CMR Institute of Technology, Bangalore			
Department(s):Electrical & Electronics Engineering			
Semester: 08	Section(s): A&B		
Electrical Design, Estimation & Costing		10EE81	Lectures/week: 04
Course Instructor(s): Keka M			
Course duration: 01 Feb., 2018 – 25 May 2018			
Course Site: https://sites.google.com/a/cmrit.ac.in/kekamukhopadhyaya/			

Course Objectives

- To discuss the purpose of estimation and costing and to discuss market survey, estimates, purchase enquiries, tenders, comparative statement and payment of bills and Indian electricity act and some of the rules.
- To discuss distribution of energy in a building, wiring and methods of wiring, cables used in internal wiring, wiring accessories, fittings and fuses.
- To discuss design of lighting points and its number, total load, sub-circuits, size of conductor.
- To discuss different types of service mains and estimation of power circuits.
- To discuss estimation of overhead transmission and distribution system and its components.
- To discuss main components of a substation, their graphical representation and preparation of single line diagram of a substation.

Prerequisites

- General concepts of motor
- Earthing concepts
- Knowledge about different loads in buildings
- General concepts of transmission & distribution and substation

Lesson Plan

Lecture #	Books and Sessions	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-6	RB 2 1.9-1.19, 19 TB 1 1.1-1.18	**UNIT-1 General Principles Of Estimation:** Introduction to estimation & costing, Electrical Schedule. Catalogues, Market Survey and source selection. Recording of estimates, Determination of required quantity of material, Labor conditions. Determination of cost material and labor Contingencies. Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode. Comparative statement, Purchase orders, Payment of bills. Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules	PPT/chalk -&talk	12%

Links to some useful online lectures:

- http://www.dgms.net/IErules1956.pdf

7-13	TB1: 1, 2 8.1-8.8, 3.9 RB-2 16.1-16.4 4.2, 4.3, 4.4	**UNIT-2 Residential Building Electrification :** General Rules guidelines for wiring of residential installation and positioning of equipments, Principles of circuit design in lighting and power circuits Procedures for designing the circuits and deciding the number of circuits, Method of drawing single line diagram. Selection of type of wiring and rating of wires and cables Load calculations and selection of size of conductor, Selection of rating of main switch Distribution board, protective switchgear ELCB and MCB and wiring accessories, Earthing of residential Installation, Sequence to be followed for preparing estimate, Preparation of detailed estimates and costing of residential installation	PPT/chalk -&talk Video link	13%

Links to some useful online lectures:

- https://www.youtube.com/watch?v=AOctHaAxEoM
- https://www.youtube.com/watch?v=-KDfwmyTPKE
- https://www.youtube.com/watch?v=WhmDdCmWJrM
- https://drive.google.com/file/d/1AmTOyV9e6z3FMcHu89ClrIOkThIiQaHh/view

14-20	RB1 5.1-5.5 RB2 16.5	**UNIT-3 Electrification Of Commercial Installation** Concept of commercial installation, Differentiate between electrification of residential and commercial installation, Fundamental considerations for planning of an electrical installation system for commercial building, Design considerations of electrical installation system for commercial building, Load calculation and selection of size of service connection and nature of supply, Deciding the size of the cables, bus bar and bus bar chambers, Mounting arrangements and positioning of switchboards, distribution boards main switch etc, Earthing of the electrical installation, Selection of type wire, wiring system and layout, Sequence to be followed to prepare estimate, Preparation of detailed estimate and costing of commercial installation.	Video link/flip class	13%

Links to some useful online lectures:

- https://www.youtube.com/watch?v=GEUyvhRNwLc&list=PLBOPowZ2ZMRBcKoTO0jXCWYZNC043dxvP
- https://www.youtube.com/watch?v=4noWwfv2DUY
- https://www.youtube.com/watch?v=uvJD1sSt1PM
- https://www.youtube.com/watch?v=c67wlH2lJL8

21-27	TB1 5.1-5.5 TB1 12.1-12.2 RB2 14.1-14.4	**UNIT-4 Service Connection, Inspection And Testing Of Installation** Concept of service connection, Types of service connection and their features, Method of installation of service connection, Estimates of underground and overhead service connections, Inspection of internal wiring installations, Inspection of new installations, testing of installations, testing of wiring installations, Reason for excess recording of energy consumption by energy meter.	PPT/chalk -&talk	12%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=AZenZfLQQgw&t=6s				
28-33	TB1 9.1-9.7	**UNIT-5 Electrical Installation For Power Circuits** Introduction, Important considerations regarding motor installation wiring, Determination of input power, Determination of input current to motors Determination of rating of cables Determination of rating of fuse, Determination of size of conduit, distribution board main switch and starter.	PPT/chalk -&talk	12%
34-45	TB1 10.1-10.39	**UNIT-6&7 Design And Estimation Of Overhead Transmission & Distribution Lines:** Introduction, Typical AC electrical power system, Main components of overhead lines, Line supports. Factors governing height of pole, Conductor materials, Determination of size of conductor for overhead transmission line, Cross arms, Pole brackets and clamps, Guys and Stays, Conductors configuration spacing and clearances, Conductors configuration spacing and clearances, Span lengths, Overhead line insulators, Insulator materials, Types of insulators, Lightning Arrestors, Phase plates, Danger plates, Anti climbing devices, Bird guards, Beads of jumpers.Anti climbing devices, Bird guards, Beads of jumpers. Muffs, Points to be considered at the time of erection of overhead lines,Erection of supports, setting of stays, Fixing of cross arms, Fixing of insulators, Conductor erection, Repairing and jointing of conductor, Dead end clamps, Positioning of conductors and attachment to insulators Jumpers, Tee-offs, Earthing of transmission lines. Guarding of overhead lines, Clearances of conductor from ground Spacing between conductors, Testing and commissioning of overhead distribution lines, some important specifications	PPT/chalk -&talk	24%
Links to some useful online lectures: ➢ https://drive.google.com/file/d/1knVsHY1QjouFvPesP9VlK_49FPTzHxub/view ➢ https://drive.google.com/file/d/10XfodY7Snnk3gxVj6uix1B0OV3wkZD5f/view ➢ https://drive.google.com/file/d/1SfnGU3I12pXBTJCAkxnXNsZGBkIphI9U/view				

