



INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION FORM

Course Title	POWER SYSTEMS-1			
Course Code	A40214			
Regulation	R15 – JNTUH			
Course Structure	Lectures	Tutorials	Practicals	Credits
	5	-	-	4
Course Coordinator	Dr. P. Mallikarjuna Sarma, Professor, EEE			
Team of Instructors	Dr. P. Mallikarjuna Sarma, Professor, EEE			

I. COURSE OVERVIEW:

This course deals with thermal, nuclear and gas power station, general aspects of DC and AC distribution systems-air and gas insulated sub-station-power factor and voltage control in power systems-economic aspects of power systems and tariff.

II. PREREQUISITES:

Level	Credits	Periods / Week	Prerequisite
UG	4	5	Knowledge of pumps, prime movers, renewable energy sources

III. COURSE ASSESSMENT METHODS:

a) Marks distribution:

Session Marks	University end Exam Marks	Total Marks
<p>There shall be two mid term examinations. Each mid term exam consists of subjective type and objective type test.</p> <p>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</p> <p>The objective test paper is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks.</p> <p>The student is assessed by giving two assignments, one, after completion of 1 to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25.</p> <p>The average of two internal tests is the final internal marks.</p> <p>The external question paper is set by JNTUH consisting of part –A and part-B. Where part consists of short answer questions carrying total marks of 25 and part part-B consists of 5 essay type questions consists</p>	75	100

of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.		
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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 OBJECTIVES

At the end of the course, the students will be able to:

- i. To attain the knowledge of layout and working of nuclear, thermal and gas of power systems.
- ii. To attain the knowledge of DC and AC distribution systems.
- iii. To attain the knowledge of layout and working of gas and air insulated of sub-station.
- iv. To attain the knowledge of how to improve power factor and voltage control.
- v. To attain the knowledge economic aspects of power systems and tariff.

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

- i. To attain the knowledge of layout and working of nuclear, thermal and gas of power systems.
- ii. To attain the knowledge of DC and AC distribution systems.
- iii. To attain the knowledge of layout and working of gas and air insulated of sub-station.
- iv. To attain the knowledge of how to improve power factor and voltage control.
- v. To attain the knowledge economic aspects of power systems and tariff.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program outcomes		Level	Proficiency Assessed by
PO1	General Knowledge: An ability to apply the knowledge of mathematics, science and Engineering for solving multifaceted issues of Electrical Engineering.	H	Assignments
PO2	Problem Analysis: An ability to communicate effectively and to prepare formal technical plans leading to solutions and detailed reports for electrical systems.	S	Exercises
PO3	Design / Development of Solutions: To develop Broad theoretical knowledge in Electrical Engineering and learn the methods of applying them to identify, formulate and solve practical problems involving electrical power.	S	Assignments
PO4	Conduct Investigations of Complex Problems: An ability to apply the techniques of using appropriate technologies to investigate, analyze, design, simulate and/or fabricate/commission complete systems involving generation, transmission and distribution of electrical energy	N	-----

PO5	Modern Tool Usage: An ability to model real life problems using different hardware and software platforms, both offline and real-time with the help of various tools along with upgraded versions.	S	Prototypes
PO6	The Engineer and Society: An Ability to design and fabricate modules, control systems and relevant processes to meet desired performance needs, within realistic constraints for social needs.	H	Design exercise
PO7	Environment and Sustainability: An ability To estimate the feasibility, applicability, optimality and future scope of power networks and apparatus for design of eco-friendly with sustainability	H	Seminars, Discussions
PO8	Ethics: To Possess an appreciation of professional, societal, environmental and ethical issues and proper use of renewable resources.	N	-----
PO9	Individual and Team Work: an Ability to design schemes involving signal sensing and processing leading to decision making for real time electrical engineering systems and processes at individual and team levels	N	-----
PO10	Communication: an Ability to work in a team and comprehend his/her scope of work, deliverables , issues and be able to communicate both in verbal ,written for effective technical presentation.	S	Seminars, Discussions
PO11	Life-Long Learning: An ability to align with and upgrade to higher learning and research activities along with engaging in life-long learning.	H	Workshops, Seminars
PO12	Project Management and Finance: To be familiar with project management problems and basic financial principles for a multi-disciplinary work.	S	Seminar, 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.	S	Projects
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	Projects

N - None

S - Supportive

H- Highly Related

IX. SYLLABUS:

UNIT I:

Power Stations:

