INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

Department of Electrical and Electronics Engineering

COURSE DESCRIPTION FORMS

Course Title	**ELECTRICAL DISTRIBUTION SYSTEM**			
Course Code	**A70226**			
Regulation	**R15**			
Course Structure	**Lectures**	**Tutorials**	**Practical's**	**Credits**
	4	**1**	**2**	**3**
Course Coordinator	Dr. P Sridhar, Professor, EEE			
Team of Instructors	Dr. P Sridhar, Professor, EEE			

I. COURSE OVERVIEW:

This electrical distribution course introduces the components of the distribution system and the way in which the system delivers power to end-use customers. Included in the course are descriptions of key system components including single and three phase lines as well as wye and delta lines. The course also addresses the ways in which distribution systems are designed to serve various types of customer loads.

II. PREREQUISITES:

Level	Credits	Periods	Prerequisite
UG	4	4	Power System-I, Power System- II, Computer Methods in Power Systems.

III. COURSE ASSESSMENT METHODS:

a) Marks distribution:

Session Marks	University End Exam Marks	Total Marks
There shall be two mid tem examinations. Each id term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1to 4 units and the second, after the completion of 4 to 8 units each carrying 5 marks. On the total the internal marks are 25. The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of 8 questions each carrying 15 marks out of which 5 questions are to be answered their by external examination is of total 75 mark	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	90 minutes	20
2	I Assignment	--	05
3	II Mid Examination	90 minutes	20
4	II Assignment	--	05
5	External Examination	3 hours	75

V. COURSE OBJECTIVE:

The course should enable the students to:

i. To provide students with understand different types of power distributions systems and their usage in to days life.
ii. To familiarize students with protection and coordination of protective devices in distribution systems.
iii. To understand students how power factor can be improved and need for its improvement.
iv. To provide information on voltage control and how to achieve it.

VI. COURSE OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

1 Understand the distribution system planning and automation
2 Differentiate the types of loads and their characteristics.
3 Explain the design considerations of sub transmission lines**.**
4 Understand different loads and their characteristics and design the distribution feeders.
5 Design a radial and loop type distribution feeders.
6 Design substations and their optimal location
7 Understand the voltage drop and power loss in distribution lines using manual methods.
8 Apply various protective devices and its coordination techniques to distribution system.
9 Recognize the necessity of distribution system protection and devices available for discriminating faults Identify and design protection system
10 Discuss the need of power factor correction and voltage drop compensation.
11 Design a suitable capacitance for voltage control in a distribution System.
12 Evaluate voltage drop and line loss calculations and design the capacitors and voltage regulating equipment to improve the power factor and voltage profile**.**
13 Apply the concept of electromagnetic and electrostatic fields to solve real time world applications.
14 Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency Assessed By
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments and Exercise
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.	N	-----
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	H	Assignments, discussion
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.	N	-----
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.	N	------
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	S	Assignments, discussion
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.	N	-----
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	N	-----
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	N	-----
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.	N	-----
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.	N	-----
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.	S	Prototype, discussions

N= None **S=Supportive** **H=highly related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	H	Lectures, Assignments
PSO2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	N	-----
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	S	Seminars and Projects

N - None **S - Supportive** **H - Highly Related**

IX. SYLLABUS:

UNIT - I
INRODUCTION &GENERAL CONCEPTS:
Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, contribution factor loss factor - Relationship between the load factor and loss factor.
Classification of loads: Residential, commercial, agricultural and Industrial and their characteristics

UNIT - II
DISTRIBUTION FEEDERS &SUBSTATIONS:
Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.
Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

UNIT - III
Distribution System Analysis: Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines

UNIT - IV
Protective devices & co-ordination: Objectives of distribution system protection, types of common faults and procedure for fault calculations. **Protective Devices:** Principle of operation of Fuses, Circuit Recourses, and line sectionalizes, and circuit breakers
Coordination of Protective Devices: General coordination procedure

UNIT - V
Voltage Control & Power Factor Improvement: Voltage Control: Equipment for voltage control, effect of series capacitors, line drop compensation. line drop compensation. Effect of AVB/AVR, power-factor control. Using Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation - Economic justification - Procedure to determine the best capacitor location

X. TEXT BOOKS:

1. TuranGonen , “Electric Power Distribution system, Engineering”, McGraw-hill Book Company.
2. A S Pabla, “Electric Power Distribution”, Tata McGraw-hill Publishing Company, 4th Edition, 1997.