46-52	TB1 13.1-13.11	**UNIT-8 Design And Estimation Of Substations** Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram Key diagram of typical substations Equipment for substation and switchgear installations, Substation auxiliaries supply, Substation Earthing	PPT/chalk-&talk	14%

Links to some useful online lectures:

- https://drive.google.com/file/d/1p0AsG18b8ViGsgPINsTRT7ML375VFYHQ/view

Text Books	
1.	Electrical Installation Estimating & Costing J.B.Gupta, VIII Edition S.K. Katria & Sons New Delhi 979-93-5014-279-0

Reference Books	
1.	Electrical Design Estimating and Costing K.B.Raina S.K.Bhattacharya, New Age International, 81-224-0363-8.
2.	Electrical Wiring Estimating and Costing S.L.UPPAL , G.C GARG ,Khanna Publishers Delhi ,9788174092403

Syllabus for Internal Assessment Tests (IAT*)

IAT #	Portion
IAT-1	Lecture# 1-13,21-27
IAT-2	Lecture# 28-48
IAT-3	Lecture# 49-52,14-20

*See calendar of events for IAT schedule.

Course Outcomes
By the end of this course, students will be able to
1. Understand the general principles of estimation and costing
2.Prepare the estimation for residential building electrification
3.Design and prepare the estimation for commercial building electrification
4.Design the service connections and substations.
5.Design, estimate and install power circuits in industries.
6.Design and estimate overhead transmission & distribution lines

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the general principles of estimation and costing	**1**	-	-	-	-	-	-	-	-	-	-	-	-	2	2	3
CO2	Prepare the estimation for residential building electrification	**2**	3	-	3	-	-	-	-	-	-	-	-	-	3	2	3
CO3	Design and prepare the estimation for commercial building electrification	**3**	3	-	3	-	-	-	-	-	-	-	-	-	3	2	3
CO4	Design the service connections and substations.	**4,8**	3	-	3	-	-	-	-	-	-	-	-	-	3	2	3
CO5	Design, estimate and install power circuits in industries.	**5**	3	-	3	-	-	-	-	-	-	-	-	-	3	2	3
CO6	Design and estimate overhead transmission & distribution lines	**6&7**	3	-	3	-	-	-	-	-	-	-	-	-	3	2	3

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Signature with date:	**Course Instructor**	**Program Coordinator**	**Head-EEE**

Appendix

Table 01: Cognitive Levels

COGNITIVE LEVELS	
Cognitive level	**REVISED BLOOMS TAXONOMY KEYWORDS**
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and

	an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1	Apply electrical and electronic principles to circuits, machines, power systems and control systems.
PSO2	Develop solutions in the areas of industrial automation, green energy systems and smart grids.
PSO3	Able to contribute to project teams in the core and associated domains of electrical and electronic technology.

Table 03: Correlation Levels

CORRELATION LEVELS	
0	No Correlation
1	Slight/Low

2	Moderate/ Medium
3	Substantial/ High

CMR Institute of Technology, Bengaluru-560037			
Department of Electrical and Electronics Engineering			
Semester	VIII	Section	A
Subject	Power System Operation and Control	Code	10EE82
Course Instructor	Prof. Divyateja Raju		
Course Duration	29.01.2018 to 25.05.2018	Total Number of Lecture Hours	65
IA Marks	25	Main Exam Marks	100

Course Objectives

- Describe the control and operations of power system.
- Explain the automatic voltage regulator and automatic load frequency control loops.
- Illustrate the different control methods of voltage and reactive power.
- Describe about the different solution methods of unit commitment problem
- Identify the factors affecting the power system security.
- Discuss about the power system state estimation and reliability.

Prerequisites

- Synchronous Generator, Swing Equation
- Interconnected Power System
- Structure of power systems

LESSON PLAN

Lecture #	Topics	Books and Chapters	% of Syllabus Covered
1-15	UNIT-1 CONTROL CENTER OPERATION OF POWER SYSTEMS:Power system control and operating states, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model. UNIT-2 AUTOMATIC VOLTAGE REGULATOR: Basic generator control loops, Cross-coupling between control loops, Exciter types, Exciter modeling, Generator modeling, Static performance of AVR loop.	TB3: 1.2-1.6,9.7 TB5: 20.1, TB2: 8.8,8.6,8.7,1.7.1, 8.5 TB1:9.7,10.5,Ex. 10A, TB1: 9.1	20%

	Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=fPrz0BkZzK8 ➢ https://www.youtube.com/watch?v=XjvefqfhT78		
16-31	UNIT-3 AUTOMATIC LOAD FREQUENCY CONTROL: Automatic Load frequency control of single area systems, Speed governing system, Hydraulic valve actuator, Turbine generator response, Static performance of speed governor, Closing of ALFC loop, Concept of control area, Static response of primary ALFC loop, Integral control, ALFC of multi-control area systems (POOL operation),The Two-Area system, Modeling the Tie-Line, Block Diagram representation of Two-Area system, Static response of Two-Area system and Tie-Line Bias control. UNIT-4 CONTROL OF VOLTAGE AND REACTIVE POWER: Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse.	TB5: 20.1, TB2: 8.8,8.6,8.7,1.7.1, 8.5 TB1:9.7,10.5,Ex. 10A, TB1: 9.1 TB2:9.15,9.4,9.7 , 9.8 TB4:5.4,5.3 TB6:3.1,3.2,4.3 TB1:3.1,2.1,3.2, Ex.3D,5.1,5.2 TB5: 19.2,19.1,19.4,9.3	20%
	Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=49EM82UO99c ➢ https://www.youtube.com/watch?v=opocYkK_oSA		
31-41	UNIT-5 OPTIMAL SYSTEM OPERATION AND UNIT COMMITMENT: Introduction , Optimal operation of generators on a bus bar, Statement of the Unit Commitment problem, need and importance of unit commitment, Constraint in Unit Commitment, Unit Commitment solution methods-Priority lists method, Forward Dynamic Programming method(excluding problem), Spinning reserve UNIT-6 POWER SYSTEM SECURITY: Introduction, factors affecting power system security, Security analysis, Contingency Selection, Techniques for contingency evaluation-D.C. load flow and fast decoupled load flow	TB1:3.1,2.1,3.2, Ex.3D,5.1,5.2 TB5: 19.2,19.1,19.4,9.3 TB1: 11.1-11.3,11.6	20%
	Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=JRbk0_Klhr4 ➢ https://www.youtube.com/watch?v=8n8ZNeQIldw		

