I*

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester:5	**Teaching Hours**: 24
Theory/Practical: Practical	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

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

CO #	Course Outcomes (CO)
1.	Plot characteristics of various transmission lines
2.	Understand concept of relays and circuit breakers
3.	Analyze various protection schemes in power system
4.	Plot characteristics of different types of relays
5.	Measure the resistance of earth
6.	Demonstrate the operation of a circuit breaker

LIST OF EXPERIMENTS

1 To find the ABCD parameters of a Transmission line.

2 To obtain the Characteristics of over current and earth fault protection relay.

3 To find the operating characteristics of fuse. (HRC or open type)

4 To find the earth resistance using three electrodes.

5 To draw the characteristics of over current static relay.

6 To simulate the different types of faults on transmission line using MiPower software.

7 To obtain the characteristics of under voltage and over voltage numeric relay.

8 To find the characteristics of bimetallic Relay.

9 To draw the characteristics of high speed impedance Relay.

10 To find the breakdown strength of transformer oil.

11 To find the resistivity of earth using four electrode method.

12 To demonstrate the operation of a Circuit breaker.

13 To develop the basic block diagram of WAVECT based microgrid simulator.

Reference Material

Manual Available in lab

Subject Code: LPCEE-: LPCEE-107

Subject Name: CONTROL AND INSTRUMENTATION LABORATORY

Programme:B.Tech(EE)	**L: 0 T: 0 P:** 2
Semester: 5	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:**1
Internal marks: 30	**PercentageofNumerical/Design/ Programming Problems**: 100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status**: Compulsory

Prerequisites: Basic Electrical Engineering

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

CO#	Course Outcomes (CO)
1.	Evaluate and imply basic control hardware models in software based approach.
2.	Check the time domain response and obtain performance parameters of a first order and second order systems.
3.	Compare linear and nonlinear control characteristics with their applications
4.	Analyze errors of physical system models from an electrical equivalent.
5.	Analyze and explore the applications & characteristics of servo motors.
6.	Evaluate the concept of stability and able to apply various techniques to find out stability

Sr. No. Name of Practical

1. To verify the control action of P, PI and PID controllers and their applications.
2. To verify the characteristics of potentiometers and to use two potentiometers as an error detector in a control system Speed control of DC motor using Pulse width modulation.
3. To determine the time domain response of a first order and second order system for step input and obtain performance parameters
4. To verify the characteristics of synchro transmitter-receiver set and to use it as an error detector.
5. To draw the speed-torque characteristics of a DC servo motor and to explore its applications.
6. To design a Lag compensator and test its performance characteristics.
7. To design a Lead-compensator and test its performance characteristics..
8. Measurement of resistance using Kelvin's Bridge
9. Measurement of frequency using Wein's Bridge.
10. To find the ratio error of Current and Potential Transformers.
11. To measure power & power factor in 3-phase circuit by 2-wattmeter method.
12. To measure insulation resistance using Meggar.
13. Measurement of displacement using LVDT.

14. To measure the earth resistance by Earth Tester.

15. To observe phase sequence of three phase circuit using rotating type phase sequence indicator.

16.. Temperature measurement using temperature sensor (RTD).

17. Light measurement using LDR and photo cell censor.

18. To plot the characteristics of a Photo reflective sensor.

19. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.

20. Design of PID controller using MATLAB/SIMULINK.

Reference Material

Manual Available in lab

Subject Code: LPCEE-108

Subject Name: MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester:5	**Teaching Hours**: 26
Theory/Practical: Practical	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Analog Electronics and Digital Electronics

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

CO#	Course Outcomes (CO)
1.	Ability to make connections on 8051 training board and understand the use and importance of 8051 microcontroller architecture
2.	Comprehend the importance of 8051 microcontroller and understand their internal architecture
3.	Acquire programming, simulation and testing skills in assembly and C language
4.	Ability to do timers, serial communication and interrupts-based programming in 8051 microcontroller
5.	Create and troubleshoot automate the circuits involving interfacing of 8051 with real world
6.	Create and troubleshoot automatic controllers employing 8051 microcontroller

Suggested List of Experiments:

1 Familiarization with 8051 microcontroller training board and demonstration of writing and executing a program on KEIL software compiler.
2 Write a program to add and multiply two numbers lying at two memory locations and display the result on KEIL software IDE.
3 Write a program to demonstrate different addressing modes in microcontroller
4 Understanding and making the header circuit of 8051 microcontroller. Demonstration of converting program written in assembly, C to HEX file and burning the same on 8051 IC.
5 Write a program to demonstrate jump, loop and call instruction in microcontroller.
6 Write a program for calculating and testing checksum byte,
7 Write a program to convert Binary (hex) to ASCII conversion.
8 Write a program to generate square wave of different frequencies and different duty cycles.
9 Write a program to generate a square wave of different duty cycles (PWM technique).
10 Write a program of flashing LED's connected to port 1 of the micro-controller.
11 Interfacing of 7-segment display with 8051 microcontroller and display numbers 0-9 with delay of 1 sec.
12 A switch is connected to pin P1.0. Write a program in C to monitor SW and create the following frequencies on pin 1.7:
   a) SW=0: 500Hz
   b) SW=1: 750Hz
   Use Timer 0, mode 1 for both of them.
13 Interfacing of 16 x 2 LCD display with 8051 microcontroller and display your first name and university roll no. on it.
14 Interfacing of 4 x 4 matrix keyboard with 8051 microcontroller.
15 Write a C program using interrupts to do the following:

a) Receive data serially and send it to P0.
b) Read port P1, transmit data serially, and give a copy of P2.
c) Make timer 0 generate a square wave of 1 kHz frequency on P0.0
Set baud rate at 9600.

16 Interfacing of 1kΩ pot with ADC and 8051 microcontroller and display proportionate voltage depending in the position of wiper on pot on 16 x 2 LCD display.

17 Interfacing of LM-35 temperature sensor with 8051 microcontroller and display the temperature on 16 x 2 LCD display.

18 Using DS12887 RTC write a C program how to read time, convert it to ASCII, and send it LCD for display.

Students are advised to make an 8051 microcontroller based minor project.

Reference Material

Manual Available in lab

Subject Code: TR-102

Subject Name: Training-II

Programme: B.Tech (EE)	**L: 0 T: 0 P: NA**
Semester:5	**Teaching Hours**: 24
Theory/Practical: Practical	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

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

CO #	Course Outcomes (CO)
1.	Identify real life engineering problems and economic solution
2.	Apply the knowledge to solve engineering problems
3.	Demonstrate the knowledge, skills and attitudes of a professional engineer
4.	Communicate with engineers and the community at large in written and oral forms
5.	acquire “Hands on” training and practice use of various tools, devices, machines
6.	Undertake problem identification, formulation and solution by considering ethical responsibility

CONTENTS:

The students are required to work in Electrical industry/company for showing applications of the knowledge gained during the course work. Students should be able to gain knowledge of various software/hardware techniques being used in the industry for designing, analysis, project planning, manufacturing, cost estimation, maintenance etc.

Subject Code: PCEE-114
Subject Name: Power Systems – II (Operation and Control)

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 36L + 12T= 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 40%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Power System-I (Apparatus and Modelling)

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
1.	Use numerical methods to analyze a power system in steady state
2.	Understand stability constraints in a synchronous grid
3.	Evaluate stability of power system after occurrence of disturbance
4.	Understand methods to control the voltage, frequency and power flow
5.	Understand the monitoring and control of a power system
6.	Understand the basics of power system economics

Detailed Contents:

PART-A

Power Flow Analysis (9L + 3T=12 Hours)

Review of the structure of a Power System, Per Unit representation of Power System Components, Formation of Bus Admittance Matrix, Real and reactive power balance equations at a Bus, Bus Specifications, Application of Gauss Seidel, Newton-Raphson and Fast Decoupled methods for the solution of the power flow equations, Computational issues in Large-scale Power Systems.

Stability of Synchronous Grids (9L + 3T=12 Hours)

Swing Equations of a synchronous machine connected to an infinite bus, Power angle curve, Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three-phase fault, Equal Area Criterion, Solution of swing equations using methods like point-by-point, forward Euler, Runge-Kutta 4^{th} order methods, Impact of stability constraints on Power System Operation, Effects of series compensation of transmission lines on stability.

PART-B

Control of Frequency and Voltage (6L+2T=08 Hours)

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing, Automatic Generation Control of single and two control areas, Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOM, Tap Changing Transformers, Power flow control using embedded dc links, phase shifters.

Monitoring and Control (6L+2T=08 Hours)

Overview of Energy Control Centre Functions, SCADA systems, Phasor Measurement Units and Wide-Area Measurement Systems, State-estimation, System Security Assessment, Normal, Alert, Emergency, Extremis states of a Power System, Contingency Analysis, Preventive Control and Emergency Control.

Power System Economics and Management (6L+2T=08 Hours)

Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing, Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services, Regulatory framework.

Text/References:

1 J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2 O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3 A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4 D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5 B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.
6 A. J. Wood, and B. F. Woolenberg, Power Generation Operation & Control, Wiley India.2013

Subject Code: PCEE-115
Subject Name: PLC and Industrial Drives

Programme:B.Tech(EE)	**L: 3 T: 0 P: 0**
Semester: 6	**Teaching Hours:** 36L+12T= 48 hours
Theory/Practical: Theory	**Credits:** 3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems**: 30%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status**: Compulsory

Prerequisites: Digital Electronics, DC and AC Electrical Machines, Power Electronics

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1	Acquire the hardware knowledge of PLC module
2	Understand the ladder programming skills of PLC module
3	Acquire the knowledge about different communication types with PLC module
4.	Acquire fundamental knowledge in dynamics and control of Electric Drives
5.	Acquire knowledge of characteristics of induction motor drives
6.	Use power electronic converters for speed control of servo motors and induction motor

DETAILED CONTENTS:

Part-A

INTRODUCTION TO PLC (6L + 2T=08Hours)

Introduction, Advantages of PLC control panel,, Architecture of PLC, Functions of various blocks that make PLC, Working principle of PLC, Memory types, Different types of input/output circuits, Concept of digital I/O & analog I/O, Concept of PLC scan cycle.

PLC PROGRAMMING (6L +2T=08 Hours)

Concept of sink and source I/O cards, Different programming methods (ladder, function block diagram, sequential text),programming devices, programming with PLC, Boolean gates, Timer/Counter instructions, Compare instructions, Move instructions, Math instructions, Concept of latching & unlatching.

INTRODUCTION TO ELECTRICAL DRIVES (6L + 2T=08 Hours)

Introduction to electric drives, block diagram of electric drive, classification of drives: According to supply system, load, protections and applications. Types of load, fundamental torque equations, equivalent values of drive parameters, nature and classification of load torques, Dynamics of motor-load combination steady state stability, load equalization.

Part-B

HARDWARE CONSTRUCTION AND ESTIMATION OF MOTOR RATING

(9L + 3T=12Hours)

Basics of hardware construction, Mechanical design, Overview of components (input bridge, IGBTs, Filter circuit, cooling system, control boards. Optional accessories (communications boards, safety modules. Estimation of Motors Rating**:** Thermal modeling of motors, Types of duty cycles, Calculation of motor rating for duty cycles, Overload factor calculation for short and intermittent duty cycle, Use of load diagrams.

SOLID STATE CONTROLLED DRIVES (9L + 3T=12Hours)

Control of AC drives fed through single-phase and three-phase semi-converter and full-converter phase-controlled configurations, their analysis, Regeneration and braking through power converters, control of three phase induction motors by stator voltage and frequency control for speeds, V/f and Vector control, Energy efficient drives, losses in electrical drive system, Energy conservation in electric drives

Text/References:

1 G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2 R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.
3 G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
4 W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.
5 B.K Bose,“Modern Power Electronics and AC Drives”,PHI,2002.

Subject Code: PEEE 101
Subject Name: RENEWABLE ENRGY RESOURCES

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6th	**Teaching Hours:** 36L + 12T =48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems: 20**%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Department Elective

Prerequisites: Basic Electrical Engineering

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1	Analyze the global and national energy scenario as regards to energy crisis
2	Analyze the available solar potential in India
3	Understand the basic physics of wind power generation
4.	Evaluate the application of fuel cell in diverse fields
5.	Evaluate the application of bio mass energy system in future development
6.	Evaluate the energy harnessing from biomass, wind, geothermal, tidal and other non conventional sources of energy

Detailed Contents

Part-A

INTRODUCTION (4L+1T=05 Hours)

Global and National energy scenarios, Limitation of conventional energy sources, need and growth of alternative energy source, Energy-Environment interaction, basic scheme and application of direct energy

SOLAR ENERGY (08L+3T =11 Hours)

Solar energy in India, Solar radiation spectra, solar geometry, Earth Sun angles and observer Sun angles, solar day length, solar collectors, estimation of solar energy availability, Applications of solar energy, solar furnace, Diode equivalent circuit of PV cell, Photovoltaic effect, different types of photovoltaic cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency.

WIND ENERGY (06L+02T = 08 Hours)

Wind systems in India, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions, Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Wind Energy Conversion systems.

Part-B

FUEL CELL **(04L+01T = 05 Hours)**

Principle of Operation of Fuel Cell, Gibb's free energy, general description of fuel cells types, construction, operational characteristics and applications.

BIO MASS ENERGY **(08L+03T = 11 Hours)**

Availability of bio-mass and its Conversion Theory, Harvesting of biomass (coppieing, pollarding, lopping, pruning, thinning), Biomass conversion technologies (thermochemical, biochemical and agrochemical) technology, briquetting, biomass gasification technology.

MISCELLANEOUS SOURCES **(06L+02T = 08 Hours)**

Geothermal system, hydro-electric plants, Tidal energy, Biodiesel, Thermo-electric and MHD generator

Text /References Books:

1. B. R. Gupta , Generation of Electrical Energy, S. Chand, 2015
2. G.D. Rai , Non-Conventional Energy Sources, Khanna Publishers, 2005.
3. S. Rao, and B.B. Parulekar, Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers, 2005.
4. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
5. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
6. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
7. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
8. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
9. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

Online Course:

https://nptel.ac.in/courses/121/106/121106014/ - 21 August 2020

https://nptel.ac.in/courses/108/108/108108078/ - 21 August 2020

Subject Code: PEEE 103
Subject Name: SOLAR AND WIND ENERGY

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6th	**Teaching Hours:** 36L + 12T =48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems: 20**%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Basic Electrical Engineering

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1	Analyze the global and national energy scenario as regards to energy crisis
2	Demonstrate the knowledge of physics of solar power generation and the associated
3	Demonstrate the knowledge of various types of solar power generations
4.	Appreciate the importance of characteristics of wind power generation and network integration issues
5.	Demonstrate the knowledge of the application of Power Electronics for Power quality improvement of wind generators
6.	Identify the problems and develop solutions for integration of wind generation in power system

Detailed Contents:

Part-A

INTRODUCTION (**06L+ 02T=08 Hours)**

Global and National energy scenarios, Limitation of conventional energy sources, need and growth of alternative energy source, Energy-Environment interaction, basic scheme and application of direct energy

SOLAR ENERGY **(08L+03T=11 Hours)**

Solar energy in India, Solar radiation spectra, solar geometry, Earth Sun angles and observer Sun angles, solar day length, solar collectors, estimation of solar energy availability, Applications of solar energy, solar furnace, Diode equivalent circuit of PV cell , Photovoltaic effect, different types of photovoltaic cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency.