XI. REFERENCES:

1. Buckingham and price, "Electrical measurements", Prentice-hall.
2. V Kamaraju, "Electrical Power Distribution Systems", Right Publishers.

XII. COURSE PLAN:

The course plan is meant as a guideline. There may be probably be changes.

Lecture No.	Learning Objectives	Topic To Be Covered	Reference
1-2	To understand the significance of distribution systems and their characteristics	Introduction to distribution systems, Load modeling and characteristics	T1:25
3-4	To understand the coincidence factor	Coincidence factor contribution factor loss factor	T1:26-28
5-6	To understand the relation between the load factor and loss factor	Relationship between the load factor and loss factor	T1:29-31
7-8	To illustrate the different types of loads and their characteristics	Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics	T1:31-35
9	To understand the design of distribution feeders	Design Considerations of distribution feeders	T1:84
10	To understand radial and loop system	Radial and loop types of primary feeders	T1:85-86
11-12	To analyze the voltage levels for feeder loading	Voltage levels, feeder loading	T1:87-88
13-14	To understand basic design of secondary distribution system	Basic design practice of the secondary distribution system	T1:121-122
15	To understand establishing substation for different locations	Location of Substations	T1:132-133
16	To compute the rating of distribution system	Rating of distribution substation	T1:132-133
17-18	Summarize the service area with in primary feeders	Service area within primary feeders	T1:135-137
19-20	To understand the benefits of optimal location of substation	Benefits derived through optimal location of substations	T1:181-187
21-22	To understand power loss calculation	Voltage drop and power-loss calculations	T1:188-191
23-24	To understand the derivation of voltage drop and power	Derivation for voltage drop and power loss in lines	T1:188-191
25	To understand the manual methods for radial networks	Manual methods of solution for radial networks	T1:201-211
26	To understand the three phase balanced lines	three phase balanced primary lines	T1:201-211
27-28	To compute the objectives of distribution system protection	Objectives of distribution system protection	T1:203
29-30	Illustrate common faults and their fault calculations	Types of common faults and procedure for fault calculations	T1:222-225
31-32	To understand the principle and operation of fuses	Protective Devices: Principle of operation of Fuses, Circuit Reclosures	T1:284-286
33-34	To understand the line sectionalizes and circuit breakers	Line sectionalizes, and circuit breakers	T1:292
35-36	To understand the Fuse to Fuse coordination and its curves	Fuse to Fuse coordination and its curves, circuit breaker to circuit breaker coordination	T1:295-296
37-38	To know the knowledge of protective device	Coordination of Protective Devices: General coordination procedure.	T1:296-297
39	To know the operation of Fuse to relay	Fuse to Relay coordination	T1:296-

Lecture No.	Learning Objectives	Topic To Be Covered	Reference
	coordination		297
40	To understand the operation of Relay to relay co ordination	Relay to Relay coordination	T1:296-297
41	To understand the operation of Fuse to Circuit breaker co ordination	Fuse to circuit breaker coordination,	T1:298-299
42	To understand the circuit breaker to relay coordination	Circuit breaker to relay coordination	T1:298-299
43-44	To understand compensation for power factor control	Capacitive compensation for power-factor control	T1:325-327
45-46	To understand the different types of power capacitors	Different types of power capacitors, shunt and series capacitors	T1:335
47-48	To understand effect of shunt capacitors	Effect of shunt capacitors (Fixed and switched).	T1:337
49-51	To understand knowledge the power factor correction, capacitor allocation	Power factor correction, capacitor allocation - Economic justification	T1:342-345
52	To understand procedure to determine the best capacitor location	Procedure to determine the best capacitor location	T1:351
53-54	To understand knowledge of voltage control	Voltage Control: Equipment for voltage control, need for voltage control	T1:365
55	To compute effect of series capacitors	Effect of series capacitors	T1:372
56-57	To understand of effect of AVB/AVR, line drop compensation	Effect of AVB/AVR, line drop compensation	T1:383
58-59		Revision	

XIII. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
i	H					H							H		
ii	S		S			S						S	H		S
iii			H										S		
iv	S					S						S			H

S=Supportive H= highly related

XIV. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	S		S									S	S		
2			S									S			H
3	S					H							S		S
4			S									S			
5			H										H		H
6	S					S						H			

Course Outcomes	Program Outcomes												Program Specific Outcomes		
7	H					S							H		S
8	H											H	S		H
9			H									H			H
10	S					H							S		S
11	H					H									
12			S									S	S		H
13	S		H			S									S
14	S		H			S							S		

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Prepared by: Dr. P Sridhar, Professor, EEE

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