42-57	UNIT-7 SYSTEM MONITORING AND CONTROL: Introduction , Energy management system, the basis of power system state estimation(PSSE), mathematical description of PSSE process, minimization technique for PSSE, Least Square estimation, Error and detection in PSSE, System security and emergency control UNIT-8 POWER SYSTEM RELIABILITY: Introduction, Modes of failures of a system, Generating system and its performance, derivation of reliability index, reliability measure for N- unit system, cumulative probability outages- Recursive Relation, Loss of load probability, Frequency and duration of a state.	TB1:12.1-12.7 RB1:14.1-14.9 RB2:1.1-1.5	20%
	Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=Z-BQhNCR9pY&list=PLeuCmpEpthZqPNHy6kcNpHysywB7t64im ➢ https://www.youtube.com/watch?v=IT-0oCOQrBY&list=PLBGyal9XbKttT26yM6gd8LqkJyB4OBJlN		

Text Books	
1.	Computer Aided Power System Analysis, G.L.Kusic, PHI, 2010
Reference Books	
1.	Modern Power System Analysis, I J Nagarath and D P Kothari, TMH, 3rd Edition, 2003
2.	Electrical Energy Systems Theory, O.J Elgerd, TMH, 2008
3.	Power generation, operation and control, Allen J Wood & Woollenberg, John Wiley and Sons,Second Edition, 1999
4.	Electric Power Systems, B.M.Weedy and B.J. Cory, Wiley student edition, 1999
5.	Computer Aided Power System Operation and Analysis, R.N. Dhar, Tata McGraw-Hill, 1987

PortionforInternal Assessment Tests*

IAT#	Portion
IAT-1	Lecture# 1-24
IAT-2	Lecture# 25–50
IAT-3	Lecture# 51–66

*See calendar of events for the schedules of IATs

Course Outcomes

By the end of this course, students will be able to

- Describe the control and operations of power system.
- Explain the automatic voltage regulator and automatic load frequency control loops.
- Illustrate the different control methods of voltage and reactive power.
- Describe about the different solution methods of unit commitment problem.

- Identify the factors affecting the power system security.
- Discuss about the power system state estimation and reliability

COGNITIVE LEVELS	
Cognitive level	**REVISED BLOOMS TAXONOMY KEYWORDS**
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

Graduate Attributes/Program Outcomes (Defined by NBA)	
POs	**Program Outcome**
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the

	engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes - Defined by Program – B.E.(TCE)	
PSOs	**Program Specific Outcome**
PSO1	Apply Electrical and electronic principles to circuits, machines, power systems and control systems
PSO2	Develop solutions in the areas of industrial automation, green energy systems and smart grids
PSO3	Able to contribute to project teams in the core and associated domains of electrical and electronic technology

CORRELATION LEVELS	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

CO-PO & CO-PSO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404.1	3	-	-	-	1	1	-	-	1	-	-	-	3	3	3
C404.2	3	-	2	-	-	-	-	-	1	-	-	-	3	3	3
C404.3	3	-	2	-	2	2	-	1	1	-	-	-	3	3	3
C404.4	3	-	-	-	1	1	-	1	1	-	-	-	3	3	3
C404.5	2	-	-	-	1	2	-	2	1	-		-	3	3	3
C404.6	3	-	2	-	1	-	-	2	1	-	-	-	3	3	3

CMR Institute of Technology, Bangalore		
Department(s): Electronics and communication		
Semester: 08	Section(s):	
DATACOMMUNICATIONS AND NETWORKING	10EE843	Lectures/week: 04
Course Instructor(s): Swathi Sharma		
Course duration: 01.02.2018 to 19.05.2018		

Course Objectives

- Introduce students to the evolution of computer networks and the concepts data Communication;
- Introduce students the general principles of network design and compare the different Network topologies;
- Introduce students to the digital and analogue representations and channels.
- Describe the mechanism and techniques of encoding.
- Introduce students to the general principles of circuit and packet switching.
- Introduce students to the wireless Local Area Networks.
- Provide students with in-depth knowledge of data link layer fundamental such as error detection, correction and flow control techniques; multiple access control techniques.

Prerequisites

- None

LESSON PLAN

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-6	TB 1.1, 1.2, 1.3, 1.4,2.1,2.2, 2.3,2.4	**Unit-1-** Data Communication , Networks , Internet, Protocol and Standards, Layered task, OSI Model, Layers in OSI Model, TCP/ IP Protcol Suite,	Chalk and Talk Projector	15
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=LANW3m7UgWs ➢ https://www.youtube.com/watch?v=lwlH6jRVLsQ ➢ https://www.youtube.com/watch?v=7rR8p6gsExY				
7-14	TB 3.1 to 4.3	**Unit -2** Data signal and digital transmission: Analog and digital signals, Transmission impairment, Data rate limits, Performance, Digital-to-Digital conversion : Line coding & Line coding schemes, Digital-to-Digital conversion: Block coding , Scrambling, Analog to digital convertion, Transmission modes	Chalk and Talk Slides for few topics	15
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=NJa8abI1FGQ ➢ https://www.youtube.com/watch?v=sRq_gM8r6pI ➢ https://www.youtube.com/watch?v=hzwnjJFMuTU				