SOLAR POWER GENERATION **(04L+01T=05 Hours)**

Solar thermal power generation, PV power generation, Energy Storage device, designing the solar system for small installations.

Part-B

WIND ENERGY **(09L+03T=12 Hours)**

Wind systems in India, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions, Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators,

Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Wind Energy Conversion systems.

POWER ELECTRONICS FOR WIND TURBINES (09L+03T=12 Hours)

Power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems, isolated wind systems, reactive power and voltage control, economic aspects, impacts on power system dynamics, Power System Interconnection

Text/Reference Books:

1. B. R Gupta., *Generation of Electrical Energy*, S. Chand,2015.
2. G.D. Rai, *Non-Conventional Energy Sources*, Khanna Publishers, 2005.
3. Rao, S. and Parulekar, B.B., *Energy Technology: Non-Conventional, Renewable andConventional*, Khanna Publishers (2005).
4. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
5. G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons, 2004.
6. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
7. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
8. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
9. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

Subject Code: PEEE-102
Subject Name: Embedded Systems & PLC

Programme: B.Tech (EE)	**L:3 T:1 P:0**
Semester: 6	**Teaching Hours**: 36L+12T=48 hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Elective

Prerequisites: Digital Electronics and Microcontrollers.

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Study of TI MSP 430/432 Arm microcontroller and overview its architecture
2.	Understand MSP 430/432 ARM I/O programming and comprehend the importance of interfacing of MSP 430/432 with LCD and keyboard
3.	Understand UART serial port, timer and Interrupt programming
4.	Acquire the hardware knowledge of PLC module
5.	Understand the ladder programming skills of PLC module
6.	Acquire the knowledge about different communication types with PLC module

DETAILED CONTENTS

PART-A

C for EMBEDDED SYSTEMS and (6L+2T=08Hours)
MSP430/432 ARM I/O PROGRAMMING

C Data types for embedded systems bit wise operations in C. MSP 430/432 micro-controller architecture and launch pad. GPIO programming and interfacing. LED and 7-segment display interfacing. I/O PORT programming and PORT mapping.

TIMERS, SERIAL PORT AND INTERRUPTS PROGRAMMING (8L+3T=11Hours)

Basics of serial communication, Programming UART ports. MSP430/432 ARM timer programming. System Tick Timer. Delay generation and counter programming. Interrupts and exception in ARM Cortex-M. ARM Cortex-M processor modes. MSP430/432 I/O Port, UART Serial Port and SysTick programming and interrupt. Interrupt priority programming.

LCD, KEYBOARD, ADC, DAC and SENSORS INTERFACING

(4L+1T=05Hours)

LCD and keyboard interfacing, ADC characteristics, ADC programming with MSP430/432, sensor interfacing and signal conditioning. Interfacing to DAC.

Part-B

ADVANCE PLC PROGRAMMING (6L+2T=08 Hours)

Introduction to PLC programming, Different programming methods (Instruction list, functional block diagram, Sequential text, signal flow chart), ABB PLC programming, SIEMENS PLC & FUJI PLC programming

PLC COMMUNICATION &TROUBLESHOOTING (6L+2T=08 Hours)

Introduction to Mod bus TCP/IP, Mod bus RTU, Ethernet/IP & Profinet, Introduction to communication ports in PLC, serial communication I/O, LAN, RS232, RS422/RS485, programmable controllers and networks, Troubleshooting in PLC.

PLC INTERFACING (6L+2T=08 Hours)

Concept of Interfacing in PLC, Sensors interfacing to PLC, Relay card interfacing with PLC, PLC to PLC, PLC to HMI, PLC to SCADA interfacing.

Text/References:

1 M.A. Mazidi, S.Chen, S.Naimi, and M. Salmanzadeh, "TI MSP432 ARM Programming for Embedded Systems".2016

2 D. Otter & Job, "Programming Logic Controller", PH international, USA,2006

3 G. Dunning, "Introduction to PLC's", Tata McGraw Hill.2005

4 K. Rajesh, "Module on PLCs and their applications",NITTR, Chandigarh,2015

E-books and online learning material:

1.https://books.google.co.in/books/about/Microprocessor_and_Microcontroller.html?id=Wcf-CwAAQBAJ&redir_esc=y

2.https://books.google.co.in/books/about/Microprocessors_and_Microcontroller.html?id=OVYGy4NhymMC

3.https://www.freebookcentre.net/Electronics/MicroProcessors-Books.html

4.https://books.google.co.in/books/about/MICROPROCESSORS_AND_MICROCONTROLLERS.html?id=viEaDAAAQBAJ&redir_esc=y

5. https://nptel.ac.in/courses/106/108/106108100/

6. https://nptel.ac.in/courses/108/105/108105102/

7. https://www.edx.org/learn/microcontrollers

8. https://edge.edx.org/courses/course-v1:BITSX+F241+2015-16_Semester_II/313201f255574e04b94a47c1fb845e87/

Subject Code: PEEE-104
Subject Name: Automatic Control & Robotics

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester:6	**Teaching Hours**: 36L+12T=48 Hours
Theory/Practical: Theory	**Credits:**4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Elective

Prerequisites:
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Understand the concept of automation
2.	Comprehend the role of automation in industries
3.	Understand different types of automatic identification methods used in industries
4.	Comprehend types of robots and their classification based of geometry, control and path movement
5.	Analyze robotics mechanics and control
6.	Ability to decide and select robot for particular application

DETAILED CONTENTS

PART-A

Industrial Automation (6L+2T=8 hours)
Fundamentals concepts and scope of automation, definition of automation, reasons for automating, types of production and automation, automation strategies, levels of automation.

Automation Assembly and Transfer Lines (12L+4T= 16 hours)
Fundamentals of automated production lines, automated assembly systems, analysis of transfer lines without storage, automated flow lines with storage buffers, types of automated assembly systems, quantitative analysis of assembly systems, automatic identification methods, bar code technology, RFID system, other AIDC technologies.

PART-B

Robotics (8L+ 3T=11hours)
Brief history- Types of robots, classification based on geometry, devices, control and path movement. Robot control systems, end effecteos, sensors, DoF-Asimov's law of robot dynamic stabilization of robot. Programming languages. Industrial application of robots.

Spatial Description and Transformation (10L+3T=13 hours)
Mathematical representation of robots- Position, orientation. Arithmetic transformation equations, link-joint description. Representation using Denavit-Hattenberg parameters, DoF- direct and inverse kinematics ,transformation of free vectors computational considerations, manipulator Kinematics, link description, link-connection description, actuator space joint space and Cartesian space SCARA Robots.

Text/References:

1. P. Mikell Groover, "Automation, Production systems, and computer integrated manufacturing",3rd edition Pearson 2009.
2. T.C. Chang & A. Richard Wysk ,"An Introduction to Automated Process Planning Systems" Prentice-Hall, Inc., 1985.
3. W. Nage, "Industrial Robotics-Groover, McGraw Hill International", 2nd edition, 2012
4. J. J Craig , "Introduction to Robotics" , Pearson education international, 3rd edition.1986

Subject Code: : PEEE-105
Subject Name: Energy Efficient Machines

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	Teaching **Hours:** 36L + 12 T= 48Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 40%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Induction Motor Basics

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
1.	Understand the importance of energy management and audit
2.	Apply energy conservation measures in industrial and agriculture sector
3.	Understand the design modifications in energy efficient motor as compared to standard motor
4.	Understand the power factor correction with non linear loads
5.	Evaluate motor efficiency and selection of drive for industrial use
6.	Apply a computational tool to analyze the payback period of energy efficient motors

Detailed Contents:

PART-A

ENERGY MANAGEMENT AND AUDIT (6L+2T= 08 hours)

Introduction to Energy Management, Energy Audit and its Need, Types of Energy Audit, Energy Conservation in context with induction motor loads in Industrial and Agricultural Sector, Energy Audit Instruments.

REACTIVE POWER MANAGEMENT IN ELECTRICAL SYSTEMS (8L+3T=11 hours)

Electricity Billing, Electrical Load Management and Maximum Demand Control, low power factor issues with standard induction motor Methods of Power Factor Improvement, Selection and Location of Capacitors, Performance. Assessment of Power Factor Correction Capacitors, Power Factor with Non-Linear Loads, Harmonics distortion factor and power quality.

ADJUSTABLE SPEED DRIVES (4L+1T=05 hours)

Introduction to AC drives**,** AC drive classification**.** Variable Frequency Drives, drives in industrial automation. AC drive evaluation and selection.

PART-B

ENERGY EFFICIENT MOTORS (10L+3T=13 hours)

Difference between Standard Motors and Energy Efficient Motors, NEMA Design A, B, C, D, Wound Rotor, Multi speed Motors, Motor Efficiency Determination Methods: Direct Measurement Method, Loss Segregation Method, Motor Efficiency Labeling, Factors for selection of Energy Efficient Motors, Over-Motoring, Eddy Current.

ECONOMICS OF ENERGY EFFICIENT MOTORS AND SYSTEMS (8L+3T=11hours)

Motor Life Cycle Cost, Direct Saving and Payback Analysis, present Worth Method with constant Power Costs and Increasing over Costs, Introduction to software like MATLAB for various computations related to energy efficient machines and energy audit.

Text Books:

1 J. C. Andreas, Energy Efficient Electric Motors, Marcel Dekker Inc.1992

2 T. Albert, Introduction to Efficient Electric System Design, The Fairmount Press Prentice Hall.

3 S.C. Tripathi, Electric Energy Utilization and Conservation, Tata Mc-Graw Hill 1991.

4 B. Charles, Handbook of Modern Electronics and Electrical Engineering, John Wiley & Sons,1986.

E-Books and online learning material:

1 . NEMA https://www.nema.org. Accessed on Aug 4 2020

2 . BEE web-link https://www.beeindia.go Accessed on Aug 4 2020

Subject Code: PREE-107
Subject Name: Computer Aided Electrical Machine Design

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	Teaching **Hours:** 36 L + 12 T= 48Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 70%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Basics of Electrical Machines

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
1.	Understand the construction and performance characteristics of electrical machines
2.	Understand the electrical, magnetic and thermal loading of electrical machines
3.	Understand the principles of electrical machine design and carry out a basic design of an electrical machine
4.	Design the dimensions and various parameters related to Transformer, Induction motor and Synchronous motor
5.	Understand the complexities of the design of permanent magnet synchronous motor , Brushless DC motors , Switched reluctance and claw-pole machines
6.	Apply a software tool for computations required in electrical machine design

Detailed Contents:

Part-A

Introduction (4L+1T =05 hours)
Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loading. Thermal considerations, heat flow, temperature rise and machine rating.

Transformers (6L+2T = 08hours)
Rating and size of a single- and three-phase transformers. Overall dimensions, window space factor, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Induction Motors (8L+3T=11hours)
Size and rating of three phase induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor. Magnetic leakage reactance, magnetizing current and short circuit current calculations.

Part-B

Synchronous Machines **(8L+3T=11 hours)**

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit Ratio, estimation of air gap length, design of rotor, design of damper winding, determination of full load field MMF, design of field winding, design of turbo alternators..

Computer aided Design (CAD) **(10L+3T=13 hours)**

Limitations of traditional designs, need of CAD analysis ,synthesis. and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation , Use of software tool in Electrical machine design. Introduction to complex structures of modern machines- Permanent magnet synchronous motor (PMSM), Brushless dc motor(BLDC), Switched reluctance motor SRM) and claw-pole machines.

Text/Reference Books:

1 A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.

2 M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

3 S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBHPublishing, 2006

4 K. L. Narang, "A Text Book of Electrical Engineering Drawings", Satya Prakashan, 1969.

5 A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.

6 K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.

E-Books and online learning material:

1 .https://www.worldcat.org/search?q=su%3AElectric+machinery+Design+and+construction.&qt=hot_subject

2 https://www.engbookspdf.com/Electric-Devices/Electrical-Machines-2nd-edition-by-Turan

Subject Code: PEEE-106
Subject Name: Digital Control System

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 36L + 12T= 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 60%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Control Systems, Discrete Mathematics

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
1.	Understand the basics of sampling, quantization and hold circuits
2.	Understand the concept of z transform and its properties
3.	Obtain discrete representation of LTI systems
4.	Apprehend state space approach for discrete systems
5.	Design digital controllers for discrete systems
6.	Design state feedback and output feedback controllers

DETAILED CONTENTS

PART-A

Discrete Representation of Continuous Systems (6L+2T = 08 Hours)
Basics of Digital Control Systems, Discrete representation of continuous systems, Sample and hold circuit. Mathematical Modeling of sample and hold circuit, Effects of Sampling and Quantization, Choice of sampling frequency, Zero Order Hold equivalent.

Discrete System Analysis (6L+2T = 08 Hours)
Z-Transform and Inverse Z Transform for analyzing discrete time systems, Pulse Transfer function, Pulse transfer function of closed loop systems, Mapping from s-plane to z plane, Solution of Discrete time systems, Time response of discrete time system.

Stability of Discrete Time System (6L+2T = 08 Hours)
Stability analysis by Jury's test, Stability analysis using bilinear transformation, Design of digital control system with dead beat response, Practical issues with dead beat response design.

PART-B

State Space Approach for discrete time systems (8L+3T = 11 Hours)
State space models of discrete systems, State space analysis. solution of lineartime invariant and linear time variant state equations, canonical forms Lyapunov Stability, Controllability, observability analysis. Effect of pole zero cancellation on the controllability & observability.

Design of Digital Control System **(6L+2T = 08 Hours)**

Design of Discrete PID Controller, Design of discrete state feedback controller, Design of set point tracker, Design of Discrete Observer for LTI System, Design of Discrete compensator, Modern control Systems in Electric Vehicles and Hybrid Electric Vehicles and its Electronic Control Unit.

Discrete output feedback control **(4L+1T = 05 Hours)**

Design of discrete output feedback control, Fast output sampling and periodic output feedback controller design for discrete time systems.

Text/Reference Books:

1 K. Ogata, "Discrete Time Control Systems", Prentice Hall, Englewood Cliffs, 1995.
2 M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
3 G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems" Addison-Wesley, 1998.
4 B.C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.
5 K. Ogata, "Modern Control Engineering", Prentice Hall, Englewood Cliffs,2001.
6 L. William Brogan, Modern Control Theory, Pearson Education India, 2011.

Online Courses and Video Lectures:

1	https://nptel.ac.in/courses/108/103/108103008/	Accessed on July18, 2020
2	https://nptel.ac.in/courses/108/106/108106024/	Accessed on July18, 2020
3	https://freevideolectures.com/course/3116/control-engineering-i	Accessed on July18, 2020

Subject Code: PCEE-108
Subject Name: Process Dynamics and Control

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	**Teaching Hours:** 36L + 12T= 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Elective-II

Prerequisites: Control Systems, Measurement and Instrumentation

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
1.	Demonstrate fundamental understanding of process control
2.	Develop the mathematical model of various chemical systems
3.	Explain different control modes and their application in controlling various processes
4.	Explain the working of electric, hydraulic and pneumatic controllers
5.	Demonstrate the working and application of different type of actuators and control valves
6.	Understand advanced control schemes

DETAILED CONTENTS

PART-A

Introduction **(4L+1T=05 Hours)**

Historical perspective, Incentives of process control, Synthesis of control system, Classification and definition of process variables.