Thermal power station: Line diagram of Thermal power station showing paths of coal, steam, water, air, ash and Flue gases. Brief description of TPS components-Economizer, Boiler, super heater, turbines, condensers, chimney and cooling towers Nuclear power stations:

Nuclear fission and chain reaction, nuclear fuels , principle of operation of nuclear reactor , reactor components – moderators, control rods, reflectors and coolants , radiation hazards-shielding and safety precautions, types of nuclear reactors and brief description of PWR ,BWR and FBR Gas power stations: principle of operation and components (Block diagram)

UNIT II:

General aspects of D.C & A.C Distribution systems:

Classification of distribution systems- comparison of DC vs Ac and underground vs over-head distribution systems- voltage drop calculations (numerical problems) in D.C distribution for the following cases: Radial D.C distributor fed one end and at the both ends (equal/unequal voltages) and Ring main distributor. Voltage drop calculations (numerical problems) in A.C Distributors for the following cases: power factor referred to receiving end voltage and with respect to respective load voltages.

UNIT III:

Air insulated & gas insulated (GIS) substations

Classifications of sub stations:-indoor & outdoor substations: substations layout showing the location of all the substation equipment. Bus bar arrangement in the sub-stations: simple arrangements of like single bus-bar, sectionalized single bus-bar ,main and transfer bus-bar system with relevant diagrams. Advantages of Gas insulated substations, different types of gas insulated substations, single line diagrams of gas insulated substations, bus bar, construction aspects of GIS, installation and maintenance of GIS comparison if Air insulated substations and Gas insulated substations

UNIT IV:

Power factor & voltage control:

Causes of low power factor –methods of improving power factor –phase advancing and generation of reactive KVAR using static capacitor-most economical power factor for constant KW load and constant KVA type loads, Numerical problems. Dependency of voltage on reactive power flow-methods voltage control: shunt capacitor, series capacitors, synchronous capacitors Tap changing and Booster Transformers

UNIT V:

Economic Aspects of power generation& Tariff:

Load curve, load duration and integrated load duration curve-load, diversity, capacity, utilization and plant use factors- Numerical problems. Costs of generation and their division into fixed, semi fixed and running costs. Desirable characteristics of tariff method- Tariff methods: Flat rate, block rate, two-part, and power factor tariff methods and numerical problems

X. TEXT BOOKS:

1. Principles of Power Systems, BY V. K. Mehta and Rohit Mehta. S. chand
2. Electrical power systems by PSR. Murthy, BSP.

XI. REFERENCES:

1. A text book of power system engineering,R.K.Rajput,LP.
2. Electrical power systemsC.L.Wadhwa,new age .
3. Generation of electrical energy,Dr.BR.Gupta,S.Chand

XII. COURSE PLAN:

Lecture No.	Learning objectives	Topic to be Covered	Reference
1	To know Explanation of TPS line diagram	Explanation of TPS line diagram	T1
2	To know Description of economizer and its function	Description of economizer and its function	T1
3	To know Types of boilers and comparison	Types of boilers and comparison	T1
4	To know Functions of super heater and condenser	Functions of super heater and condenser	T1
5	To know Types of steam turbine with neat diagram	Types of steam turbine with neat diagram	T1
6	To know Description of chimney and cooling tower	Description of chimney and cooling tower	T1
7	To know Explanation of nuclear fission, fusion and chain reaction	Explanation of nuclear fission, fusion and chain reaction	T1R2
8	To know Principle of operation nuclear reactors and its components	Principle of operation nuclear reactors and its components	T1
9	To know Nuclear radiation hazards	Nuclear radiation hazards	T1R2
10	To know Types of nuclear reactors	Types of nuclear reactors	T1R3
11	To know Explanation of pressurized water reactor and fast breeder reactor.	Explanation of pressurized water reactor and fast breeder reactor.	T1
12	To know Principle of operation of gas sub-station	Principle of operation of gas sub-station	T1
13	To know Methods of improving thermal efficiency by regenator, inter cooling ,reheating	Methods of improving thermal efficiency by regenator, inter cooling ,reheating	T1
14	To know Revision of TPS components	Revision of TPS components	T1
15	To know Status of current thermal power stations	Status of current thermal power stations	T1R2
16	To know Classification and comparison of DC and AC distribution systems	Classification and comparison of DC and AC distribution systems	T1R2
17	To know Design features of distribution systems	Design features of distribution systems	T1