15-20	TB 5.1 to 6.2	**Unit-3:** Analog transmission and multiplexing: Digital to analog conversion(ASK and FSK), Digital to analog conversion (PSK and QAM), Analog to Analog conversion, Multiplexing(FDM, WDM), Multiplexing (Synchronous time division multiplexing, Statistical time division multiplexing), Spread Spectrum	Chalk and Talk and flipped class room	15
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=SkaakLTMt_s ➢ https://www.youtube.com/watch?v=K6fHyUzGbLg ➢ https://web.stanford.edu/class/ee102b/contents/DigitalModulation.pdf				
21-26	TB 7.1 to 7.2 and 10.1.to 10.5	**Unit 4: Transmission medium Error detection and correction** Twisted pair cable, Coaxial cable, Fibre-Optic cable , Radio waves, Microwaves, Infrared, Introduction to error detection / correction; Block coding, Linear block codes, Cyclic codes, Checksum.	Chalk and Talk Video Lectures for some topics	15
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=WPkT-Uw5qX0 ➢ https://www.youtube.com/watch?v=6gbkoFciryA				
27-33	TB 11.1 to 11.6	**Unit 5: Data link control,** **Framing,** Flow and error control, Protocols, Noiseless channels, Noisy channels, HDLC, Point to point protocol.	Chalk and Talk	10
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=C_Vj6iQwhvY ➢ https://www.youtube.com/watch?v=5BqMcgxIsws				
34-40	TB 12.1 12.3 13.1 to13.5	**Unit 6:MULTIPLE ACCESS, ETHERNET:** Random Access , Controlled Access, Channelization, Ethernet, IEEE standards, Standard Ethernet , changes in the standard, Fast Ethernet; Gigabit Ethernet.	Chalk and Talk	15
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=4QUM0Sb0YFA ➢ https://www.youtube.com/watch?v=igEABrdZyIo ➢ https://www.youtube.com/watch?v=OWQHxzQ0s-s				
41- 46	TB:14.1 to 14.2 15.1 to	**Unit 7: WIRELESS LANS AND CONNECTION OF LANS:** IEE 802.11 , Bluetooth, Bluetooth	Chalk and Talk	15

	15.3	–L2CAP, Connecting devices, Backbone Networks, Virtual LANs.		
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=MSWmiB0MvlM ➢ https://www.youtube.com/watch?v=TXmOpc5_PO8				
47-52	TB 16.1 to 17.5	**Unit 8: Cellular telephony:** SONET / SDH: Architecture, ,SONET / SDH: Layers, SONET Frames, STS Multiplexing , ATM : Design goals, Problems, Architecture, Switching and ATM Layers	Chalk and Talk	10
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=TfY_p9FRlT4 ➢ https://www.youtube.com/watch?v=alPCfEd6xVs&t=28s ➢ https://www.youtube.com/watch?v=XxE8CstsQnA&t=17s ➢ https://www.youtube.com/watch?v=WToiJS8x1CQ				

Text Books	
1.	**Data communication and networking. B Ferouzan, TMH 2006**
Reference Books	
1.	**Computer networks, James F. Kurose, Keith W Ross, Pearson education 2003**
2.	**Introduction to data communication and networking Wayne Tomasi Pearson education 2007**

Syllabus for Internal Assessment Tests (IAT)*

IAT #	Syllabus
IAT-1	Class # 01 – 20
IAT-2	Class # 21– 40
IAT-3	Class # 41– 52

* : See calendar of events for the schedules of IATs.

Course Outcomes
By the end of this course, students will be able to
1. Understand the basic concepts of data communications , understand the significance & purpose of protocols and standards ; discuss their key elements that are used in data communications and networking;
2. Distinguish between analog and digital signals , understand techniques used to convert digital data and analog signals to digital signals for parallel and serial transmission.
3. Able to distinguish between the different types of bit errors and can explain the concept of bit redundancy and how it is generally achieved in the facilitation of error detection and the main methods of error correction
4. Show clear understanding of the concept, advantages, and analysis of cyclic codes .explain the design and implementation of cyclic redundancy check; and able to compare and contrast cyclic redundancy check and checksum in terms of implementation and performance.
5. Understand connecting LAN's, backbone networks, and virtual LAN's

6. Identify the requirements for high-order communication systems. Also understand the techniques and protocols used (DSL, SONET, ATM).

COGNITIVE LEVELS	
Cognitive level	**REVISED BLOOMS TAXONOMY KEYWORDS**
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

PROGRAM OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO)	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1	Apply electrical and electronic principles to circuits, machines, power systems and control systems.
PSO2	Develop solutions in the areas of industrial automation, green energy systems and smart grids.
PSO3	Able to contribute to project teams in the core and associated domains of electrical and electronic technology.

Table 3 : correlation levels

CORRELATION LEVELS	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the basic concepts of data communications , understand the significance & purpose of protocols and standards ; discuss their key elements that are used in data communications and networking;	**1**	2	1	1	1	-	1	-	-	-	-	-	1	-	-	-
CO2	Distinguish between analog and digital signals; understand techniques used to convert digital data and analog signals to digital signals for parallel and serial transmission.	**1,2**	2	3	1	1	-	1	-	-	-	-	-	1	-	-	-
CO3	Able to distinguish between the different types of bit errors and can explain the concept of bit redundancy and how it is generally achieved in the facilitation of error detection and the main methods of error	**3,4**	2	3	2	2	2	2	1	-	1	-	-	1	-	-	-

	correction																
CO4	Show clear understanding of the concept, advantages, and analysis of cyclic codes .explain the design and implementation of cyclic redundancy check; and able to compare and contrast cyclic redundancy check and checksum in terms of implementation and performance.	**5,6**	1	2	1	-	2	1	-	-	-	-	-	1	-	-	-
CO5	Understand connecting LAN's, backbone networks, and virtual LAN's	**7**	2	2	-	-	2	-	-	-	-	-	-	2	-	-	-
CO6	Identify the requirements for high-order communication systems. Also understand the techniques and protocols used (DSL, SONET, ATM).	**8**	2	1	1	-	1	-	-	-	-	1	-	-	-	-	-

CMR Institute of Technology, Bangalore		
Department(s): Electrical & Electronics Engineering		
Semester: 08	Section(s): A&B	Lectures/week: 04
Subject: Electrical Distribution System		Code: 10EE844
Course Instructor(s): Chaithanya S S		
Course duration: 01 Jan 2018 – 25 May 2018		
Course Site: https://sites.google.com/a/cmrit.ac.in/electrical_distribution_system_10ee844/home		

Course Objectives

- Explain different planning techniques in distribution systems and the use of automation in it.
- Examine the load growth using the load characteristics.
- Analyze the economic and financial aspects that undergoes in the planning of the distribution system.
- Design the layout of a substation under specified constraints.
- Predict the load variations and estimate the system losses.
- Planning and monitoring the control of system performance using the automation tool SCADA.