Mathematical Modeling **(8L+3T=11 Hours)**

Need and application of mathematical modeling, Lumped and distributed parameters, Analogies, Thermal, Electrical and chemical systems, Modeling of Continuous Stirred Tank Reactor, Modeling of heat exchanger, Interacting and non-interacting type of systems, Dead time elements.

Actuators **(6L+2T=08 Hours)**

Hydraulic, Pneumatic actuators, Solenoid, E-P converters, Control valves, Types, Functions, Quick opening, Linear and equal percentage valve, Ball valves, Butterfly valves, Globe valves, Pinch valves, Valve application and selection

PART-B

Control Modes **(8L+4T=12 Hours)**

Definition, Characteristics and comparison of on-off, Proportional (P), Integral (I), Differential (D), PI, PD, PID, Dynamic behavior of feedback controlled processes for different control modes ,Control system quality, Integral Absolute Error, Integral Square Error, Integral Time Absolute Error criterion, Tuning of controllers Ziegler-Nichols, Cohen-Coon methods

Realization of Control Modes **(5L+1T=06 Hours)**

Realization of different control modes like P, I, D in Electric, Pneumatic, Hydraulic controllers.

Advanced Controls **(5L+1T=06 Hours)**

Introduction to advanced control schemes like Cascade, Feed forward, Ratio, Selective, Override, Split range and Auctioneering control

Text/ Reference Books:

1 C.D Johnson., Process Control Instrumentation Technology, Prentice–Hall of India Private Limited, 1992.
2 G. Stephanopoulos, Chemical Process Control, Prentice–Hall of India Private Limited, 1983.
3 P.Harriot, Process Control, Tata McGraw Hill,1982
4 B.G.Liptak, Instrument Engineers Handbook, Butterworth, Heinemann, 2002
5 D.E Seborg, T.F. Edgar, and D.A. Mellichamp, Process Dynamics and Control, John Wiley, 2004
6 D C Johnson, Instrumentation Technology, (7th Edition) Prentice Hall India, 2002.
7 B Connel, Process Instrumentation Applications Manual, McGrawHill, 1996.
8 B. Wayne Bequette, Process control: modeling, design, and simulation Prentice Hall PTR, 2003
9 K. Krishnaswamy, Process Control, New Age International, 2007

Online Courses and Video Lectures:

1 https://www.youtube.com/watch?v=BtxAWUVEcUk Accessed on Aug 04, 2020
2 https://www.youtube.com/watch?v=6pFgqMwxLhs Accessed on Aug 04, 2020
3 https://www.youtube.com/watch?v=p4KEKCenc0E Accessed on Aug 04, 2020
4 https://sites.chemengr.ucsb.edu/~ceweb/faculty/seborg/teaching/slides.html Accessed on Aug 04, 2020

Subject Code: LPCEE-109

Subject Name Power Systems Laboratory-II

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester:6	**Teaching Hours**: 24
Theory/Practical: Practical	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Power System apparatus and modeling

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

CO#	Course Outcomes (CO)
1.	Acquire the skill of using computer packages with the help of high-level programming language and software tools in power system studies
2.	Acquire the skill of using power system related tools for power system studies
3.	Develop computer program for load flow analysis
4.	Understand the procedure and steps needed to perform short circuit analysis
5.	Carry out stability studies of power system
6.	Simulate load frequency control of single area system

Sr. No.	Name of Practical
1	Introduction to mathematical/programming/software tools for power system studies like MiPower and high level programming language (MATLAB, C++ etc).
2	To develop single line diagram of power system using software tool
3	To develop a program for formation of Bus Admittance Matrix
4	To develop a program for formation of Bus Impedance Matrix using building algorithm method.
5	To develop a program for load flow analysis using Gauss-Seidel Method.
6	To develop a program for load flow analysis using Newton-Rapson Method.
7	Use of software tools for Symmetrical FaultsAnalysis.
8	Use of software tools for Unsymmetrical FaultsAnalysis.
9	Use of software tools for Load Frequency Control without and with PI Controller.
10	To develop Program for Economic Load Dispatching of power systems.
11	Use of Software tools for stability studies.
12	Use of software tool for contingency analysis.
13	Use of software tool for voltage profile improvement.
14	Use of software tool for Distributed Generation placement.
15	Visit to load dispatch centre is suggested.

Reference Material

Manual Available in lab

Subject Code: LPCEE-110

Subject Name: PLC and Automation Laboratory

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester:6	**Teaching Hours**: 24
Theory/Practical: Practical	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Basics of Microprocessor and Microcontroller hardware and software.

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

CO#	Course Outcomes (CO)
1.	Acquire programming, simulation and testing skills in C language
2.	Comprehend the importance of embedded based automation
3.	Acquire skill in interfacing peripherals, relays, Lamps, pushbuttons and sensors with different PLC models
4.	Implement and troubleshoot the circuits involving interfacing of PLC with real world
5.	Create and troubleshoot automatic process control employing PLC and embedded based modules
6.	Evaluate the performance of industrial practical circuits using PLC

Software & Hardware: - choose anyone from these

CODESYS software (ABB), MICROWIN SMART (SIMATIC S7-200), SX-programmer (FUJI PLC), MICROLOGIX (ALLEN BRADLEY).

LIST OF EXPERIMENTS

3 Demonstration of MSP432 microcontroller and LauchPad.

4 Enable the simple digital I/O feature of P2.0, P2.1 and P2.2 pins.

5 Toggling all three LEDs on MSP432 LauchPad board.

6 Read a switch and write it on LED.

7 Display a 2 digit number on 2-digit 7-segment display.

8 Initialize and display “Hello World” on LCD display.

9 Program to send “YES” to a UART0 on MSP432 LauchPad.

10 Creating a delay using SysTick.

11 Toggling a blue LED at 1Hz using Timer-32 one shot mode.

12 Program to exhibit the interrupt feature of MSP432 ARM microcontroller.

13 ADC14 conversion of external temperature sensor.

14 Creating a sawtooth waveform using DAC.

15 Implementation of different logic gates using PLC.

16 PLC Program to Latch and Unlatch Output With Time Delay.

17 Implementation of DOL and star delta starter using PLC.

18 Motor forward and reverse direction control using PLC.

19 Implement a PLC based traffic light control system.

20 PLC Program for Burglar Alarm Security System.

21 PLC Program to control level of a single/multiple tank(s).

22 PLC Program to operate drilling of parts.

23 PLC Program to sort and count parts for on Conveyor.

24 PLC Program to regulate and acquire temperature of a process at different intervals.

25 PLC program to fault detection and production of induction motor by using sensors.

26 PLC program to Industrial Monitoring system.

27 PLC program to automate industrial or school or college time management system.

Reference material: Lab Manual

Subject Code: LPCEE-111

Subject Name: Industrial Drives Laboratory

Programme:B.Tech(EE)	**L: 0 T: 0 P:** 2
Semester: 6	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems**: 100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status**: Compulsory

Prerequisites: Basic Electrical Engineering

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

CO#	Course Outcomes (CO)
1.	Analyze speed and direction control of single phase and three phase electric motors using ac and dc drive
2.	Analyze speed control of stepper motor using drives
3.	Evaluate methods of speed control of servo motor using drives
4.	Conduct and analyze PLC based ac/dc motor control operation
5.	Design a set up for microcontroller-based speed control of stepper motor and dc motor
6.	Understand regenerative/dynamic braking operation of ac motor and dc motor

Sr. No. Name of Practical

1. Safety instruction for start up of drives.
2. Basic parameterization of drive and commissioning.
3. Starting and running characteristics of converters for different modes V/f based and vector based control drives and analysis.
4. To start, stop, forward and reverse the single phase and three phase induction motors using single phase and three phase AC drives using standard software tools.
5. Real time monitoring and its analysis.
6. Speed control of Brushless DC motor.
7. Speed control of stepper motor using drives.
8. Speed control of servo motor using servo drive.
9. PLC based AC/DC motor control operation.
10. Microcontroller based speed control of stepper motor.
11. Microcontroller based speed control of DC motor.
12. Regenerative/ dynamic braking operation of DC motor.
13. Regenerative/ dynamic braking operation of AC motor.
14. Speed control of three phase slip ring motor using static rotor resistance control.
15. Understanding adaptive logic and project on drives.

Reference Material

Manual Available in lab

Subject Code: PREE-102

Subject Name: Minor Project

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester:6	**Teaching Hours**: 24
Theory/Practical: Practical	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

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

CO#	Course Outcomes (CO)
1.	Acquire ability to work in team
2.	Evaluate application of a particular tool/ component for specific application
3.	Acquire ability to apply thinking and problem solving skills
4.	Develop habit of responsibility sharing
5.	Apply knowledge gained for analysis and design of circuits
6.	Learn about their social responsibility

Contents:

The students are required to work in team and to formulate software/hardware based projects showing applications of the knowledge gained during the course work. The students should be able to find out the ratings/ suitability of various components/software in their project work.

Subject code-PEEE-109
Subject Name- *POWER SYSTEM RELIABILITY*

Programme: B.Tech- EE	**L: 3 T: 1 P: 0**
Semester: 7	**Teaching Hours:** 36L + 12T = 48 hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:20**%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Basic knowledge of working of systems/ sub-systems
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the concept of reliability
2	Analyse data and calculate reliability related parameters
3	Calculate reliability of sub-system/system
4	Acquaint with significance of power system reliability
5	Understand functional zones and models of hierarchical levels
6	Assess reliability of generation, transmission and distribution systems

PART A

Reliability Engineering ***(3L+1T=04 Hours)***

Introduction to Reliability and Quality, History of Reliability, Failure Modes, Causes of Failure (Unreliable Systems), Redundancy Techniques.

Reliability Design and Analysis ***(9L+3T=12 Hours)***

Reliability and Cost, Failure Data Analysis, Failure Density, Failure Rate, Component Reliability, Mean Time to Failure (MTTF), Mean Time Between Failure (MTBF), Markov's Model of Reliability Function.

System Reliability Models ***(6L+2T=08 Hours)***

Introduction, System with Series and Parallel Components, k out of m Systems, Fault Tree Analysis (FTA), Reliability evaluation from Fault Tree.

PART B

Power System Reliability ***(9L+3T=12 Hours)***

Background, Probabilistic Reliability Criteria, Power System Analysis, Functional Zones and Hierarchical Levels.

Reliability Assessment ***(9L+3T=12 Hours)***

Evaluation in Hierarchical Level- I (Generation Facilities) – Generation System Model, Loss of Load Indices, Evaluation in Hierarchical Level –II (Transmission Facilities) - Basic Adequacy Indices, Distribution System Reliability.

Text Books/ References:
1. R Billinton and Allan RN, Reliability evaluation of power systems, 2nd Edition, Springer, 1996

2. R. Billinton , Allan RN and Salvaderi L, Applied reliability assessment in electrical power systems. IEEE Press, New York, 1991
3. E Balaguruswamy., Reliability Engineering, Mc-GrawHill International, 2017
4. L.S.Srinath., Reliability Engineering, East-West Press Private Ltd, 2017

Links:

Reliability of systems – IIT Kanpur – https://youtu.be/_c-iZ2BAXPw

Subject Code: PEEE-110

Subject Name: *OPTIMIZATION TECHNIQUES*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 7	**Teaching Hours**: 36L+12T=48hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Applied Mathematics

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Develop the mathematical model of an optimization problem
2.	Apply linear programming for solving the optimization problems having linear objective function and constraints
3.	Apply non-linear programming for solving the optimization problems having non-linear objective function and constraints
4.	Decipher the framework of soft optimization techniques
5.	Acquaint with concepts and modeling of Artificial Neural Networks
6.	Apply genetic algorithm for solving optimization problems

DETAILED CONTENTS

PART-A

Introduction to Optimization ***(3L+1T=04hours)***

Statement of an optimization problem, Classification of optimization problems, Optimization techniques, Engineering applications of optimization.

Linear Programming ***(6L+2T=08 Hours)***

Standard form of linear programming, Graphical solution, Simplex method, two phase simplex method, Computer implementation of the simplex method.

Non-Linear Programming ***(9L+3T=12 Hours)***

Unimodal function, Dichotomous and Fibonacci search for one dimensional problems, Steepest descent and Conjugate gradient methods for unconstrained multi-variable problems, Interior and exterior penalty function methods for constrained multi-variable problems.

PART-B

Artificial Neural Networks ***(9L+3T=12 Hours)***

Machine learning using Artificial Neural Networks, learning algorithms, supervised learning: feed forward networks, radial basis function, unsupervised learning: self-organizing map, adaptive resonance architectures, hop field network.

Evolutionary Optimization Techniques ***(9L+3T=12 Hours)***

Genetic algorithm: working principle, Basic operators and terminologies, building block hypothesis, Travelling Salesman Problem, Introduction to Particle swam and Ant colony optimizations.

Text / References:

1 S.S. Rao,Optimization : Theory and applications, Wiley Eastern Ltd., 1979
2 G.V. Reklaitis, Engg. optimization Methods & applications, Wiley, 2006
3 E David. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009.
4 A James. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Edn., 2003.
5 R.J Jyh-Shing, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2003.
6 M. Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.
7 H. Simon, Neural Networks: A Comprehensive Foundation, Prentice Hall International Inc, 1999.

Subject Code: PEEE-111

Subject Name: *POWER SYSTEM PLANNING*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 7	**Teaching Hours**: 36L+12T=48hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 20%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Power Systems

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Understand the objectives of regional and national planning strategies of electric power
2.	Acquire knowledge about the concept of load forecasting
3.	Apply the concept of generation, transmission and distribution planning in power system
4.	Acquire knowledge regarding selection of size and site of generating stations and substations
5.	Evaluate loss of energy indices
6.	Design distribution system based on voltage and power loss calculations

DETAILED CONTENTS

PART-A

Introduction of Power System Planning ***(9L+3T=12 Hours)***

Objectives, Regional and National Planning, Long and Short term Planning, Structure of Power System, Planning Methods, Electricity Regulation, Load Forecasting: Characteristics of Loads, Methodology of Forecasting, Energy Forecasting, Peak Demand Forecasting, Total Forecasting, Annual and Monthly Peak Demand Forecasting. Least Cost Power Planning, Integration of Distribution System Management.

Generation System Planning ***(9L+3T=12 Hours)***

Probabilistic Generation and Load Models- Determination of Loss of Load Probability and Expected Value of Demand not Served, Outage Performance and System Evaluation of Loss of Load and Loss of Energy Indices, Power Supply Availability Assessment. Distributed Power Generation, Renovation and Modernization of Power Plants.

PART-B

Transmission System Planning ***(9L+3T=12 Hours)***

Overview of Transmission Planning, Necessity of Probabilistic Transmission Planning, Probabilistic Planning Criteria, Procedure of Probabilistic Planning, Network Reconfiguration. Right – of – Way, Network Studies, High – Voltage Transmission, Conductors, Sub – Stations, Power Grid, Reactive Power Planning, Energy Storage.

