7. SUBJECT DETAILS

7.4 POWER SYSTEMS-I

7.4.1 Objective and Relevance

7.4.2 Scope

7.4.3 Prerequisites

7.4.4 Syllabus

i. JNTU

ii. GATE

iii. IES

7.4.5 Suggested Books

7.4.6 Websites

7.4.7 Experts' Details

7.4.8 Journals

7.4.9 Findings and Development

7.4.10 Session Plan

i. Theory

ii. Tutorial

7.4.11 Student Seminar Topics

7.4.12 Question Bank

i. JNTU

ii. GATE

iii. IES

7.4.1 OBJECTIVE AND RELEVANCE

The main objective of this course is to expose the students in to the field of power systems engineering.This course provides a wide coverage of working principle and design considerations of various power plants, analysis of AC and DC distributors, working and layout of different types of substations, necessity of improving the power factor and different methods available for reactive power compensation. Electrical power plays significant role in day to day life of entire mankind. This course concerns the generation and distribution of power alongwith the economics aspects.

7.4.2 SCOPE

The scope of this subject is to provide a deep knowledge in working and design considerations of power plan ts, distribution system and substations .It also provides a clear and concise exposure to the necessity of improving th e power factor and voltage control by adopting different methods of reactive power compensation. It also provides a basic knowledge about cost of power generation and different types of tariff system in electrical power generations and distribution suytems.

7.4.3 PREREQUISITES

It requires knowledge of Network theory basic principle of operation of prime movers an d turbines and applied mathematics.

7.4.4.1 JNTU SYLLABUS

UNIT-I
OBJECTIVE
The objective of this unit is to provide a basic knowledge on layout of thermal power plan t. It also provides an exposure to the relevant aspects of thermal power plant and the functions of power plant accessor ies. Provide a basic knowledge on working and layout of nuclear and gas power plan ts. This also provides an exposure to the various aspects of nuclear fission and chain reaction, types of nuclear reactors.

SYLLABUS
THERMAL POWER STATIONS & GAS AND NUCLEAR POWER STATIONS
Line diagram of Thermal Power Station (TPS) showing paths of coal, steam, water, air, ash and flue gasses. Brief description of TPS components: Economizers, Boilers, Super heaters, Tur bines, Condensers, Chimney and cooling towers.
Nuclear Power Stations: Nuclear Fission and Chain reaction. Nuclear fuels.- Principle of operation of Nuclear reactor. Reactor components : Moderators, Contol 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 approach only)

- Author:Sathya Sai Baba

"Love all. Serve all. Help ever. Hurt never."

UNIT-II

OBJECTIVE

The objective of this unit used to provide the classifications, comparison of different distribution systems, requirements and design considerations and voltage drop calculations in D.C distributors. Provides the voltage drop calculations in A.C distributors and importance of power factor management.

SYLLABUS

GENERAL ASPECTS OF DISTRIBUTION SYSTEMS AND D.C. DISTRIBUTION SYSTEMS

Classification of the distribution systems, Comparision of DC vs AC and Under-ground vs. Over-head distribution systems. Requirements and design features of distribution systems. Voltage drop calculations (numerical problems) in D.C. distributors for the following cases: Radial D.C. distributor fed for one end and at the both ends (equal/unequal voltages) and ring main distributor.

A.C. DISTRIBUTION SYSTEMS

Voltage drop calcutations (numerical problems) in A.C, Distributors for the following cases: Power factors reffered to recieving end voltage and with respect ot respective load voltages.

UNIT-III

OBJECTIVE

The objective of this unit is to provide a basic knowledge about working of different types of substations and layout and bus bar arrangements in the substations.

SYLLABUS

SUBSTATIONS

Classification of substations: Air insulated substations. Indoor and outdoor substations: Substations layout showing the location of all the substation equipment.

Bus bar arrangements in the Sub-stations: Simple arrangements like single busbar, sectinalized single bus bar, main and transfer bus bar, system with relevant diagrams.

Gas insulasted substations(GIS), Advantages of gas insulated substations, different types of gas insulated substations, single line diagram of gas insulated subsstations, bus bar, construction aspects of GIS, In stallation and main tenance of GIS, Comparision of the Air insulated substations and gas insulated substations.