Prerequisites

- Basics of power system

Lesson Plan				
Lecture #	**Book & Sections**	**Topics**	**Portions coverage**	
			Teaching Aids	% of Syllabus Covered
1-7	**TB1-1.1-1.10** TB2-5.1-5.2	**POWER SYSTEM PLANNING AND AUTOMATION:** Introduction, Factors affecting system, planning, present planning techniques, planning models, future trends in planning, systems approach, distribution automation.	Chalk and Talk Video Lectures for some topics	14.5
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=nbPmsBmo03Y ➢ https://www.youtube.com/watch?v=ub2gC2k91DU ➢ https://www.youtube.com/watch?v=0WVy0zqhYVk&t=44s				
8-16	**TB1-2.1-2.6**	**UNIT-2) LOAD CHARACTERISTIC:** Basic definition, relation between load and load factor, load growth.	Chalk and Talk Video Lectures for some topics	11.3
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=kxRypN4lxOA ➢ https://www.youtube.com/watch?v=NF4VRKa7LSM ➢ https://www.youtube.com/watch?v=WfzPvVdmUho				

17-29	TB2-3.1-3.6	**UNIT-3&4) SYSTEM PLANNING:** Planning process, planning criteria, system developers, dispersed generation,distribution systems, economics and finance, mapping.	Chalk and Talk Video Lectures for some topics	24.2
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=SSpT8vAPBvk				
30-40	TB1 7.1- 7.4 8.1 -8.3	**UNIT-5&6) DESIGN AND OPERATION:** Engineering design, operation criteria, substation and feeder, voltage control, harmonics, load variations, system losses, energy management.	Chalk and Talk Video Lectures for some topics	21.5
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=x-obqbuXSUg ➢ https://www.youtube.com/watch?v=um0Shx9DWSI				
41-46	TB 1: (7.1-7.6, 7.8) RB 1: (10.1-10.3,10.5, 10.7,10.8, 10.9)	**UNIT-7)DISTRIBUTION AUTOMATION:** Definitions, communication, sensors, SCADA.	Chalk and Talk	12.5
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=0WVy0zqhYVk ➢ https://www.youtube.com/watch?v=e77FqCyrQ64 ➢ http://slideplayer.com/slide/10170549/# ➢ https://www.youtube.com/watch?v=5ZiIA-kMV8M				
47-52	TB2-6.1-6.7	**UNIT-8)OPTIMIZATION:** Introduction, costing of schemes, typical network configurations, planning terms,and network cost modelling, synthesis of optimum line network.	Chalk and Talk	16

Text Books	
1(TB1)	Electric Power distribution system Engineering, TuranGonen, 2ND Edition CRC Press
2(TB2)	Electric Power distribution, A.S Pabla, 5th edition, TMH

Syllabus for Internal Assessment Tests (IAT*)

IAT #	Syllabus
IAT-1	Lecture# 1-17
IAT-2	Lecture# 18-40
IAT-3	Lecture# 40-52

*See calendar of events for IAT schedule.

Course Outcomes
By the end of this course, students will be able to
1. Explain different planning techniques in distribution systems and the use of automation in it.
2. Examine the load growth using the load characteristics.
3. Analyze the economic and financial aspects that undergoes in the planning of the distribution system.
4. Design the layout of a substation under specified constraints.
5. Predict the load variations and estimate the system losses.
6. Planning and monitoring the control of system performance using the automation tool SCADA.

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C806.1	Explain different planning techniques in distribution systems and the use of automation in it.	**1**	1	0	0	0	0	0	0	0	1	0	0	0	1	1	1
C806.2	Examine the load growth using the load characteristics.	**2**	2	0	0	0	0	0	0	0	1	0	0	0	3	3	3
C806.3	Analyze the economic and financial aspects that undergoes in the planning of the distribution system.	**3&4**	3	0	0	0	0	0	2	0	1	0	0	0	2	2	3
C806.4	Design the layout of a substation under specified constraints.	**5&6**	3	0	3	0	0	2	1	0	1	0	0	0	3	3	3
C806.5	Predict the load variations and estimate the system losses.	**5&6**	3	0	0	0	0	0	0	0	1	0	0	0	2	2	3
C806.6	Planning and monitoring the control of system performance using the automation tool SCADA.	**7 & 8**	0	0	0	3	0	3	0	0	1	0	0	0	3	3	3

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Signature with date: | **Course Instructor** **Program Coordinator** **Head-EEE**

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	**Revised Blooms Taxonomy Keywords**
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1	Apply electrical and electronic principles to circuits, machines, power systems and control systems.
PSO2	Develop solutions in the areas of industrial automation, green energy systems and smart grids.
PSO3	Able to contribute to project teams in the core and associated domains of electrical and electronic technology.

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

CMR Institute of Technology, Bangalore		
Department(s): Electrical & Electronics Engineering		
Semester: 08	Section(s): A&B	Lectures/week: 04
Subject: Energy Auditing And Demand Side Management		Code: 10EE842
Course Instructor(s): SHAREN RANJIT		
Course duration: 01 Jan 2018 – 25 May 2018		
Course Site: https://sites.google.com/a/cmrit.ac.in/sharen-ranjit-energy-auditing-demand-side-management/		

Course Objectives

- Understand the concept of energy audit, types, index and cost risk analysis with depreciation Techniques
- Measurement and presentation of audit results
- Describe the analysis of load management, conservation of energy, power factor Improvement methods, energy efficient motors
- Analyse energy saving studies on lighting system
- Explain power factor correction and location of capacitors
- Analyse the benefits of demand side management and organize awareness programs

Prerequisites

- Simple Interest
- Compound Interest

LESSON PLAN				
Lecture #	**Books and Chapters**	**Topics**	**Teaching Aids**	**% of Syllabus Covered**
1-6	TB1(1.1 – 1.23)	**Unit1:Introduction:-**Energy situation-world & India Energy Consumption Energy conservation Codes Standards Legislation	Chalk and Talk PPT Video Lectures for some topics	10%
	Links to some useful online lectures: https://www.youtube.com/watch?v=9g7ZtSev1a8			
7-14	TB1(2.1 – 2.22)	**Unit2:Energy Economic Analysis:-** The time value of money concept Developing cash flow models Payback analysis Depreciation Taxes and tax credit Numerical problems	Chalk and Talk PPT	16%