Distribution System Planning ***(9L+3T=12 Hours)***

Design of Sub Transmission Lines and Distribution Substations, Design Considerations of' Primary and Secondary Distribution Systems, Voltage Drop and Power Loss Calculations. Upgradation of Existing Lines and Sub – Stations, Network Development, System Studies, Urban Distribution, Rural Electrification, Villages Self – Sufficiency in Energy, Community Power, Self – Generation.

Text / References:

1. Y Wallach, Power System Planning, McGraw Hill International, 1993

2. P. Sullivan, Power System Planning, McGraw Hill International, 1977

3. S Dasari, Electric Power System Planning, IBT Publishers, New Delhi, 2008

4. J.R McDonald, Modern Power System Planning, McGraw Hill International, 1994

Links:

1. http://nrldc.in/.

2. http://ieeexplore.ieee.org/document/194918/.

3. www.theiet.org/sectors/energy/documents/modelling-5.cfm?type=pdf

4. Central Electricity Regulatory Commission, Regulations and Orders - www.cercind.org.

5. Electricity Act 2003 and National Policies – www.powermin.nic

Subject Code: PEEE-112
Subject Name: *ARTIFICIAL INTELLIGENCE TECHNIQUES*

Programme: B.Tech (EE)	**L:3 T:1 P:0**
Semester: 7	**Teaching Hours**: 36L+12T=48 hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 20%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Engineering Mathematics and programming language

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1	Elucidate the knowledge and general concepts of artificial intelligence
2	Understand the architecture of expert system and its role in process control
3	Conceptualize Artificial Neural Networks, learning and pattern classification
4	Illustrate the concept of fuzzy logic and its applications
5	Comprehend the concept of genetic algorithms and its applications
6	Apply software tool for analysis of artificial intelligence techniques

DETAILED CONTENTS

PART-A

Introduction ***(3L+1T=04Hours)***

Introduction to Artificial Intelligence (AI), The Foundations of AI, The history of AI, Intelligent Agents, Structure of Agents, The Concept and Importance of AI, Human Intelligence vs. Machine Intelligence.

Expert Systems ***(6L+2T=08Hours)***

Expert Systems, Advantages and Disadvantages, Expert System Architecture, Functions of Various Parts, Mechanism and Role of Inference Engine, Types of Expert System, Tuning of Expert Systems, Role of Expert Systems in Instrumentation and Process Control.

Artificial Neural Networks ***(9L+3T=12Hours)***

Structure and Function of a Single Neuron, Artificial Neuron Models, Types of Activation Functions, Neural Network Architectures, Neural Learning, Evaluation of Networks, Supervised Learning, Back Propagation Algorithm, Unsupervised Learning, Application of Neural Networks for Classification, Clustering, Pattern Associations, Function Approximation.

Part-B

Fuzzy Logics ***(9L+3T=12 Hours)***

Fuzzy Sets and Systems, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rule Generation, Defuzzification and its methods, Fuzzy Controllers.

Genetic Algorithms ***(9L+3T=12 Hours)***

Introduction and Concept, Coding, Reproduction, Crossover and Mutation Scaling, Fitness, Applications, Swarm Intelligence and their applications.

Text/References:

1. D.W.Petterson, , Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India ,2007.
2. J.M. Zurada, , Introduction to Artificial Neural Network System, Jaico Publication, 2006.
3. M.T Hagan,., Neural network design, Prentice Hall of India. 2014
4. T.J Ross, Fuzzy logic with engineering applications, TMH, 2011

Subject Code: PEEE-113
Subject Name: *SUB-STATION AUTOMATION*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 7	**Teaching Hours**: 36L+12T = 48 hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Electrical Circuit Analysis, Power System (I and II).

Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Develop the layout of substation
2.	Evaluate various parameters for designing the substation
3.	Understand the functions of equipment in substation
4.	Interface the automation system using standard IEC 61850
5.	Monitor the real time parameters of substation
6.	Analyse various faults and their clearance

DETAILED CONTENTS

PART-A

Sub-Station Design ***(06L+02T = 08 Hours)***

Introduction to different bus bar schemes, Single Line Diagram (SLD), Layout development from SLD, Structure Loading Layout, Cable trench layout, Incoming and Outgoing Circuits.

Calculations of Design parameters ***(06L+02T=08 Hours)***

Short Circuit calculations, Cantilever Strength, Temperature rise calculations, Sag-Tension Calculations, Earthing Calculations, Battery-Sizing Calculations.

Equipment and Accessories ***(06+02T = 08 Hours)***

Power Transformers, Circuit Breaker, Instrument Transformer, Switchgear, Surge Arrestor, Isolators, Line traps, Power Line carrier Communication System, Control and Protection System, DC Auxiliary System.

PART-B

Sub-Station Automation System (SAS) ***(12L+04T=16 Hours)***

Serial Communication, Local Area Networks, Intelligent Electronic Devices, Networking Media, Systems for power utility automation (IEC Standard 61850), SCADA system - Control and Monitoring with Data Concentration and Distribution, Alarming and Measurement, Sub-station Human Machine Interface (HMI).

Protection and Safety ***(06+02=08 Hours)***

Fault Clearance System, Requirements of protection system, Factors influencing reliability, Capacitor Bank faults, Substation Cyber Security.

Text / References:

1. P.Evelio, Substation Automation Systems: Design and Implementation, Wiley , 2015.
2. M.K Khedkar. and Dhole.G.M. , A Text book of Electric Power Distribution Automation. , University Science Press, 2010.
3. B.R Gupta, Power System Analysis and Design, S. Chand, 2005
4. D John. MacDonald, Electric Power Substations Engineering, CRC press, 2012

Online Learning Material:

1. https://www.eaton.com/us/en-us/products/utility-grid-solutions/grid-automation-system-solutions/fundamentals-of-substation-automation.html
2. https://etap.com/product/intelligent-substation-automation

Subject Code:PEEE-114
Subject Name: *DIGITAL SIGNAL PROCESSING*

Programme: B.Tech (EE)	**L: 3 T: 0 P: 0**
Semester: 7th	**Teaching Hours**: 36L + 12T = 48 Hours
Theory/Practical: Theory	**Credits**: 3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems**:40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Fundamentals of signals and Systems
Additional Material allowed in ESE: Scientific Calculator

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

CO #	Course Outcomes (CO)
1.	Represent signals mathematically in continuous, discrete-time, and frequency domain
2.	Analyse discrete-time systems using z-transform
3.	Understand the Discrete-Fourier Transform and the Fast Fourier Transform algorithms
4.	Apply the knowledge of convolution sum method to analyse digital signal processing systems
5.	Design digital filters for various applications
6.	Apply digital signal processing for the analysis of real-life signals

DETAILED CONTENTS

Part-A

Discrete-time signals and systems ***(06L+02T=08 Hours)***

Sequences, representation of signals on orthogonal basis, Representation of discrete systems using difference equations, Sampling and reconstruction of signals – aliasing, Sampling theorem and Nyquist rate.

z-transform ***(06L+02T=08 Hours)***

Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z -transforms.

Discrete Fourier Transform ***(06L+02T=08 Hours)***

Frequency Domain Analysis, Discrete Fourier Transform (DFT) and its properties, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Part-B

Design of Digital filters ***(12L+04T=16 Hours)***

Design of Finite Impulse Response (FIR) Digital filters: Window method, Park-McClellan's method. Design of Infinite Impulse Response (IIR) Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Applications of Digital Signal Processing ***(06L+02T=08 Hours)***

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using Auto Regressive Moving Average (ARMA) Model, Linear Mean-Square Estimation, Wiener Filter.

Text/Reference Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.

Subject Code: PEEE-115
Subject Name: *SMART GRIDS*

Programme: B.Tech	**L: 3 T: 1 P: 0**
Semester: 7	**Teaching Hours**:36L+12T = 48 Hours
Theory/Practical: Theory	**Credits:**3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 30%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Power System and Microcontrollers

Additional Material allowed in ESE: Scientific Calculator (Non-programmable)
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Understand the basic concepts, components, and architecture of smart grid
2.	Comprehend the various measurement technologies in smart grid
3.	Apprehend the importance of renewable energy in smart system
4.	Demonstrate knowledge about battery technology and energy storage in smart grids
5.	Elucidate integration of renewable energy sources with micro-grid
6.	Solve smart grid challenges using modern communication techniques

PART-A

Introduction to Smart Grid ***(06L+02T=08 Hours)***

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust and Self-Healing Grid, Present development, Introduction to International policies in Smart Grid.

Sensors and Measurement ***(06L+02T=08 Hours)***

Sensors for Smart Grid, Monitoring and Measurement Technologies, Phasor Measurement Units (PMU), Smart meters, Smart Appliances, Multi Agent Systems (MAS) Technology, Micro grid and Smart grid comparison, Wide Area Measurement.

Distributed Generation and Energy Storage ***(08L+03T=11 Hours)***

Solar Energy, Photo-voltaic (PV) Systems, Wind turbine Systems, Biomass, Small and Micro Hydro Power, Geothermal heat pumps, Batteries, Flow Batteries, Fuel Cell and hydrogen electrolytes, Flywheel, Super conduction magnetic energy storage systems, super capacitors.

PART-B

Micro-Grid ***(04L+01T=05 Hours)***

Concept of micro-grid, need and applications of micro-grid, formation of micro-grid, Issues of interconnection, protection, and control of micro-grid.

Smart Communication ***(12L+04T=16 Hours)***

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network.

Text/Reference:

1. A. Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011
2. C.W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press 2009
3. J. Ekanayake, N. Jenkins, K. Liyanage, "Smart Grid: Technology and Applications", Wiley 2012
4. S.Borlase, "Smart Grid: Infrastructure, Technology and solutions " CRC Press,2012
5. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer,2012

E-Book and Online learning material:

1. N.P. Padhy, "Introduction to smart grid", IIT Roorkee
2. N. Prasad Padhy, Premalata Jena, "Introduction to Smart Grid," NPTEL
3. M. Vadari, M. Balasubramanyan, Distributed Energy – Smart Grid Resources for the Future, IEEE, Coursera
4. M. Vadari and M. Balasubramanyan, Smart Grids: Electricity for the Future, IEEE & EDX

Links:

1. https://swayam.gov.in/courses/4778-july-2018-introduction-to-smart-grid
2. https://onlinecourses.nptel.ac.in/noc18_ee42/preview

Subject Code: PEEE-116
Subject Name: *BIOMEDICAL SIGNALS AND INSTRUMENTATION*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 7	**Teaching Hours:** 36L+12T=48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**20%
External Marks: 60	**Duration of End Semester exam (ESE)**: 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Basic Electrical Engineering, Measurement and Instrumentation.
Additional Material allowed in ESE: NIL
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Understand biomedical signals
2.	Identify electrodes and transducers used in medical equipment
3.	Comprehend the concept of biomedical recorders and monitors
4.	Acquire knowledge of therapeutic equipment
5.	Recognize patient safety measures
6.	Utilize bio-instrumentation in cellular or molecular biology investigations

DETAILED CONTENTS

PART-A

Biomedical Signals ***(07L+02T=09 Hours)***

Origin of Bioelectric Signals, Human body, Heart and Circulatory System, Electrodes, Transducers, ECG, EMG, EEG and NVC.

Recording & Monitoring Instruments ***(11L+04T=15 Hours)***

Recording Electrodes, Physiological Transducers, Biomedical Recorders, Heart rate measurement, Temperature and pH measurement, Foetal Monitoring System, Biomedical Telemetry.

PART-B

Imaging System ***(06L+02T=08 Hours)***

Working with X-Rays, CT scanner, MRI, NMR, Ultrasonic System.

Therapeutic & Physiotherapy Equipment ***(06L+02T=08 Hours)***

Cardiac Pacemakers, Cardiac defibrillator, SW Diathermy & MW Diathermy.

Patient Safety ***(06L+02T=08 Hours)***

Electric Shock Hazards, Test Instruments, Biomedical Equipment.

Text/Refernces:

1. G. John Webster, Bioinstrumentation, John Wiley & Sons 2004
2. C. Leslie , Fred J. Weibell & Erich A Pfeiffor,Biomedical Instrumentation and Measurements 2nd edition, PHI 2001
3. Khandpur, Handbook of Biomedical Instrumentation 2nd edition, TMH 2003

E-Books and online learning material:

1. https://brainmaster.com/software/pubs/brain/The_Biomedical_Engineering_Handbook_.pdf

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/102/101/102101068/

Subject code-PEEE-117
Subject Name- *HIGH VOLTAGE ENGINEERING*

Programme: B.Tech- EE	**L: 3 T: 1 P: 0**
Semester: 8	**Teaching Hours:** 36L+12T=48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**10%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Power System
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Classify the insulating materials
2	Understand theories and mechanisms of breakdown in gaseous, liquid and solid dielectrics
3	Appreciate applications of various insulating materials
4	Comprehend methods of generation of various high voltages
5	Evaluate compensation requirement in EHVAC transmission line
6	Understand the merits of high voltage DC transmission

PART A

Dielectric Breakdown ***(10L+04T=14 Hours)***

Gases: Ionization process, Townsend's current growth equations, 1st and 2nd ionization coefficients, Townsend's criterion for breakdown, Streamer theory of breakdown, Paschen's law of Gases, Gases used in practice, Partial Discharge measurements.
Liquids: Conduction and breakdown in pure and commercial liquids, Suspended particle theory, Cavitation and Bubble theory, Stressed oil volume theory, Liquids used in practice.
Solids: Intrinsic, Electromechanical and Thermal breakdown composite dielectrics, Solid dielectrics used in practice.

Insulating Materials for High Voltage ***(04L+01T=05 Hours)***

Applications of insulating materials used in power transformers, rotating machines, circuit breakers, cables and power capacitors.

Generation of High Voltages ***(04L+01T=05 Hours)***

High Voltage Direct Current (HVDC), High Voltage Alternating Current (HVAC), Power frequency and High frequency: Impulse voltage generation, Tripping and contact of Impulse Generator.

PART B

Extra High Voltage (EHV) Transmission and Corona Loss ***(09L+03T=12 Hours)***

Need for EHV Transmission, Use of bundled conductors, Corona loss, Factors affecting the corona loss, Radio Interference due to corona, Shunt and series compensation in EHV lines.

High Voltage Direct Current (HVDC) Transmission ***(09L+03T=12 Hours)***

Advantages, disadvantages and economics of HVDC Transmission system, Types of Direct Current (DC) links, Converter station equipment.