UNIT-IV

OBJECTIVE

The objective of this unit is to provide the knowledge on the importance of the power factor methods to improving the power factor and management of reactive power flow.

SYLLABUS

POWER FACTOR AND VOLTAGE CONTROL

Causes for low p.f.,-Methods of Improving p.f.-Phase advancing and generation of reactive KVAR using static capacitors, Most economical p.f. for constant KW load and constant KVA type loads, numerical problems.

Dependency of voltage on reactive power flow - methods of voltage control: Shunt capacitors, Series Capacitors, synchronous capacitors, tap changing and booster Transformers.

"I decided to get involved with kindness because it is the foundation of what a safe community is based on."

- Author:Rita, Education Administrator, CO

UNIT-V

OBJECTIVE

The objective of this unit is to provide the various factors of the economical operations of the power systems,discuss various costs / tariffs encountered in the operation of the power systems.

SYLLABUS

ECONOMIC ASPECTS OF POWER GENERATION

Load curve, load duration and integrated load duration curves-load, demand, diversity, capacity, utilization and plant use factors, Numerical problems

TARIFF METHODS

Costs of genration and their division into fixed, semi-fixed and running costs. Desirable charecteristics of a tariff method, tariff methods: Flat rate, Block-rate, two-part, three-part and power factor tariff methods and nemerical problems.

7.4.4.2 GATE SYLLABUS

UNIT-I

Thermal Power Plant.
Nuclear Power Plant.

UNIT-II

Distribution Systems

UNIT-III

Protection of Transformers, lines, busbars and generators.

UNIT-IV

Voltage control and power factor corrections.

UNIT-V

Economic operations.

"Random Acts of Kindness is the most exciting thing I've ever done. It has changed my life. People are so receptive. It just grows and grows!" - Author:Betty, Community Organizer, WA

7.4.4.3 IES SYLLABUS

UNIT-I

Thermal Power Plant.
Nuclear Power Plant.

UNIT-II

Not Covered.

UNIT-III

Not Covered.

UNIT-IV

Voltage control

UNIT-V

Economic Operations.

7.4.5 SUGGESTED BOOKS

TEXT BOOKS

T1 A Text Book on Power System Engineering, M.L.Soni,P.V.Gupta,U.S.Bhatnagar and A.Chakraborti, Dhanpat Rai & Co. Pvt. Ltd., 1999.
T2 Principles of Power Systems, V.K. Mehta and Rohit Mehta, S. Chand & Company Ltd., New Delhi 2004.

REFERENCE BOOKS

R1 Elements of Power Station design and practice, M.V. Deshpande, Wheeler Publishing.
R2 Electrical Power Systems, C.L.Wadhawa, New age International (P) Limited Publishers 1997.
R3 Electrical Power Generation, Transmission and Distribution, S.N.Singh., PHI, 2003.
R4 Gas turbine performance, PP Wals, P.Fletcher, Blackwell Publisher, 2004.

7.4.6 WEBSITES

1. www.ee.washington.edu
2. www.esca.com
3. www.ne.ac.sg
4. www.iitb.ac.in
5. www.annauniv.edu
6. www.ieeecss.org
7. www.ieee.com

"Kindness builds self-esteem. It provides students with an opportunity to feel pride in who they are and in what they do." - Author:Janice, Teacher, NJ

7.4.7 EXPERTS' DETAILS

INTERNATIONAL

1. H.Song
   ALSTOM
   ESCA, Bellevue, WA 98004, USA
   email: haili.song @esca.com

2. C C Liu
   Dept. of Electrical Engineering
   University of Washington
   Seattle, WA 98195, USA
   email: liu@ee.washington.edu

NATIONAL

1. Prof. R. Vaidyalingam
   Department of Electrical and Electronics
   SSN College of Engineering
   Old Mahabalipuram Road
   SSN Nagar, PIN - 603110, Tamilnadu, India
   email : info@ssnce.ac.in

2. Prof. Mangal Wadekar
   Department of Electrical Engineering
   V J T I, Matunga
   University of Mumbai
   Mumbai
   Website: www.vjti.ac.in