15-22	TB1(3.1 – 3.12)	**Unit3:Energy Auditing:-**Introduction Elements of energy audits Energy use profiles Measurements in energy audits Presentation of energy audit results	Chalk and Talk PPT VideoLectures for some topics	16%
	Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=3CtuDwrntsE			
23-30	TB2(4.1 – 4.23)	**Unit4:Electrical system optimization:-**The power triangle Motor horse power Power flow concept	Chalk and Talk VideoLectures for some topics	10%
	Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=R_Z-A9KZr58 ➢ https://www.youtube.com/watch?v=20Vb6hlLQSg ➢ https://www.youtube.com/watch?v=DPAbMpIOHsU ➢ https://www.youtube.com/watch?v=NF4VRKa7LSM ➢ https://www.youtube.com/watch?v=TevUAck45z8 ➢ https://www.youtube.com/watch?v=PNh6PO3aM4s ➢ https://www.youtube.com/watch?v=4PIhvPTONug ➢ https://www.youtube.com/watch?v=2Ryn9R89fnA			
31-42	RB1(5.1 – 5.33)	**Unit 5&6:Electrical equipment and power factor:-** correction & location of capacitors Energy efficient motors Lighting basics Electrical tariff Concept of ABT	Chalk and Talk VideoLectures for some topics	20%
	Links to some useful online lectures: https://www.youtube.com/watch?v=20NE1uT5CgA			
43-52	RB2(8.1-8.25)	**Unit 7&8:Demand side management**:-Introduction to DSM Concept of DSM Benefits of DSM Different techniques of DSM-time of day pricing Multi-utility power exchange model	Chalk and Talk VideoLectures for some topics	28%
	Links to some useful online lectures: **https://www.youtube.com/watch?v=deT0_ERH7ls**			

Text Books	
1.	Albert Thumann Fundamentals of Energy Auditing, Prentice Hall Inc., ISBN-0-88173-581-7
2.	Pabla Electrical Distribution, 2004 Tata McGraw-Hill, ISBN-13: 9780071447836
Reference Books	
1.	Ashok V. Desai Energy Demand-Analysis, Management *and* Conservation, Wiley Eastern, ISBN-812240202

2.	Tata Energy Research Institute Hand book on energy auditing, Narosa*Publishers*Ltd,ISBN-9788185419718

Syllabus for Internal Assessment Tests (IAT*)

IAT #	Syllabus
IAT1	**Class# 01–14**
IAT2	**Class# 15 –30**
IAT3	**Class# 31–52**

*See calendar of events for IAT schedule.

Course Outcomes
By the end of this course, students will be able to
1. Understand the concept of energy audit, types, index and cost risk analysis with depreciation Techniques
2. Measurement and presentation of audit results
3. Describe the analysis of load management, conservation of energy, power factor Improvement methods, energy efficient motors
4. Analyze energy saving studies on lighting system
5. Explain power factor correction and location of capacitors
6. Analyse the benefits of demand side management and organize awareness programs

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C805.1	Understand the concept of energy audit, types, index and cost risk analysis with depreciation Techniques	**1 2 3**	2	-	-	-	-	-	-	-	1	-	-	-	3	3	1
C805.2	Measurement and presentation of audit results	**2 3**	3	-	-	-	1	-	-	-	-	-	-	-	3	2	2
C805.3	Describe the analysis of load management, conservation of energy, power factor Improvement methods, energy efficient motors	**4 5 6**	3	-	-	-	2	-	-	1	-	-	-	-	2	2	2
C805.4	Analyze energy saving studies on lighting system	**5 6**	3	-	-	-	1	-	-	1	1	-	-	-	2	2	2
C805.5	Explain power factor correction and location of capacitors	**4 6**	3	-	-	-	-	-	-	-	-	-	-	-	3	2	2
C805.6	Analyze the benefits of demand side management and organize awareness programs	**7 8**	2	-	-	-	1	-	-	1	1	-	-	-	1	2	2

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Signature with date:	**Course Instructor**	**Program Coordinator**	**Head-EEE**

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	**Revised Blooms Taxonomy Keywords**
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1	Apply electrical and electronic principles to circuits, machines, power systems and control systems
PSO2	Develop solutions in the areas of industrial automation, green energy systems and smart grids
PSO3	Able to contribute to project teams in the core and associated domains of electrical and electronic technology

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

CMR Institute of Technology, Bangalore			
Department(s): Computer Science & Engineering			
Semester: 08	Section(s): A&B	Lectures/week: 04	
Subject: Reactive Power Management		Code: 10EE831	
Course Instructor(s): Prof. Sharen Ranjit			
Course duration: 01 Jan 2018 – 25 May 2018			
Course Site: https://sites.google.com/a/cmrit.ac.in/sharen-ranjit-courses-reactive-power-management/			

Course Objectives

- Identify the importance of reactive power, power factor, need for & techniques used for reactive power compensation
- Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads
- Summarize various compensation methods in transmission lines
- Extend the system compensation with the use of static VAR compensator, thyristors and other power electronic configurations.
- solve various real life power system problems concerning reactive power compensation
- Contribute to quality of systems, quality of power & quality of service in electrical transmission and distribution sectors.

Prerequisites

- Power Triangle
- Compensation

Lesson Plan				
Lecture #	**Book & Sections**	**Topics**	**Portions coverage**	
			Teaching Aids	% of Syllabus Covered
1-8	RB1- 11.2-11.2.7	**Uint-01: Introduction:** Importance of reactive power control in Electrical power systems, Reactive power devices.	Chalk and Talk Video Lectures for some topics	12%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=wJAddr2NsNw				