Text Books/ References:

1. V.Kamaraju and Naidu M.S., High Voltage Engineering, Tata McGraw-Hill Education, 2004
2. E.W., Kimbark, High Voltage Direct Current Transmission, Wiley-Interscience, 2004
3. R.D Bagamudre., Extra High Voltage A.C. Transmission Engineering, New Age International Publishers, 2011 4. B.R. Gupta, Power System Engineering and Design, New Age Publishers, 2007
5. E.Kuffel, and Abdullah, M., High Voltage Engineering, Pergamon Press, 1970
6. C. L.Wadhwa, High Voltage Engineering, New Age Publications, 2012
7. K.R Padiyar,, HVDC Power Transmission Systems: Technology and System Interactions, New Age International, 1990

Links:

www.cpri.in
https://onlinecourses.nptel.ac.in

Subject Code: PEEE-118
Subject Name: *SCADA AND DISTRIBUTED CONTROL SYSTEM*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester: 8	**Teaching Hours:** 36L+12T=48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**20%
External Marks: 60	**Duration of End Semester exam (ESE)**: 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Power System
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Comprehend Distributed Control System structure
2.	Understand components of Human Machine Interface
3.	Identify different elements of Supervisory control and Data acquisition
4.	Interpret the functionality of various elements of Supervisory control and Data acquisition
5.	Analyse real time control of power system parameters
6.	Control the process parameters using Distributed Control System and Supervisory control and Data acquisition

DETAILED CONTENTS

PART A

DCS Structure ***(08L+02T=10 Hours)***

DCS architecture, Database organization in DCS, System elements of DCS: Field station, Intermediate station, Central computer station, Reliability parameters of DCS, Classification of alarms in DCS.

HMI in Automation ***(10L+04T=14 Hours)***

Automation system structure, transfer of control commands for Instrumentation subsystem, Classification of various types of devices connected to Instrumentation subsystem, Control subsystem-functional steps performed by control subsystem, Human Interface subsystem, active display elements and active control elements of operator panel, basic approach and mimic approach for the construction of HMI panel.

PART B

Introduction to SCADA ***(06L+02T=08 Hours)***

Introduction of SCADA, Application area of SCADA, Major elements of SCADA, Advantages and disadvantages of SCADA, Comparison of SCADA, DCS, PLC and Smart Instrumentation

Real Time Systems and SCADA Software ***(06L+02T=08 Hours)***

Introduction of real time control, Real time control for Continuous process, master-slave communication access method, scan interval, SCADA software components, Concept of Functional Block Diagram technique, Comparison of centralized and distributed processing, High Level Data Link Control (HDLC) Protocol.

SCADA Hardware: ***(06L+02T=08 Hours)***

Hardware structure of Remote Terminal unit (RTU), Test the given RTU, Maintenance procedure of RTU Introduction to ANSI/IEEEC37.1, hardware structure of Master Terminal Unit (MTU), functions of MTU

Text/References:

1. G. Bela. Liptak Process Control- Instrument Engineers Handbook, Chilton book co., 1985
2. K. Sharma Overview of Industrial Process Automation , Elsevier pub, 2016
3. D. Popovic and V. Bhatkar, Marcel Dekker, Distributed Computer Control Systems in Industrial Automation, 1990
4. D. Bailey, Edwin Wright, Newnes, Practical SCADA for industry (an imprint of Elsevier), 2003

E-Books and online learning material:

1. **https://plc4me.com/pdf-scada-supervisory-control-and-data-acquisition-ebook-free/**

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc20_me39/preview
2. https://nptel.ac.in/courses/108/105/108105062/

Subject code-PEEE-119
Subject Name- *HIGH VOLTAGE TRANSMISSION SYSTEMS*

Programme: B.Tech- EE	**L: 3 T: 1 P: 0**
Semester: 8	**Teaching Hours:** 36L+12T=48 Hours
Theory/Practical: Theory	**Credits: 4**
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**10%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Power System
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand basics of EHV AC transmission
2	Elucidate corona effect, associated problems and remedial measures
3	Comprehend compensation methods and design parameters of EHV AC transmission line
4	Know fundamentals HVDC converter station and advantages of HVDC transmission
5	Estimate effects of Harmonics due to converter station in power system
6	Understand the concept, types and applications of multi-Terminal HVDC system

PART A

EHV AC Transmission ***(06L+02T=08 Hours)***

Hierarchical AC Transmission voltage levels, choices, applications, need for EHV transmission, Engineering features, rated voltages, number of circuits, intermediate sub-stations, EHV systems in India.

Corona Effects ***(06L+02T=08 Hours)***

Phenomenon of Corona, disruptive critical voltage, visual critical voltage, corona loss, factors and affecting coronal loss, radio interference due to corona, bundled conductors, corona in bundled conductor lines.

Compensation and Design of Transmission Line ***(06L+02T=08 Hours)***

Line voltage regulation and compensation, static VAR systems, types, shunt compensation, series compensation, functions, tuned power lines.
Selection of conductor size, choice of voltage, choice of span, number of circuits, conductor configuration, insulation design, selection of ground wire.

PART B

High Voltage Direct Current (HVDC) Transmission ***(06L+02T=08 Hours)***

Introduction, advantages of DC transmission, types of DC links, power flow equations, converter connections, six pulse bridge (Graetz Circuit), 12-pulse bridge, converter transformer, control equipment, ground return, HVDC systems in India.

Harmonics and Filters ***(06L+02T=08 Hours)***

Fundamentals, Fourier series analysis, characteristic harmonics, non-characteristic harmonics, reasons and harmful effects, harmonic filters-shunt & series filters, resonance, quality factor.

Multi-Terminal HVDC Systems ***(06L+02T=08 Hours)***

Two pole HVDC with earth return, MTDC system with series connected converters, MTDC system with parallel connected converters, control of parallel connected systems, applications of MTDC systems.

Text Books/ References:

1. S. Rao, EHV-AC, HVDC Transmission & Distribution Engineering, Khanna Publishers, 1993
2. B.R. Gupta, Power System Analysis and Design, Wheeler Publishing, 1998
3. R.D Begamudre, Extra High Voltage A.C. Transmission Engineering, New Age International Publishers, 1952
4. K.R Padiyar, HVDC Power Transmission Systems: Technology and System Interactions, New Age International, 1990
5. N. G. Hingorani, L. Gyugyi, Understanding FACTS, IEEE Press, USA, 1999
6. E.W Kimbark, High Voltage Direct Current Transmission, Wiley-Interscience, 2004
7. E. Kuffel, and Abdullah, M., High Voltage Engineering, Pergamon Press, 1970
8. A.T Johns and Y.H. Song, Flexible AC Transmission System, IET Press, 1999

Links:

1. www.cpri.in
2. https://onlinecourses.nptel.ac.in

Subject code-PEEE-120
Subject Name- *Data Communication and Networks*

Programme: B.Tech- EE	**L: 3 T: 1 P: 0**
Semester: 8	**Teaching Hours:** 36L+12T=48 Hours
Theory/Practical: Theory	**Credits: 4**
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**10%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Basics of Electronics and Computer Engineering
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand Network essentials, Network Architecture, TCP/IP and OSI model
2	Analyse and solve networking problems in the area of guided and unguided transmission media
3	Design the switching and multiplexing methodologies for different Networks
4	Contrast the design issues and working of protocols at different layers of TCP/IP and OSI models
5	Identify the bottlenecks and errors during data transmission and provide solution
6	Illustrate the various routing processes at Network Layer

Part A

Introduction to Data Communication and Networking ***(03L+01T=04hours)***

Uses of Computer Networks, Network Hardware, Network Software Internet Reference Models (OSI and TCP/IP)

Physical Layer ***(03L+01T=04hours)***

Basis for Data Communication, Guided Transmission Media, Wireless Transmission Medium, Circuit Switching and Telephone Network, High Speed Digital Access

Switching and Multiplexing ***(12L+04T=16 hours)***

Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Study of Multiplexing: Many to one/one to Many, Frequency division Multiplexing, Time division Multiplexing.

Part B

Introduction to computer networks and the Internet ***(03L+01T=04hours)***

Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, electronic mail, Domain name system, Peer-to-Peer file sharing, Layering concepts.

Data Link and MAC Layer ***(12L+04T=16 hours)***

Data Link Layer Design Issues, Error Detection and Correction: CRC, Checksum and Hamming Code; Data Link Control and Protocols, Medium Access Layer: Channel Allocation Problem, Multiple Access, CSMA, CSMA/CD, CSMA/CA

Network layer ***(03L+01T=04hours)***

Virtual circuit and Datagram networks, Router, Internet Protocol, Routing Algorithms: distance vector and link state routing.

Text Reference books:

1. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition, 2007
2. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition, 2000
3. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" Elsevier Morgan Kaufmann Publisher, 5th Edition., 2011
4. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall, 1997
5. S. Keshav, "An Engineering Approach to Computer Networking" , Pearson Education, 2001
6. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition, 1996
7. Andrew Tanenbaum, "Computer networks", Prentice Hall, 1977
8. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall, 1980
9. William Stallings, "Data and computer communications", Prentice Hall, 1981

Subject code-PEEE-121
Subject Name- *POWER QUALITY IMPROVEMENT*

Programme: B.Tech- EE	**L: 3 T: 1 P: 0**
Semester: 8	**Teaching Hours:** 36L+12T=48 Hours
Theory/Practical: Theory	**Credits: 4**
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**10%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites:
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Comprehend different types of power quality phenomena
2	Acquire knowledge of power quality standards and indices
3	Identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system
4	Demonstrate the principle of voltage regulation and power factor improvement methods
5	Appreciate the relationship between distributed generation and power quality
6	Demonstrate the power quality monitoring concepts and the usage of measuring instruments

PART-A

Introduction ***(12L+04T=16 Hours)***

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long– duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations. Sources and Effects of power quality problems, types of power quality disturbances - Voltage sag (or dip), Swell, Transients and voltage flicker. Nonlinear loads – IEEE and IEC standards. CBEMA and ITIC Curves, Power Quality indices, Measurement of Power and Power Factor in non-sinusoidal systems, Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.

Voltage Regulation and power factor improvement ***(06L+02T=08 Hours)***

Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

PART-B

Harmonic distortion and solutions ***(06L+02T=08 Hours)***
Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of

harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering – Numerical problems.

Distributed Generation and Power Quality ***(06L + 02T = 08 Hours)***

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks.

Monitoring and Instrumentation ***(06L+02T=08 Hours)***

Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – Application of intelligent systems – PQ monitoring standards.

Textbooks

1. R C Dugan, M F McGranaghan, S Santoso, and H W Beaty, Electrical Power Systems Quality, Second Edition, McGraw–Hill, 2012.
2. M.H.J. Bollen Electric power quality problems IEEE series-Wiley india publications, 2011.
3. B W Kennedy Power Quality Primer, , First Edition, McGraw–Hill, 2000.

Reference Books

1. M HJ Bollen Understanding Power Quality Problems: Voltage Sags and Interruptions, , First Edition, IEEE Press; 2000.
2. J Arrillaga and N R Watson Power System Harmonics, , Second Edition, John Wiley & Sons, 2003.
3. W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York. Electric Power Quality control Techniques, 2000
4. C. shankaran Power Quality, CRC Press, 2001
5. C.DE Franciso LA Rosa–CRC Press (Taylor & Francis).Harmonics and Power Systems, 1980
6. E.F. fuchs, Mohammad A.S. Masoum–Elsevier.Power Quality in Power systems and Electrical Machines , 2000

Subject Code: PEEE-122
Subject Name: *VIRTUAL INSTRUMENTATION*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester:8	**Teaching Hours**: 36L+12T=48hours
Theory/Practical: Theory	**Credits:**4
Internal marks:40	**Percentage of Numerical/Design/ Programming Problems:**20%
External Marks:60	**Duration of End Semester exam (ESE):**3 hr
Total marks:100	**Elective Status:** Department Elective

Prerequisites: Measurement, Instrumentation and Control Systems

Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Understand the basics of Digital Signals
2.	Develop the architecture of Virtual Instrumentation
3.	Comprehend various techniques of interfacing external instruments to PC
4.	Know about various application software
5.	Appreciate various graphical programming environment
6.	Learn about applications of Virtual Instrumentation

DETAILED CONTENTS

PART-A

Review of Digital Instrumentation ***(6L+2T=08hours)***

Representation of analog signals in digital domain, Review of quantization in amplitude and time axes, Sample and Hold, Sampling Theorem, Digital to analog and analog to digital Converters,

Fundamentals of Virtual Instrumentation ***(9L+3T=12 Hours)***

Block diagram and architecture of virtual instrumentation, Virtual Instrumentation for process, control and design, PC based data acquisition (DAQ), Typical on board DAQ card resolution, Multiplexing of analog inputs, Concept of Universal DAQ card, Design of digital voltmeter with transducer input, Timers and Counters.

Communication Network Modules ***(3L+1T=04 Hours)***

Interfacing of external instruments to a PC, Interface buses – RS 232, RS 422, RS 485, USB standards-IEEE 488 standard, Instrumentation buses, Ethernet and TCP/IP protocol.

PART-B

Application development software (LabVIEW) ***(9L+3T=12 Hours)***

LabVIEW application development for virtual instrumentation (VI), Creating a virtual instrument in

LabVIEW, Dataflow programming concepts, Sub VIs and modular code creation, arrays in LabVIEW, Creating one dimensional, two dimensional and multidimensional arrays.

Graphical System Design ***(6L+2T=08 Hours)***

Graphical System Design (GSD) Model, Design flow with GSD, Data formulation, Types of waveforms, waveform graphs, waveform charts, XY graphs, Intensity graphs & charts, Digital waveform graphs, Displaying special planners on the XY graph.

Analysis Tools and Applications ***(3L+1T=04 Hours)***

Fourier transform, Correlation (Windowing and filtering tools), ON/OFF controller, VI based temperature monitor, PID controller, Simulation of a second order system

Text / References:

7. S. Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument society of America, 1994.
8. Peter W. Gofton, 'Understanding Serial Communications', Sybex International., 1988
9. Robert H. Bishop, 'Learning with Lab-sview', Prentice Hall, 2003.
10. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000
11. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.

Subject Code: PEEE-123
Subject Name: *DIGITAL PROTECTION OF POWER SYSTEM*

Programme: B.Tech (EE)	**L: 3 T: 1 P: 0**
Semester:8	**Teaching Hours**: 36L+12T=48hours
Theory/Practical: Theory	**Credits:**4
Internal marks:40	**Percentage of Numerical/Design/ Programming Problems:**30%
External Marks:60	**Duration of End Semester exam (ESE):**3 hr
Total marks:100	**Elective Status:** Department Elective

Prerequisites: BASICS OF POWER SYSTEM PROTECTION

Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Comprehend the various elements of digital power system
2.	Understand the basics of Digital Power System Protection
3.	Apply the mathematical tools in digital protection schemes
4.	Develop various algorithms related to digital relays
5.	Apply the digital protection schemes for various power system equipment
6.	Learn about the recent advancements in digital power system protection

DETAILED CONTENTS

PART-A

Introduction ***(3L+1T=04hours)***

Need for Power System Protection, Protection schemes, Classification of relays, Working of electromechanical relays, comparison between electromechanical, static and digital relays.

Mathematical Background ***(6L+2T=08 Hours)***

Forward, Backward and Central Finite difference techniques, Interpolation formulae, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis ,Fourier series and Fourier transformation.

Basics of Digital Relaying ***(9L+3T=12Hours)***

Analog and Digital Signals, Quantization, Signal conditioning: transducers, surge protection, analog, filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing, Error, sample and hold circuits, multiplexers, analog to digital conversion.

PART-B

Digital Protection Algorithms ***(9L+3T=12 Hours)***

Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm.

Least Squares based algorithms. Differential equation based algorithms. Travelling Wave based Techniques, Mann and Morrison algorithm, Fourier and Walsh based algorithms.