18	To know Problems on radial distribution fed at one end	Problems on radial distribution fed at one end	T1R3
19	To know Problems on radial distribution fed at both ends with equal voltages	Problems on radial distribution fed at both ends with equal voltages	T1R3
20	To know Problems on radial distribution fed at both ends with unequal voltages	Problems on radial distribution fed at both ends with unequal voltages	T1R2
21	To know Problems on ring distribution	Problems on ring distribution	T1R2
22	To know Problems on ac distribution for power factor referred to receiving end voltages	Problems on ac distribution for power factor referred to receiving end voltages	T1R3
23	To know Problems on ac distribution for power factor referred to the respective load voltages	Problems on ac distribution for power factor referred to the respective load voltages	T1R2
24	To know Explanation of feeder, distributor, service mains	Explanation of feeder, distributor, service mains	T1
25	To know Problems on uniformly distributed load distributor	Problems on uniformly distributed load distributor	T1
26	Tutorial	Tutorial	T1
27	Problems	Problems	T1R3
28	Revision of unit	Revision of unit	T1
29	To know Classification of sub-station	Classification of sub-station	T1
30	To know Equipment in substation and their explanation and their location	Equipment in substation and their explanation and their location	T1
31	To know Bus bars and their function, arrangement of single bus bar, sectionalized bus bar with diagram their advantages and disadvantages	Bus bars and their function, arrangement of single bus bar, sectionalized bus bar with diagram their advantages and disadvantages	T1
32	To know Arrangements of main and transfer busbars with diagram.	Arrangements of main and transfer bus bars with diagram.	T1
33	To know Advantages of gas insulated sub station	Advantages of gas insulated sub station	T1
34	To know Single diagram of GIS	Single diagram of GIS	T1
35	To know Installation and maintenance of GIS	Installation and maintenance of GIS	T1
36	To know Disadvantages of low power factor and causes of low power factor	Disadvantages of low power factor and causes of low power factor	T1
37	To know Methods of improving power factor	Methods of improving power factor	T1
38	problems	problems	T1R2

39	derivation of most economical power factor for constant KW load	derivation of most economical power factor for constant KW load	T1R3
40	To know derivation of most economical power factor for constant KVA load	derivation of most economical power factor for constant KVA load	T1R3
41	problems	problems	T1R2
42	To know Dependency of voltage on reactive power flow	Dependency of voltage on reactive power flow	T1R3
43	To know Methods of voltage control	Methods of voltage control	T1
44	To know Voltage control by synchronous condenser	Voltage control by synchronous condenser	T1
45	To know Voltage control by tap changing and booster transformer	Voltage control by tap changing and booster transformer	T1
46	To know Definitions related demand	Definitions related demand	T1
47	To know Plant capacity factor, plant use factor, load curve	Plant capacity factor, plant use factor, load curve	T1
48	Problems	Problems	T1R3
49	To know Significance of load and diversity factors	Significance of load and diversity factors	T1
50	To know Load duration curve ,integrated load duration curve, mass curve	Load duration curve ,integrated load duration curve, mass curve	T1
51	Problems	Problems	T1R3
52	To know Base load and peak load stations	Base load and peak load stations	T1
53	To know Costs of generator, fixed cost, semi-fixed cost and running cost	Costs of generator, fixed cost, semi-fixed cost and running cost	T1
54	To know Desirable characteristics of tariffs, types of tariffs	Desirable characteristics of tariffs, types of tariffs	T1
55	To know Flat, block rate and 2 port tariffs	Flat, block rate and 2 port tariffs	T1
56	To know Types of power factor tariffs	Types of power factor tariffs	T1
57	problems	problems	T1R3
58	problems	problems	T1R2
59	Problems	Problems	T1R2
60	Revision of unit	Revision of unit	T1
61	Review of previous question papers	Review of previous question papers	T1
62	Review of previous question papers	Review of previous question papers	T1

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		S	S			H	H			S	H	S	H		S
II	H	H			S	S	S			S	S	S	S	H	S
III		S	S			H	H			S	H	S	H	S	
IV	H	H	S		S	S	S			S	S	S		S	
V		H				S	S			S	H	S	H		S

S – Supportive

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	H	H			S	H	S	H		S
2	S	S	S		S						S	S	H	S	S
3	H	H				S				S	S	S	S	S	
4	H	H			S							S	S	S	S
5	S	S	S							S	S			H	

S – Supportive

Prepared by: Mr. P. Mallikarjuna Sarma, Assistant professor

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