REGIONAL

1. Prof. M. Vijayakumar
   Associate Professor, Electrical Engg. Department
   JNTU College of Engineering
   Ananthapur, A.P.
   www.jntu.ac.in

2. Prof. B.V. Sankar Ram
   Professor
   Electrical Engg. Dept.
   JNTU College of Engineering
   Kukatpally, Hyderabad
   www.jntu.ac.in

7.4.8 JOURNALS

INTERNATIONAL

1. IEEE Transactions on Power Systems
2. IEEE Transactions on Power Delivery
3. IEEE Transactions on Energy Conversion
4. Institution of Electrical Engineers

NATIONAL

1. Institution of Engineers (India)
2. System Society of India

7.4.9 FINDINGS AND DEVELOPMENTS

1. "Environmental Impact of Power Generation: Issues in Environmental Science and Technology" edited by R. E. Hester, R.M. Harrison - Science - Page 11, 1999.
2. "Power Gen eration Retrofitting: Optimising Power Plant Performan ce" edited by Paul Winkle - Technology - 148 pages, 2005
3. "Composite power system reliability evaluation using genetic algorithm" by P. Raja Rajeswari, P. Renuga and Dr. N.Ramaraj at NACPED -05, Govt. College of Engineering, Thirunelveli, TN, PP 65, 20th April, 05.
4. "Economic load dispatch: An evolutionary programming Approach" by S. Prabakaran, G.Baskar at NACPED -05, Govt. College of Engineering, Thirunelveli, TN, PP 109, 20th April, 05.
5. "Short term load forecasting using ANN and WNN" by M. Ulagammai, Dr. P.Venkatesh and Dr. P.S.Kannan, S.Ravi Chandran at NACPED -05, Govt. College of Engineering, Thirunelveli, TN, PP 132, 20th April, 05.
6. "Optimal Load Shedding in Interconnected Power System" by P. Raddhaakrushna, Mrs. P. Kalpana, at NCAEE-2005, Bharath Instt. of Higher Education & Research, Chennai, PP 225-231, 16th March, 2005.
7. "A New Load Flow Technique for Radial Distribution System" by K.S. Vaithiyalingam, Y. Mohemed Shuaib, at NCAEE-2005, Bharath Instt. of Higher Education & Research, Chennai, PP 232-239, 16th March, 2005.

7.4.10. SESSION PLAN

i. Theory

Sl. No.	Topics in JNTU Syllabus	Modules and Sub modules	Lecture No.	Suggested Books	Remarks
		UNIT - I			
1	Line diagram of Thermal Power Station showing paths of coal, steam, water, air, ash and flue gases.	Objectives, Introduction-TPS Schematic layout of a typical coal fired TPS	L1	T2-Ch1, T1-Ch2 R3-Ch5, R5-Ch1.1.8	GATE IES
		Main parts of thermal power plant and their functions	L2	T2-Ch2, T1-Ch2 R3-Ch5, R5-Ch1.1.8	GATE IES
		Coal storage and coal handling Ash storage and ash handling	L3	T1-Ch2, R3-Ch5 R5-Ch1.1.8	GATE IES
2	Brief description of TPS components: Economizers, boilers, super heaters, turbines, condensers, chimney and cooling towers.	Economizers Boilers Air preheaters, super heaters and reheaters	L4	T2-Ch2, T1-Ch2 R3-Ch5, R5-Ch1.1.8	GATE IES
		Turbines, condensers spray pond cooling towers and chimney	L5	T2-Ch2, T1-Ch2 R3-Ch5, R5-Ch1.1.8	GATE IES
3	Nuclear fission and chain reaction, Nuclear fuels, Principles of operation of Nuclear reactor.	Objectives, Introduction Nuclear fission and chain reaction Principle operation and line diagram of nuclear reactor	L6	T2-Ch2, T1-Ch4 R3-Ch7, R5-Ch1.1.9	GATE IES
4.	Reactor components: Moderators, Control rods, Reflector and Coolants, Radiation hazards, Shielding and safety precautions.	Components of nuclear plant Control rods functions Reflectors functions Coolants functions Radiation hazards Shielding and safety precautions	L7	T1-Ch4, R3-Ch7 R5-Ch1.1.9	GATE IES
5	Types of Nuclear reactors and brief description of PWR, BWR and FBR	Nuclear reactor types Boiling water reactor	L8	T1-Ch4,R3-Ch7 R5-Ch1.1.9	GATE IES
		Pressurized water reactor Fast breeder reactor Comparison of thermal and fast breeder reactor	L9	T1-Ch4, R3-Ch7 R5-Ch1.1.9	GATE IES
6	Gas power station: Principle of operation and components (block diagram approach only).	Introduction to gas power station Principle operation of GPS	L10	T2-Ch2, T1-Ch6 R3-Ch8, R5-Ch1.1.10	
		Layout diagram and components Advantages of gas turbine plants over steam plants	L11	T2-Ch2, T1-Ch6 R5-Ch1.1.10	