Protection of Transformers and Generators ***(9L+3T=12 Hours)***

Transformer protection: Current derived restraints, Voltage based restraints, Flux restraint function based on the gap in inrush current, Generator protection, Differential protection of stator windings, Other generator protection functions, Recent trends in digital protection of power system equipment.

Text / References:

12. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009

13. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press,1999 .

14. G. Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006

15. Y.G. Paithankar and S.R. Bhide, Fundamentals of Power System protection, PHI, 2003

Subject Code: PEEE-124
Subject Name: *FUZZY EXPERT SYSTEMS*

Programme: B.Tech (EE)	**L:3 T:1 P:0**
Semester: 8	**Teaching Hours**: 36L+12T=48 hours
Theory/Practical: Theory	**Credits:** 4
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 30%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Department Elective

Prerequisites: Engineering Mathematics and programming languages.

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Represent the various forms of fuzzy system
2.	Perform fuzzification and defuzzification of a given situation/process
3.	Develop fuzzy rules for a fuzzy system
4.	Understand basic steps involved to design a Fuzzy-Logic controller
5.	Apply software tool for designing fuzzy logic-based controllers
6.	Implement fuzzy logics for simple managerial and engineering applications

DETAILED CONTENTS

PART-A

Introduction ***(6L+2T=08Hours)***

Crisp and Fuzzy Sets- Definition, Representation, Operations and Properties, Classical Relations and Fuzzy Relations-Cardinality, Operations and Properties, Fuzzy Cartesian Product and Composition.

Fuzzification and Defuzzification ***(8L+3T=11Hours)***

Fuzzy Membership Function-Features and Forms, Fuzzification-Definition, Need and Method, Fuzzy Linguistic Variables and Defuzzification-Definition, Need and Methods, Lambda Cut for Fuzzy Sets and Relations.

Fuzzy Rule Based System ***(4L+1T=05Hours)***

Formation of Fuzzy Rules, Approximate Reasoning, Canonical Rule Forms, Decomposition of Compound Rules, Aggregation and Properties of Fuzzy Rules, Fuzzy Inference System, Graphical Techniques of Inference

Part-B

Fuzzy Logic Applications ***(10L+3T=13 Hours)***

Review of Conventional Control Systems Theory, Fuzzy Logic Control-Need, Design Steps and Models, Design of a Fuzzy Controller for Automatic Generation Control by using software tools, Applications of Fuzzy Logics in the Fields of Managerial Decision Making, Optimization and Pattern Recognition.

Fuzzy Control Systems ***(8L+3T=11 Hours)***

Control System Design Problem, Control Surface, Simple Fuzzy Logic Controllers, Fuzzy Engineering Process Control. Applications of Fuzzy Control Systems in Real-Life.

Text/References:

1. J. Timothy Ross, Fuzzy logic with Engineering Applications, McGraw Hill, 1995
2. G.Klir., B.B Yuan., Fuzzy sets and Fuzzy Logic, Prentice Hall of India Private Limited, 1997
3. J. Yen , Langari Reza, Fuzzy Logic: Intelligence, Control, and Information, PHI, 1998
4. N.P Padhy., Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005
5. G. Bojadziev and M. Bojadziev, Advances in Fuzzy Systems —Applications and Theory: Volume 5(Fuzzy Sets, Fuzzy Logic, Applications), world scientific, 1996

Subject Code: PREE-103/104/105
Subject Name: Major Project/ Project -I/ Project -II

Programme: B.Tech(EE)	**L:0 T:0 P:6**
Semester:7/8	**Teaching Hours:**72
Theory/Practical: Practical	**Credits:** 03
Internal Marks:120	**Percentage of Numerical/ Design/Programming Problems:**100
External Marks: 80	**Duration of End Semester Examination:** 1.5 Hours
Total Marks:200	**Elective Status:** Compulsory

Prerequisites: Exposure to subjects of Electrical engineering

On Completion of the course, the student will be able to:

CO#	Course Outcome
1	Demonstrate the depth of knowledge gained
2	Do a full literature survey
3	Develop ability to analyse a problem
4	Work in a team and share responsibility
5	Write a report for the work done
6	Show social responsibility

Students will be required to work in groups and make a working project/simulation project which should showcase the applicability of the knowledge gained. They are required to submit a synopsis followed by building up of the project. Getting the optimal solution of the problem is the ultimate goal. Students are required to submit a project report detailing the work performed by them during the project period.

Subject Code: TR-103

Subject Name: Training-III

Programme: B.Tech (EE)	**L: 0 T: 0 P: NA**
Semester: 7	**Teaching Hours**: ---
Theory/Practical: Practical	**Credits:** 1
Internal marks: 60	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:40	**Duration of End Semester exam (ESE):** 3 Hours
Total marks:100	**Elective Status:** Compulsory

Prerequisites: Fundamentals of Electrical and Electronics Engineering

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

CO #	Course Outcomes (CO)
1.	Identify industry engineering problems and economic solution.
2.	Apply the knowledge to mitigate industry problems.
3.	Demonstrate the knowledge of an engineer.
4.	Communicate with engineers and the community at large in written and oral forms.
5.	Acquire “Hands on” training and practice use of various software tools, devices, machines.
6.	Undertake problem identification, formulation and solution by considering ethical responsibility.

CONTENTS:

The students are required to work in industry/companies etc for showing applications of the knowledge gained during the course work. Students should be able to gain knowledge of various software/hardware techniques being used in the industry for analysis, project planning, manufacturing, cost estimation, maintenance, testing and designing etc.

Subject Code: TR-104

Subject Name: Industrial Training

Programme: B.Tech (EE)	**L: 0 T: 0 P: NA**
Semester:7/8	**Teaching Hours**: ---
Theory/Practical: Practical	**Credits:**15
Internal marks: 350	**Percentage of Numerical/Design/ Programming Problems:** 100%
External Marks:150	**Duration of End Semester exam (ESE):** 3 Hours
Total marks:500	**Elective Status:** Optional

Prerequisites: Fundamentals of Electrical and Electronics Engineering

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

CO #	Course Outcomes (CO)
1.	Identify industry engineering problems and economic solution.
2.	Apply the knowledge to mitigate industry problems.
3.	Demonstrate the skills and attitudes of an engineer.
4.	Communicate with engineers and the community at large in written and oral forms.
5.	Acquire “Hands on” training and practice use of various tools.
6.	Undertake problem identification, formulation and solution by considering ethical responsibility.

CONTENTS:

The students are required to work in industry/companies etc preferably stipend based for whole semester showing applications of the knowledge gained during the course work and be industry/corporate ready by the end of training. Students should be able to gain knowledge of various software/hardware techniques being used in the industry for analysis, project planning, manufacturing, cost estimation, maintenance, troubleshooting, testing, erection, procurement, commissioning, designing etc.

Subject Code: PREE-106
Subject Name: Technical Seminar on Recent and Advanced Topics

Programme: B.Tech(EE)	**L:0 T:0 P:2**
Semester: 8	**Teaching Hours:**24
Theory/Practical: Practical	**Credits:**01
Internal Marks:50	**Percentage of Numerical/ Design/Programming Problems:**100
External Marks: 00	**Duration of End Semester Examination:** 00
Total Marks:50	**Elective Status:** Compulsory

Prerequisites: Exposure to subjects of Electrical engineering

On Completion of the course, the student will be able to:

CO#	Course Outcome
1	Demonstrate the depth of knowledge gained
2	Do a full literature survey
3	Have the ability of public speaking
4	Express his views regarding a problem in form of a report
5	Write an ethical technical report
6	Develop confidence for disseminating the knowledge gained.

Students will be required to choose a topic of their choice in consent with the faculty in charge. They shall be required to submit a synopsis. Thereafter each student shall be required to present the topic in front of the class using power point. A report on the seminar will have to be submitted for completion of the course.

Subject Code: OEEE-101
Subject Name: Energy Auditing and Management

Programme: B.Tech (EE)	**L: 3 T: 0: P: 0**
Semester:6	**Teaching Hours**: 36L
Theory/Practical: Theory	**Credits:**3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:**Open Elective

Prerequisites: Basic Electrical Engineering
Additional Material allowed in ESE:Scientific Calculator
On Completion ofthe course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Understand the current energy scenario and importance of energy conservation
2.	Enumerate the concepts of energy management
3.	Apply the methods of improving energy efficiency in different electrical systems
4.	Understand the concepts of different energy efficient devices
5.	Have knowledge of various instruments used for energy audit
6.	Have an idea about various international protocols/agreements related to energy conservation

DETAILED CONTENTS

PART-A

Energy Scenario (6 Hours)

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change, Energy Conservation Act-2001 and its features.

Basics of Energy and its various forms (6 Hours)

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, benefits of power factor improvement, performance assessment of PF capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Energy Management & Audit (6 Hours)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments, Material and Energy balance, Facility as an energy system, methods for preparing process flow, Sankey Diagram, material and energy balance diagrams.

PART-B

Energy Efficiency in Electrical Systems (6 Hours)

Electricity billing, distribution and transformer losses. Electric motors Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors, Specifications of energy efficient motors & Transformers.

Energy Efficiency in Industrial Systems (6 Hours)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

]Energy Efficient Technologies in Electrical Systems (6 Hours)

Automatic power factor controllers, soft starters with energy saver, variable speed drives, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology. Applications of Instruments used in energy audit: Clamp Meter, Multimeter, Maximum demand indicator, Tacho meter, Energy Analyzer, Thermal Imager.

Text/References:

1 Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2 Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3 S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4 Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Websites:

https://beeindia.gov.in/content/energy-auditors

https://www.peda.gov.in/

Subject Code: OEEE-102
Subject Name: Elements of Power System

Programme: B.Tech (EE)	**L:** 3 **T**: 0: **P**: 0
Semester: 6	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Open Elective

Prerequisites: Basic of Electrical Engineering
Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Understand the concepts of power systems
2.	Comprehend the various power system elements
3.	Study the performance of overhead transmission lines
4.	Understand the concept of neutral grounding
5.	Analyze the basic concept of designing transmission lines
6	Learn the concepts of High voltage DC and Flexible AC Transmission system

DETAILED CONTENTS

PART-A

Power System Components: (6 Hours)
Single line Diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, Transmission line, Bus bar, Circuit breaker and isolator.

Supply System and Transmission Lines: (6 Hours)
Different kinds of supply system and their comparison, Choice of transmission voltage Transmission Lines Configurations, Types of conductors, Resistance of line, Skin effect, Kelvin's law, Proximity Effect.

Over Head Transmission Lines: (6 Hours)
Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect, Surge impedance loading.

PART-B

Neutral grounding: (6 Hours)
Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices.

Electrical Design of Transmission Line: (6 Hours)
Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires.

EHV AC and HVDC Transmission: (6 Hours)
Introduction to Extra high voltage AC and High voltage DC transmission lines, kinds of dc links, merits and demerits of HVDC Transmission. Introduction to Flexible AC Transmission system.

Text/References:

1 W. D. Stevenson, "Element of Power System Analysis", McGraw Hill,1982.
2 C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition,2009.
3 Asfaq Hussain, "'Power System", CBS Publishers and Distributors, Fifth Edition,2007.
4 B. R. Gupta, "Power System Analysis and Design", S. Chand & Co., Seventh Edition,2010.
5 M. V. Deshpande, "Electrical Power System Design" Tata Mc Graw Hill,2001.
6 Soni, Gupta & Bhatnagar, "A Course in Electrical Power", Dhanpat Rai & sons,1990.
7 S. L. Uppal, "Electric Power", Khanna Publishers,1985.
8 S.N.Singh, " Electric Power Generation, Transmission& distribution." PHI Learning, Second Revised edition, 2008.

E-books and online learning material:

1. Elements of power systems by U.A Bakshi and M.V Bakshi,First Edition,2008.
https://books.google.co.in/books?id=KzzEGnCt-bEC&printsec=frontcover&dq=elements+of+power+system&hl=en&sa=X&ved=2ahUKEwj0-cL5wf_qAhXP4zgGHYlaBw0Q6AEwAXoECAMQAg#v=onepage&q=elements%20of%20power%20system&f=false

2. Elements of power system by Pradip Kumar Sandhu, Second Edition,2015.
https://books.google.co.in/books?id=xXemCwAAQBAJ&printsec=frontcover&dq=elements+of+power+system&hl=en&sa=X&ved=2ahUKEwjnicDL9f7qAhVM8HMBHf1MCFQQ6AEwAHoECAUQAg#v=onepage&q=elements%20of%20power%20system&f=false

Video Lectures:

1 https://www.youtube.com/watch?v=z58HfJID8oI
2 https://www.youtube.com/watch?v=GVxY3nE5mO8&list=PLLy_2iUCG87AVyRAN4QwVQrC8vSg1vWa6

Subject Code: OEEE-103
Subject Name: *BIOMEDICAL ENGINEERING*

Programme: B.Tech (EE)	**L: 3 T: 0 P: 0**
Semester: 6	**Teaching Hours:** 36L
Theory/Practical: Theory	**Credits:** 3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**20%
External Marks: 60	**Duration of End Semester exam (ESE)**: 3 hr
Total marks: 100	**Elective Status:** Open Elective

Prerequisites: Basic Electrical Engineering
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Acquire knowledge of biomedical instruments
2.	Identify with electrodes and transducers in medical equipment
3.	Comprehend the concept behind biomedical recorders and monitors
4.	Analyse different biomedical instrument signals
5.	Understand Telemetry and Telemedicine
6.	Acquire knowledge of therapeutic equipment

DETAILED CONTENTS

PART A

Introduction to Bio Instrumentation ***(06L)***

Problems encountered in measuring a living system, Electric shock Hazards, safety codes for Electro-medical equipment. Resting and action potentials, propagation of action potential, the bioelectric potential-with special reference to ECG, EEG and EMG.

Electrodes and Transducers in Medical Equipment ***(06L)***

Recording electrodes, electrical conductivity of electrodes, jellies and creams, Displacement, pressure, body temperature measurement, photoelectric transducers optical fiber sensors

Biomedical Recorders and Monitors ***(06L)***

Electrocardiograph, electro-encephalograph, electro-myograph, Biofeedback instrumentation, System concepts, cardiac monitor, bedside patient monitoring system, measurement of heart rate, pulse rate, blood pressure measurement, temperature, respiratory rate, catheterization of laboratory instrument.

PART-B

Heating Tissues Methods, Biomedical Telemetry and Telemedicine ***(06L)***

Physiological effect of heat, short wave dia-therapy, infra-red radiation, microwave diathermy, surgical diathermy. Introduction and application to Biomedical Engineering.

Modern Imaging System ***(06L)***

Computed tomography, magnetic resonance imaging system, thermal camera based on IR sensors, Image Reconstruction techniques.