➢ https://www.youtube.com/watch?v=R_Z-A9KZr58 ➢ https://www.youtube.com/watch?v=PpznZLu7kpI ➢ https://www.youtube.com/watch?v=0f7YkVorOmY ➢ https://www.youtube.com/watch?v=opocYkK_oSA ➢ https://www.youtube.com/watch?v=fBjNGFIUFzY				
6-13	**TB1 :** 1.1,1.2,1.4.3-1.9.2	**Uint-02: Theory of Load Compensation:** Introduction-Requirement for compensation**,** Objectives in load compensation**,** Specifications of a load compensator**,** Power factor correction and voltage regulations in single phase system**,** Phase balancing and p.f. correction of unsymmetrical loads**,** Compensation in term of symmetrical components.	Chalk and Talk Video Lectures for some topics	13%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=RU6jtai4wys				
14-22	**TB1 :** 2.1,2.1.1,2.1.2, 2.2.2-2.2.5	**Uint-03: Reactive Power Control**: Introduction**,** Fundamental requirement in AC Power transmission**,** Fundamental transmission line equation**,** Surge impedance and natural loading, Voltage and current profiles of uncompensated radial and symmetrical line on open circuit**,** Uncompensated line under load**,** Effect of line length, load power and power factor on voltage and reactive power	Chalk and Talk Video Lectures for some topics	13%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=ZIiWdqIV_8Y				
23-29	**TB1** : 2.3.2-2.4	**Uint-04: Passive and active compensators**: Uniformly distributed fixed compensation**,** Passive shunt compensation**,** Control of open circuit voltage by shunt reactance**,** Reactance of shunt reactors**,** Multiple shunt reactors along the line	Chalk and Talk Video Lectures for some topics	13%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=G5xyHSBHcxQ				
30-36	TB1 : **2.5-2.6.3**	**Uint-05: Series compensation**: Objectives and practical limitations, Symmetrical line with mid-point series capacitor and shunt reactor, Power transfer characteristics and maximum transmissible power for a general case, Fundamental concepts of compensation by sectioning.	Chalk and Talk Video Lectures for some topics	15%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=pWFRpr_olKE				

37-43	TB1 : **4.1-4.2.2,4.3-4.3.3,7.1,7.4-7.6**	**Uint-06: Principles of Static Compensation**: Principle of operation of thyristor controlled reactor, Thyristors switched capacitor, Series Capacitors: Introduction, Protective gear, Reinsertion schemes, Varistor protective gear	Chalk and Talk Video Lectures for some topics	11%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=jIlley7qdMY				
44-47	TB1 : **8.1-8.4.2,8.5-8.5.3**	**Uint-07: Synchronous Condenser**: Introduction, Power system Voltage control, Emergency reactive power supply, Starting methods, Starting motor, reduced voltage starting, Static starting	Chalk and Talk Video Lectures for some topics	10%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=opocYkK_oSA&t=989s				
48-52	**TB1 :** 10.1-10.4,10.6,11.1, **11.2,11.2.4-11.2.6**	**Uint-08: Harmonics effects**: Resonance, Shunt capacitors and filters, Reactive Power Coordination, Reactive power management, Transmission benefits, Reactive power dispatch & equipment impact, Telephone interferences, Reactive power dispatch & equipment impact.	Chalk and Talk Video Lectures for some topics	13%
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=Mq-PF1vo9QA				

Text Books	
1.	Reactive Power control in Electric Systems by T.J.E.Miller ,Wiley India Pvt. Ltd 2012 ,ISBN-978-81-265-2520-1
2.	Reactive Power Management ,D Tagare,TMH,1st Edition,2004
Reference Books	
1.	Power System Stability and Control by P. Kundur, TMH, 9th reprint, 2007, TMH, 9th reprint, 2007,ISBN-978-0-07-063515-9

Syllabus for Internal Assessment Tests (IAT*)

IAT #	Syllabus
IAT1	Class # 01-22
IAT2	Class # 23 - 43
IAT3	Class # 44-52

*See calendar of events for IAT schedule.

Course Outcomes
By the end of this course, students will be able to
1. Identify the importance of reactive power, power factor, need for & techniques used for reactive power compensation.
2. Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads.
3. Summarize various compensation methods in transmission lines
4. Extend the system compensation with the use of static VAR compensator, thyristors and other power electronic configurations.
5. solve various real life power system problems concerning reactive power compensation
6. Contribute to quality of systems, quality of power & quality of service in electrical transmission and distribution sectors.

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C803.1	Identify the importance of reactive power, power factor, need for & techniques used for reactive power compensation	**1,2**	2	-	-	-	-	-	-	-	1	-	-	-	3	3	2
C803.2	Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads	**2**	3	-	-	-	-	1	-	-	-	-	-	-	3	2	2
C803.3	Summarize various compensation methods in transmission lines	**3,4**	3	-	-	-	-	-	-	-	1	-	-	-	2	2	2
C803.4	Extend the system compensation with the use of static VAR compensator, thyristors and other power electronic configurations.	**5,6**	3	-	-	-	-	1	-	-	-	-	-	-	2	2	2
C803.5	solve various real life power system problems concerning reactive power compensation	**5,8**	3	-	-	-	-	1	-	-	-	-	-	-	3	2	3
C803.6	Contribute to quality of systems, quality of power & quality of service in electrical transmission and distribution sectors.	**7,8**	2	-	-	-	-	-	-	-	1	-	-	-	1	2	2

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Signature with date: | **Course Instructor** | **Program Coordinator** | **Head-EEE**

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	**Revised Blooms Taxonomy Keywords**
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1	Apply electrical and electronic principles to circuits, machines, power systems and control systems
PSO2	Develop solutions in the areas of industrial automation, green energy systems and smart grids
PSO3	Able to contribute to project teams in the core and associated domains of electrical and electronic technology

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

CMR Institute of Technology, Bangalore		
Department(s): Electrical & Electronics Engineering		
Semester: 08	Section(s): B	Lectures/week: 04
Subject: Renewable Energy Sources		Code: 10EE836
Course Instructor(s): Prof. Kashif Ahmed		
Course duration: 01 Jan 2018 – 25 May 2018		
Course Site: https://sites.google.com/a/cmrit.ac.in/kashifahmed6522/		

Course Objectives

- To discuss different conventional and non-conventional energy resources and availability of renewable energy.
- To explain sun – earth geometric relationship, Earth – Sun Angles and their Relationships
- To discuss about solar radiation geometry and solar thermal systems, their configuration & their applications.
- To discuss types of solar electrical systems, their configurations and their applications
- To explain different methods of energy storage
- To discuss different types of wind energy conversion systems (WECS), site selection for WECS and its applications
- To discuss biomass production, types of biomass gasifiers, properties of producer gas.
- To discuss biogas, its composition, production, benefits.
- To discuss tidal energy resources, their classifications and benefits
- To discuss principles of ocean thermal energy conversion, production of electricity and benefits
- To discuss different emerging technologies