Therapeutic Equipment ***(06L)***

Pace makers, cardiac defibrillators, pain relief through electrical stimulation, Hemodialysis Machine, electronics in anesthetic machine

Text/Refernces:

1. G. John . Webster, Bio instrumentation, John Wiley & Sons 2004
2. L. Cromwell, Fred J. Weibell & Erich A Pfeiffor, Biomedical Instrumentation and Measurements 2nd edition, PHI 2001
3. Khandpur, Handbook of Biomedical Instrumentation 2nd edition, TMH 2003

E-Books and online learning material:

1. **https://brainmaster.com/software/pubs/brain/The_Biomedical_Engineering_Hand-book_.pdf**

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/102/101/102101068/

Subject Code: OEEE-104
Subject Name: *Automation Control and Robotics*

Programme: B.Tech (EE)	**L: 3 T: 0 P: 0**
Semester: 7	**Teaching Hours:** 36L
Theory/Practical: Theory	**Credits:** 3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:**20%
External Marks: 60	**Duration of End Semester exam (ESE)**: 3 hr
Total marks: 100	**Elective Status:** Open Elective

Prerequisites: Basic Electrical Engineering
Additional Material allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1.	Understand basic concept of robotics
2.	Analyse Instrumentation systems and their various applications
3.	Comprehend the differential motion and statics in robotics
4.	Recommend appropriate robot configurations for various applications
5.	Understand various implementation issues for robotics
6.	Analyse the dynamics and control in robotics industries

PART-A

Introduction ***(06L)***

Robot configurations, Robot Anatomy Basic Components of Robot Systems: Manipulators, end effectors, sensors, controllers etc. Mechanical System in Robotics: Robot motion analysis and control, Homogeneous transformations and robot kinematics, Kinematic chains, position analysis. Programming languages

Drives for Robot ***(06L)***

Stepper motor, DC motors, AC motors, hydraulic and pneumatic systems, drive selection for robotics joints

AI in Robotics ***(06L)***

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

PART-B

Python and ROS ***(09L)***

Introduction to OpenCV, Open NI and PCL - Programming Kinect with Python using ROS, OpenCV, and Open NI - Working with Point Clouds using Kinect, ROS, Open NI and PCL.

Interfacing with ROS using Python ***(09L)***

Building Chef Bot hardware - Writing a ROS Python driver for Chef Bot - Understanding Chef Bot ROS launch files - Working with Chef Bot Python nodes and launch files - The Calibration and Testing of Chef Bot - The Calibration of Xbox Kinect using ROS - Wheel odometry calibration - Testing of the robot using GUI.

TEXT BOOKS:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.

2. J.J.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGrawHill Singapore, 1996.

REFERENCE BOOKS:

1. G. Ashitava, Robotics-Fundamental Concepts and Analysis‘, Oxford University Press, Sixth impression, 2010.

2. K. K.Appu Kuttan, Robotics, I K International, 2007.

3. W.Edwin, Applied Robotics, Cengage Learning, 2003.

4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.

5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai, 1998.

6. S.Ghoshal, ―Embedded Systems & Robotics‖ – Projects using the 8051 Microcontroller‖, Cengage Learning, 2009.

Subject Code: OEEE-105
Subject Name: *SOFT OPTIMIZATION TECHNIQUES*

Programme: B.Tech (EE)	**L:3 T:1 P:0**
Semester: 7	**Teaching Hours**: 36L
Theory/Practical: Theory	**Credits:** 3
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:** 40%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Open Elective

Prerequisites: Engineering Mathematics and programming languages.

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Comprehend the difference between soft and hard computing
2.	Understand the concept of fuzzy logic and its tools
3.	Analyse the single objective optimization problems using Genetic Algorithm
4.	Illustrate the concept of multi-objective optimization problems
5.	Apply Soft computing to solve problems in varieties of application domains
6.	Appreciate the concept of neural network for real life problem solving

DETAILED CONTENTS

PART-A

Introduction ***(4L)***

Concept of Computing, “Soft” Computing vs “Hard” Computing, Characteristics of Soft Computing, Applications of Soft Computing.

Fuzzy Logic ***(8L)***

Introduction to Fuzzy Logic, Fuzzy Sets and Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Rules, Propositions, Implications and Inferences, Defuzzification Techniques, Some Applications of Fuzzy Logic.

Genetic Algorithms ***(6L)***

Concept of "Genetics" and "Evolution" and Its Application to Probabilistic Search Techniques, Basic GA Framework and Different GA Architectures, GA Operators, Encoding, Crossover, Selection, Mutation, Solving Single-Objective Optimization Problems using GAs.

Part-B

Multi-Objective Optimization Problem Solving ***(9L)***

Concept of Multi-Objective Optimization Problems (MOOPs) and Issues of Solving Them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto Approaches to Solve MOOPs, Pareto-Based Approaches to Solve MOOPs, Some Applications with MOEAs.

Artificial Neural Networks ***(9L)***

Biological Neurons and Its Working, Simulation of Biological Neurons to Problem Solving, Different ANNs Architectures, Training Techniques for ANNs, Applications of ANNs to solve Some Real-Life Problems.

Text/References:

1. F. Martin, Mc neill, and Ellen Thro, AP Professional, Fuzzy Logic: A Pratical approach, 2000.
2. J. Ross, Willey,Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy 2010.
3. K Nikola. Kasabov,Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, MIT Press, 1998.
4. M Ahmed. Ibrahim Fuzzy Logic for Embedded Systems Applications, , Elesvier Press, 2004.
5. M Melanie An Introduction to Genetic Algorithms, , MIT Press, 2000.
6. E. David Goldberg, Pearson Education Genetic Algorithms In Search, Optimization And Machine Learning, , 2002.
7. L Randy. Haupt and sue Ellen Haupt Practical Genetic Algorithms, , John Willey & Sons, 2002.
8. S. Rajasekaran, and G. A. Vijayalakshmi Pai Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis, and Applications, , Prentice Hall of India, 2007.

Subject Code: : OEEE-106
Subject Name: *Energy Efficient Machines*

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6	Teaching **Hours:** 36L
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Open Elective

Prerequisites: Induction Motor Basics

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
1.	Understand the importance of energy management and audit
2.	Apply energy conservation measures in industrial and agriculture sector
3.	Understand the design modifications in energy efficient motor as compared to standard motor
4.	Understand the power factor correction of non-linear loads
5.	Evaluate motor efficiency and selection of drive for industrial use
6.	Apply a computational tool to analyze the payback period of energy efficient motors

Detailed Contents:

PART-A

Energy Management and Audit (6L)

Introduction to Energy Management, Energy Audit and its Need, Types of Energy Audit, Energy Conservation in context with induction motor loads in Industrial and Agricultural Sector, Energy Audit Instruments.

Reactive Power Management in Electrical Systems (8L)

Electricity Billing, Electrical Load Management and Maximum Demand Control, low power factor issues with standard induction motor Methods of Power Factor Improvement, Selection and Location of Capacitors, Performance. Assessment of Power Factor Correction Capacitors, Power Factor with Non-Linear Loads, Harmonics distortion factor and power quality.

Adjustable Speed Drives (4L)

Introduction to AC drives**,** AC drive classification**.** Variable Frequency Drives, drives in industrial automation. AC drive evaluation and selection.

PART-B

Energy Efficient Motors **(10L)**

Difference between Standard Motors and Energy Efficient Motors, NEMA Design A, B, C, D, Wound Rotor, Multi speed Motors, Motor Efficiency Determination Methods: Direct Measurement Method, Loss Segregation Method, Motor Efficiency Labeling, Factors for selection of Energy Efficient Motors, Over-Motoring, Eddy Current.

Economics of Energy Efficient Motors and Systems **(8L)**

Motor Life Cycle Cost, Direct Saving and Payback Analysis, present Worth Method with constant Power Costs and Increasing over Costs, Introduction to software like MATLAB/ANSYS for various computations related to energy efficient machines and energy audit.

Text Books:

1 J. C. Andreas, Energy Efficient Electric Motors, Marcel Dekker Inc.1992

2 T. Albert, Introduction to Efficient Electric System Design, The Fairmount Press Prentice Hall.

3 S.C. Tripathi, Electric Energy Utilization and Conservation, Tata Mc-Graw Hill 1991.

4 B. Charles, Handbook of Modern Electronics and Electrical Engineering, John Wiley & Sons,1986.

E-Books and online learning material:

1 . NEMA https://www.nema.org. Accessed on Aug 4 2020

2 . BEE web-link https://www.beeindia.go Accessed on Aug 4 2020

Subject code – OEEE-107
Subject Name- *GENERATION OF ELECTRIC POWER*

Programme: B.Tech- EE	**L: 3 T: 0 P: 0**
Semester: 8	**Teaching Hours:** 36L
Theory/Practical: Theory	**Credits: 3**
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems: 20%**
External Marks: 60	**Duration of End Semester exam (ESE): 3 hr**
Total marks: 100	**Elective Status:** Open Elective

Prerequisites: Basic Electrical Engineering
Additional Material allowed in ESE: Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Evaluate and compare the performance of conventional energy sources
2.	Evaluate and compare the performance of non-conventional energy sources
3.	Understand the concept of cogeneration plants
4.	Analyse the load curves and related factors for determining power generation needs
5.	Perform economic analysis of different electric energy generation techniques
6.	Determine the most economic power factor

PART A

Conventional Sources ***(08L)***

Thermal-steam, Hydro-Electric, Diesel Plant, Gas Power Plant, Nuclear Power Plant, Global and National energy scenarios, Limitation of conventional energy sources basic scheme and application of direct energy.

Non-Conventional Sources ***(06L)***

Environmental aspects of energy utilization, Solar Energy, Construction and working of solar cells and PV modules, Wind Energy, Fuel Cell, Bio Mass Energy, constructional details of various biogas plants, Tidal Energy.

Cogeneration ***(4L)***
Definition and scope, Topping and Bottoming Cycles, Benefits, Cogeneration technologies.

PART B

Loads And Load Curves ***(9L)***
Types of loads, connected load, maximum demand, demand factor, group and peak diversity factors, chronological load curve, load duration curve, mass curve, load factor, capacity factor, utilization factor, load forecasting.

Economics of Electric Energy Generation ***(9L)***
Capital cost of power plants, annual fixed and operating costs, unit cost of electrical energy, and effect of load factor on unit cost, depreciation, objectives and types of electricity tariff, determination of most economic power factor.

Text Books/ References:

1 M.V.Deshpande, Power plant engineering, Tata McGraw Hill, 2018

2 B.R.Gupta, , Generation of electric energy, S. Chand, 2010

3 I.J. Nagrath, and D.P. Kothari, Power system engineering, Tata McGraw-Hill Education, 2003

4 P.K Nag,. Power plant engineering, Tata McGraw-Hill Education., 2001

5 A. J. Wood, and B. F. Woolenberg, Power Generation Operation & Control, Wiley India., 2000

6 G. Boyle, Renewable energy-power for a sustainable future, Oxford University Press, 1980

7 G.D.Rai, Non-conventional energy sources, Khanna Publishers, 2001

Online Learning Matertial:

1 http://www.fayoum.edu.eg/stfsys/stfFiles//243//2512//Ch%204%20%20Principles%20of%20Power%20system.pdf – Accessed on 27/08/2020

2 https://byjus.com/physics/conventional-and-nonconventional-sources-of-energy/-Accessed on 27/08/2020

3 https://nptel.ac.in/courses/121/106/121106014/- Accessed on 27/08/2020

4 http://www.ignou.ac.in/upload/Unit-7-58- Accessed on 27/08/2020

Subject code – OEEE-108
Subject Name- RELIABILITY ENGINEERING

Programme: B.Tech-EE	**L: 3 T: 0 P: 0**
Semester: 8	**Teaching Hours:** 36L
Theory/Practical: Theory	**Credits: 3**
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems: 20%**
External Marks: 60	**Duration of End Semester exam (ESE): 3 hr**
Total marks: 100	**Elective Status:** Open Elective

Prerequisites: Basics of Probability Analysis
Additional Material allowed in ESE: Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Understand basic concept of reliability engineering
2.	Comprehend different reliability functions
3.	Analyse the failure data and component reliability
4.	Evaluate the reliability of engineering systems using different techniques
5.	Understand the qualitative concept of availability and maintainability
6.	Analyse improvement of availability and reliability of any system

PART A

Basic Concept of Reliability Engineering ***(06L)***

Reliability and Quality, History of Reliability, Failure Modes, Causes of Failure (Unreliable Systems), Redundancy Techniques.

Reliability Design and Analysis ***(06L)***

Reliability and Cost, Failure Data Analysis, Failure Density, Failure Rate, Component Reliability, Mean Time to Failure (MTTF), Mean Time Between Failure (MTBF), Markov's Model of Reliability Function.

System Reliability Models ***(06L)***

Introduction, System with Series and Parallel Components, k out of m Systems, Fault Tree Analysis (FTA), Reliability evaluation from Fault Tree.

PART B

Maintainability and Availability Concepts ***(09L)***

Concept of Maintainability, Qualitative aspect of Availability, Availability Function, Concept of Preventive Maintenance, Concept of traditional RCM.

Reliability Management ***(09L)***

Economic Issues Manufacture and Customer Cost, Reliability Achievement Cost Model, Reliability Management Policies, Objectives, Reliability Data Acquisition.

Text Books/ References:

1. E Balaguruswamy., Reliability Engineering, Mc-GrawHill International, 2017
2. L.S Srinath.., Reliability Engineering, East-West Press Private Ltd, 2005

3. M.L Shooman., Probabilistic Reliability: An Engineering Approach, Mc-Graw-Hill, 2004
4. R. Ramakumar , Engineering Reliability, Prentice Hall, NJ., 2001
5. R Billinton., Power System Reliability Calculation, MIT Press, USA, 2000
6. Endreyni, Reliability Modeling in Electric Power System, John Wiley, New York, 2013

Links:

Reliability of systems – IIT Kanpur - https://www.youtube.com/watch?v=_c-iZ2BAXPw
https:// en.m.wikipedia.org/reliability engineering. 8. https://onlinecourses.nptel.ac.in

Subject Code: OEEE-109
Subject Name: *Electric Vehicles*

Programme: B.Tech (EE)	**L: 3 T: 0: P: 0**
Semester:6	**Teaching Hours**: 36L
Theory/Practical: Theory	**Credits:**3
Internal marks:40	**Percentage of Numerical/Design/ Programming Problems:**40%
External Marks:60	**Duration of End Semester exam (ESE):**3 hr
Total marks:100	**Elective Status:** Open Elective

Prerequisites: Basic Electrical Engineering

Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Understand the development of Electric Vehicles and available technologies
2.	Comprehend environmental and economic impact of electric vehicles
3.	Appreciate the concept of Electric Traction
4.	Select a suitable drive scheme for developing an electric vehicle
5.	Acquaint with different possible ways of energy storage
6.	Appreciate various charging technologies for Electric Vehicles

DETAILED CONTENTS

PART-A

Introduction ***(06L)***

Electric vehicles (EV) development, past, present and future, comparison with IC engine drive vehicles, Configuration of Electric Vehicle, social and environmental importance of Electric Vehicles

Electric Drive Trains ***(06L)***

Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive train topologies, fuel efficiency analysis

Electric Propulsion Unit ***(06L)***

Different types of motors used in EV and their torque-speed characteristics, motor control techniques, sensor-less control, drive system efficiency

PART-B

Energy Storage ***(09L)***

Introduction to Energy Storage Requirements in Electric Vehicles, Battery based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Sizing power electronic devices for energy storage, Regenerative Braking, Cooling System

Charging System Technology for Electric Vehicles ***(09L)***

Charging of EV in 3 Levels, Onboard Charger: Single stage, two stage, Multifunctional, Integrated, Multifunctional. Off-board Charger: Bidirectional &Unidirectional AC/DC convertors, Bidirectional & Unidirectional DC/DC convertors, Fast Charging Stations, Charging Methods: Constant Current-

Constant Voltage (CC-CV), Five step charging pattern, Pulse Charging Method
Case Study: Design of Battery Electric Vehicle (BEV)

Text/References

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, " Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
3. T. Denton, "Electric and Hybrid Vehicles" , Routledge, 2016.

E-Books and Online Learning Material

1. https://nptel.ac.in/courses/108/103/108103009/
2. https://nptel.ac.in/courses/108/106/108106170/
3. http://ceb.ac.in/knowledge-center/E-BOOKS/Modern%20Electric,%20Hybrid%20Electric%20&%20Fuel%20Cell%20Vehicles%20-%20Mehrdad%20Ehsani.pdf
4. https://www.routledge.com/rsc/downloads/CRC_Hybrid_Vehicles_Freebook.pdf
5. https://books.google.co.in/books?id=bQFuTCGNYWgC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
6. https://link.springer.com/content/pdf/10.1007/s42835-020-00547-x.pdf

Subject Code: MnPCEE-101
Subject Name: Electrical Machines

Programme: B.Tech (EE)	**L: 2 T: 0 P: 0**
Semester: even	**Teaching Hours**: 24
Theory/Practical: Theory	**Credits:** 2
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:60**%
External Marks: 60	**Duration of End Semester exam (ESE):** 3 hr
Total marks: 100	**Elective Status:** Compulsory

Prerequisites: Basics of Electrical Engineering
Additional Material allowed in ESE: Scientific Calculator
On Completion ofthe course, the student will have the ability to:

CO #	Course Outcomes (CO)
1.	Understand construction and working principle of Transformers
2.	Understand construction and working principle of DC machines
3.	Understand construction and working principle of Three-phase Induction Motors
4.	Understand construction and working principle of Synchronous Machines
5.	Develop conditions for maximizing the performance of AC and DC machines
6.	Apply various methods for determining voltage regulation of synchronous generator

DETAILED CONTENTS

PART-A

TRANSFORMERS ***(06 Hours)***

Working principle, Construction, types, EMF equation, Transformer on no load and on load, exact and approximate equivalent circuit, O.C & S.C.test on transformer, regulation of transformer, losses & efficiency, condition for maximum efficiency, All day efficiency, Efficiency curve, Sumpner's test, Auto transformer, Parallel operation and its conditions.

DC MACHINES ***(06 Hours)***

DC Generator: Construction features, emf equation of dc generator, methods of excitation, losses condition for maximum efficiency.

DC Motor: Working principle, voltage equation, condition for maximum power, torque developed, starting and speed control.

PART-B

Three-Phase induction motor ***(06 Hours)***

Construction, types, rotating magnetic field, principle of operation, slip, frequency of rotor current, rotor emf, rotor current, expression for torque, conditions for maximum torque, torque slip characteristics, starting torque, effect of change in supply voltage on torque, slip and speed, relation between full load torque and maximum torque, starting methods.

Synchronous Machines ***(06 Hours)***

Alternator: Basic principle, construction, pitch factor, distribution factor, emf equation, alternator on load, voltage regulation, synchronous impedance method, mmf method, ZPF method, parallel operation, synchronization of alternator. Synchronous motor: Basic principle, methods of starting, application.

Text / References:

1. A. E. Fitzgerald and C. Kingsley, *"Electric Machinery",* McGraw Hill Education, 2013.
2. M. G. Say, *"Performance and design of AC machines",* CBS Publishers, 2002.
3. P. S. Bimbhra, *"Electrical Machinery",* Khanna Publishers, 2011.

4. I. J. Nagrath and D. P. Kothari, *"Electric Machines",* McGraw Hill Education, 2010.
5. A. S. Langsdorf, *"Alternating current machines",* McGraw Hill Education, 1984.

Subject Code: MnPCEE-102
Subject Name: Electrical Measurement & Instrumentation

Programme: Minor Specialization Course for Electrical Engineering	**L: 3 T: 0 P: 0**
Semester:odd	**Teaching Hours: 36**
Theory/Practical: Theory	**Credits:3**
Internal marks: 40	**Percentage of Numerical/Design/ Programming Problems:30%**
External Marks: 60	**Duration of End Semester exam (ESE): 3 hr**
Total marks: 100	**Elective Status: Compulsory**

Prerequisites: Basic Electrical Engineering
Additional Material allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes (CO)
1.	Compare different types of instruments-their working principles
2.	Understand the working of wattmeter and energy meters
3.	Acquire knowledge of AC potentiometers and bridges
4.	Understand the use of transducers for physical variables
5.	Comprehend different flux and permeability measurements methods
6.	Understand the working and applications of CRO and DSO

DETAILED CONTENTS

PART-A

BASIC CONCEPTS OF MEASUREMENTS (8Hours)

Concepts relating to Measurements, True value, Accuracy, Precision, Errors in Measurements, calibration of meters, significance of IS standards of Instruments, Classification of meters , operating forces ,essentials of indicating instruments, deflecting, damping, controlling torques. Ammeters and voltmeters , moving coil, moving iron, constructional details and operating, principles shunts and multipliers, Measurement of power and energy, Dynamometer type wattmeter for single phase, induction type energy meters for single phase.

BRIDGE MEASUREMENTS (6Hours)

Wheatstone Bridge, Kelvin Bridge ,AC Bridges, A. C. bridges for inductance measurement Maxwell, Hays, anderson and owen bridges, capacitance measurement – Desauty and Schering Bridge. measurement of frequency by Wien's bridge, Wagner"s earthing device.

POTENTIOMETERS (4Hours)

Potentiometers: Principle of D. C. potentiometer, direct reading potentiometers, accurate forms of potentiometers, A. C. potentiometer principle, polar and Co - ordinate type A. C. potentiometer, applications of A. C. and D. C. potentiometers.

PART-B

MAGNETIC MEASURMENTS (6Hours)

Measurement of flux and permeability, flux meter, hall effect Gaussmeter for BH curve and permeability measurement, hysteresis measurement, principle of ballistic galvanometer, determination of BH curve , hysteresis loop, Lloyd Fisher square for measurement of iron losses,

SENSORS AS TRANSDUCERS (6Hours)

Definition and classification of transducers, transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature, basic principles and working of LVDT, piezo electric force transducer , RTD, Thermistors.

ANALOG AND DIGITAL ELECTRONIC INSTRUMENTATION (6Hours)

Analog electronic voltmeter, tuned and sampling voltmeters, Digital counter-timer and frequency meter , digital voltmeter and multimeter, CRO and Digital Storage Oscilloscope.

Text / References:

1. H.frick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice-Hall of India, Reprint 1988.
2. B.E. Jones, "Instrumentation Measurement and Feedback", Tata McGraw-Hill, 1986.
3. E.W Golding, "Electrical Measurement and Measuring Instruments", 3rd Edition, Sir Issac Pitman and Sons, 1960.
4. H. Buckingham. and E.N Price,, "Principles of Electrical Measurements", 1961.
5. E.O Doebeling, "Measurement Systems Application and Design" McGraw Hill PublishingCompnay, 1990
6. A.S Mooris, Principle of Measurement and Instrumentation, Prentice Hall of India,1999
7. J.W Dalley., Riley, W.F. and Meconnel, K.G., Instrumentation for Engineering Measurement, John Wiley & Sons, 1999
8. A.K.Sawhney, " A course in Electrical and Electronics Measurements and Instruments" DhanpatRai& Co. (Pvt.) Ltd. 2000
9. J. B. Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria&Sons, 2013
10. H. S Kalsi., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012
11. W.D Cooper, "Modern Electronics Instrumentation" Prentice Hall of India, 2009
12. P.Purkait, B.Biswas, S.Das and C. Koley, Electrical and Electronics Measurements andInstrumentation, McGraw Hill Education (India) Pvt. Ltd.,2013

Subject Code: MnPCEE-103
Subject Name: POWER GENERATION, TRANSMISSION & UTILIZATION

Programme: B.Tech.	**L:** 3 **T: 0 P:** 0
Semester: Odd	**Teaching Hours:** 36L
Theory/Practical: Theory	**Credits: 3**
Internal Marks: 40	**Percentage of Numerical/Design Problems: 60**%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
1.	Understand the various components of Electric supply system
2.	Comprehend the various methods of power generation and its comparisons
3.	Understand the different systems of electric power transmission
4.	Analyze the effect of line parameters and other factors effecting the transmission of electric power
5.	Design of illumination systems
6.	Comprehend different electric heating and electric welding methods

Detailed Contents

Part-A

ELECTRICAL SUPPLY SYSTEM (04L)

Single line diagram of a typical supply scheme, Components, comparisons, Various systems of power transmission, comparison - DC system, Single phase system, Two phase, Three phase.

ELECTRICAL POWER GENERATION (06L)

Conventional and non-conventional energy sources - comparison, Generation of electrical energy, Selection of sight, hydroelectric, thermal and nuclear power plants Detailed layout, explanation and comparison of hydroelectric, thermal and nuclear power plants, calculation of total electrical energy generated in hydroelectric and thermal power stations – problems

OVER HEAD LINE COMPONENTS (08L)

Conductor materials, Line supports, Insulators, String efficiency, Sag, Transmission line parameters - Two wire and three wire – calculation – Resistance - Inductance – Capacitance - Transposition. Classification of overhead transmission lines, Line losses, Voltage regulation, Transmission efficiency, Ferranti effect, Corona, Skin effect – Problems.

Part-B

ELECTRICAL ILLUMINATION (09L)

Importance of lighting, properties of good lighting scheme, laws of illumination, photometry, types of lamps, lighting calculations, basic design of illumination schemes for residential, commercial, street lighting, and sports ground, energy efficiency lamps.

ELECTRICAL HEATING AND WELDING (09L)

Role electric heating for industrial applications, resistance heating, induction heating, dielectric heating, electric arc furnaces. Brief introduction to electric welding, welding generator, welding transformer and the characteristics.

Text /References Books:

1. V.K. Mehta, Rohit Mehta. Principles of Power System: S Chand & Co., 2010
2. J B Gupta. A course in Power Systems: S K Kataria &sons., 2010
3. C.L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', New Age International Pvt. Ltd, 2003.
4. B.R. Gupta, 'Generation of Electrical Energy', Eurasia Publishing House (P) Ltd, New Delhi, 2003
5. H. Partab, 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Co, New Delhi, 2004.
6. E. Openshaw Taylor, 'Utilization of Electrical Energy in SI Units', Orient Longman Pvt. Ltd, 2003.
7. J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K.Kataria and Sons, 2002.

E-books and online learning material:

1. Electric Power Generation,Transmission and distribution by Leonard
https://www.pdfdrive.com/electric-power-generation-transmission-and-distribution-e157931607.html

2.Electric Energy Generation And Utilisation And Conservation by KK Kumar
http://www.sasurieengg.com/e-course-material/EEE/IV-Year%20Sem%208/EE2451%20EEGUC.pdf

Subject Code: MnPEEE-101
Subject Name: RENEWABLE ENERGY SYSTEMS

Programme: B.Tech.	**L:** 3 **T: 0 P:** 0
Semester: Even	**Teaching Hours:** 36L
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems: 20**%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcomes
1.	Analyze the global and national energy scenario as regards to energy crisis
2.	Analyze the available solar potential in India
3.	Understand the basic physics of wind power generation
4.	Evaluate the application of fuel cell in diverse fields
5.	Evaluate the application of bio mass energy system in future development
6.	Evaluate the energy harnessing from biomass, wind, geothermal, tidal and other non conventional sources of energy

Detailed Contents

Part-A

INTRODUCTION (04L)

Global and National energy scenarios, Limitation of conventional energy sources, need and growth of alternative energy source, Energy-Environment interaction, basic scheme and application of direct energy

SOLAR ENERGY (06L)

Solar energy in India, Solar radiation spectra, solar geometry, Earth Sun angles and observer Sun angles, solar day length, solar collectors, estimation of solar energy availability, Applications of solar energy, solar furnace, Diode equivalent circuit of PV cell , Photovoltaic effect, different types of photovoltaic cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency.

WIND ENERGY (08L)

Wind systems in India, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions, Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Wind Energy Conversion systems.

Part-B

FUEL CELL **(06L)**

Principle of Operation of Fuel Cell, Gibb's free energy, general description of fuel cells types, construction, operational characteristics and applications.

BIO MASS ENERGY **(06L)**

Availability of bio-mass and its Conversion Theory, Harvesting of biomass (coppieing, pollarding, lopping, pruning, thinning), Biomass conversion technologies (thermochemical, biochemical and agrochemical) technology, briquetting, biomass gasification technology.

MISCELLANEOUS SOURCES **(06L)**

Geothermal system, hydro-electric plants, Tidal energy, Biodiesel, Thermo-electric and MHD generator

Text /References Books:

1. B. R. Gupta, Generation of Electrical Energy, S. Chand.
2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 2005.
3. S. Rao, and B.B. Parulekar, Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers, 2005.
4. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
5. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
6. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
7. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
8. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
9. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

Online Course:

https://nptel.ac.in/courses/121/106/121106014/ - 21 August 2020

https://nptel.ac.in/courses/108/108/108108078/ - 21 August 2020

Subject Code: MnLPCEE-101
Subject Name: *Electrical Machines Laboratory*

Programme: B.Tech (EE)	**L: 0 T: 0 P: 2**
Semester: even	**Teaching Hours**: 24
Theory/Practical: Theory	**Credits:**1
Internal marks: 30	**Percentage of Numerical/Design/ Programming Problems:**100%
External Marks:20	**Duration of End Semester exam (ESE):**1.5hr
Total marks:50	**Elective Status:** Compulsory

Prerequisites: Basic Electrical Engineering

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

CO #	Course Outcomes (CO)
1.	Construct equivalent circuits for single phase transformer by performing open and short circuit tests
2.	Comprehend the requirement of starting and speed control methods of induction motors in the various applications of industry
3.	Determine voltage regulation of synchronous generator
4.	Construct equivalent circuits for induction motor by performing no-load and block rotor tests
5.	Construct characteristic curves of DC machines
6.	Perform parallel operation of single-phase transformers

Sr. No.	Name of Practical
1	To operate two single phase transformers of different KVA ratings in parallel and plot the variation of currents shared by each transformer versus load current.
2	To perform Open Circuit and Short circuit Test on a transformer and find its efficient and regulation.
3	Speed control of DC Shunt Motor using a) Armature control and b) field control methods.
4	To obtain Magnetizing Characteristics, Internal & External Characteristic of Self Excited DC Shunt Generator. Also obtain the critical filed resistance of the machine from magnetizing Characteristics.
5	To obtain Speed-Torque characteristics of DC Series Motor.
6	To obtain Speed-Torque characteristics of DC Shunt Motor.
7	To study different starters of D. C. motor.
8	To study different starters of three phase induction motor.
9	To perform No load and Block rotor test on induction motor and plot equivalent circuit.
10	To Study the effect of Inserting resistance on rotor of Slip ring induction motor.
11	To draw the V curves for synchronous machine.
12	To find the voltage regulation of synchronous machine.
13	To study capacitor start and capacitor run induction motor.

Reference Material
Manual Available in lab