Prerequisites

- Different conventional and non-conventional energy resources
- Energy scenario in the World and particularly in India
- Sun-Earth geometry
- Basic solar and wind conversion technique
- Process of photosynthesis
- Biogas production

<table>
<tr><th colspan="5">Lesson Plan</th></tr>
<tr><th rowspan="2">Lecture #</th><th rowspan="2">Book & Sections</th><th rowspan="2">Topics</th><th colspan="2">Portions coverage</th></tr>
<tr><th>Teaching Aids</th><th>% of Syllabus Covered</th></tr>
<tr><td>1-4</td><td>TB1, Chapter 1</td><td>INTRODUCTION : Different conventional and non-conventional energy resources, Energy scenario in the World and particularly in India, Sun-Earth geometry, Basic solar and wind conversion technique, Process of photosynthesis, Biogas production from waste

UNIT 1: ENERGY SOURCES - Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario</td><td>Chalk and Talk

Video Lectures for some topics</td><td>5</td></tr>
<tr><td colspan="5">Links to some useful online lectures:

➢ https://www.youtube.com/watch?v=MHutG0e58os
➢ https://www.youtube.com/watch?v=KEeH4EniM3E</td></tr>
<tr><td>5 - 10</td><td>TB1, Chapter 2</td><td>UNIT 2: SOLAR ENERGY BASICS - Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems); Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer</td><td>Chalk and Talk

Video Lectures for some topics</td><td>15</td></tr>
<tr><td colspan="5">Links to some useful online lectures:

➢ https://www.youtube.com/watch?v=rnM1hXJf4WU
➢ https://www.youtube.com/watch?v=5wa2R4z1fss</td></tr>
<tr><td>11-16</td><td>TB1, Chapter 3</td><td>UNIT 3: SOLAR THERMAL SYSTEMS - Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, concentrating dish type, Solar driers, Solar Still, Solar Furnaces, Solar Green Houses</td><td>Chalk and Talk

Video Lectures for some topics</td><td>10</td></tr>
<tr><td colspan="5">Links to some useful online lectures:

➢ https://www.youtube.com/watch?v=NsCZD1MZPPo
➢ https://www.youtube.com/watch?v=Kje2UESRE9A</td></tr>
<tr><td>17-25</td><td>TB1, Chapter 4 and 5</td><td>UNIT 4: SOLAR ELECTRIC SYSTEMS - Solar Thermal Electric Power Generation – Solar Pond and</td><td>Chalk and Talk</td><td>20</td></tr>
</table>

		Concentrating Solar Collector (parabolic trough, parabolic dish, Central Tower Collector). Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems – stand-alone and grid connected; Applications – Street lighting, Domestic lighting and Solar Water pumping systems **ENERGY STORAGE -** Introduction, Necessity of Energy Storage, and Methods of Energy Storage (classification and brief description using block diagram representation only)	Video Lectures for some topics	
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=wvl0QAQCJyc ➢ https://www.youtube.com/watch?v=X4yMJDj9dEI				
26-31	TB1, Chapter 6	**UNIT 5: WIND ENERGY -** Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, Advantages and Disadvantages of WECS	Chalk and Talk Video Lectures for some topics	15
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=LNXTm7aHvWc ➢ https://www.youtube.com/watch?v=DILJJwsFl3w				
32-36	TB1, Chapter 7	**UNIT 6: BIOMASS ENERGY -** Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants – KVIC and Janata model; Biomass program in India	Chalk and Talk Video Lectures for some topics	10
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=3UafRz3QeO8				
37-41	TB1, Chapter 9	**UNIT 7: ENERGY FROM OCEAN -** Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Estimation of Energy – Single basin and Double basin type TPP (no derivations. Simple numerical problems), Advantages and Limitations of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages & Limitations of OTEC	Chalk and Talk Video Lectures for some topics	15

Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=IASV8IH-ytE ➢ https://www.youtube.com/watch?v=IoRmdVlqNko				
42-44	TB1, Chapter 10	**UNIT 8: EMERGING TECHNOLOGIES -** Fuel Cell, Small Hydro Resources, Hydrogen Energy, and Wave Energy. (Principle of Energy generation using block diagrams, advantages and limitations)	Chalk and Talk **Video Lectures for some topics**	10
Links to some useful online lectures: ➢ https://www.youtube.com/watch?v=imV_ufIzxPY ➢ https://www.youtube.com/watch?v=fYfs-qYGzvs				

Text Books	
1.	Rai G. D.: Non-Conventional Source of Energy, Khanna Publishers, 4th Edition, 2007. ISBN: 81-7409-073-8
2.	Khan B. H: Non-Conventional Energy Resources, TMH, 2nd Edition. ISBN: 978-93-5260-188-2
Reference Books	
1.	Mukherjee D and Chakrabarti S.: Fundamentals of Renewable Energy Systems, New Age International Publishers, 2005

Syllabus for Internal Assessment Tests (IAT*)

IAT #	Syllabus
IAT-1	Class # 2– 16
IAT-2	Class # 17 – 36
IAT-3	Class # 37 – 44

*See calendar of events for IAT schedule.

Course Outcomes
By the end of this course, students will be able to
1. Distinguish the renewable and non- renewable sources of energy with advantages and disadvantages
2. Estimate solar radiation geometry
3. List the different applications of solar thermal systems
4. Summarize the different applications of wind energy and biomass energy
5. Demonstrate the working of tidal power plant and OTEC
6. Compare world and Indian energy scenario

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Distinguish the renewable and non-renewable sources of energy with advantages and disadvantages	**1**	2	2	1	1	-	2	3	-	-	-	-	2	2	3	3
CO2	Estimate solar radiation geometry	**2**	3	3	3	3	2	2	3	2	-	-	-	2	2	3	3
CO3	List the different applications of solar thermal and electrical systems	**3,4**	2	2	2	1	3	2	3	3	-	-	-	1	2	3	3
CO4	Summarize the different applications of wind energy and biomass energy	**5,6**	2	2	2	1	3	2	3	3	-	-	-	1	2	3	3
CO5	Demonstrate the working of tidal power plant and OTEC	**7**	3	2	3	1	3	2	3	2	-	-	-	2	2	3	3
CO6	Explain the principles of emerging technologies	**8**	3	2	3	2	3	2	3	3	-	-	-	2	2	3	3

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