Do thou restrain the haughty spirit in thy breast, for better far is gentle courtesy.

- Homer

Sl. No.	Topics in JNTU Syllabus	Modules and Sub modules	Lecture No.	Suggested Books	Remarks
		UNIT-II			
7	Classification of distribution systems, Comparison of DC vs. AC distribution systems.	Objectives, Introduction A.C distribution D.C distribution Methods of obtaining D.C three wire systems	L12	T2-Ch12, T1-Ch14 R3-Ch16, R5-Ch13	IES
8	Underground vs. Over head distribution systems, Requirements and design features of distribution systems.	Overhead vs. Underground systems Connection schemes of distribution systems	L13	T2-Ch12, T1-Ch14 R3-Ch16, R5-Ch3	IES
		Requirements of distribution systems Design consideration in Distribution systems	L14	T2-Ch12, T1-Ch14 R3-Ch16, R5-Ch3	IES
9	Voltage drop calculations (numerical problems) in D.C distributors for the following cases: Radial DC distributors fed one end and at the both ends (equal / un-equal voltages)	Types of D.C distributor Radial D.C distributor fed at one end	L15	T2-Ch13, T1-Ch14 R3-Ch16, R5-Ch3	
		Numerical problems	L16	T2-Ch13, T1-Ch14 R3-Ch16, R5-Ch3	
		Radial D.C distributor fed at both ends with equal voltages	L17	T2-Ch13, R3-Ch16	
		Problems	L18	T2-Ch13, R3-Ch16	
		Radial D.C distributor fed at both ends with unequal voltages and problems	L19	T2-Ch13, R3-Ch16	
10	Ring main distributor	Ring main distributor	L20	T2-Ch13, T1-Ch14 R3-Ch16, R5-Ch3	
		Problems on ring main distributor	L21	T2-Ch13, T1-Ch14 R3-Ch16, R5-Ch3	
11	Voltage drop calculations (numerical problems in A.C. distributors) for the following cases: Power factors referred to receiving end voltage	Objectives, Introduction Voltage drop calculations in AC distribution systems	L22	T2-Ch14, T1-Ch14 R3-Ch16, R5-Ch3	
		Different cases: Power factor referred to receiving end voltage	L23	T2-Ch14, T1-Ch14 R3-Ch16, R5-Ch3	
		Numerical problems	L24	T2-Ch14, T1-Ch14 R3-Ch16, R5-Ch3	
		Numerical problems	L25	T2-Ch14, T1-Ch14 R3-Ch16, R5-Ch3	
12	Power factors referred to with respect to respective load voltage	Power factor referred to the respective load voltages	L26	T2-Ch14, T1-Ch14 R3-Ch16	
		Numerical problems	L27	T2-Ch14, R3-Ch16	
		Numerical problems	L28	T2-Ch14, R3-Ch16	

I detest that man who hides one thing in the depths of his heart, and speaks for another.

- Homer, The Iliad

Sl. No.	Topics in JNTU Syllabus	Modules and Sub modules	Lecture No.	Suggested Books	Remarks
		UNIT-III			
13	Classification of substations : Air insulated substations, indoor and outdoor substations.	Objectives, Introduction Types of substations Indoor and outdoor substations	L29	T2-Ch25, T1-Ch15 R3-Ch17, R5-Ch3.3.5	
14	Substations layout showing the location of all the substation equipments Bus bar arrangements in the substations : Simple arrangements like single bus bar, Sectionalized single bus bar, main and transfer bus bar system with relevant diagram.	Layout of substation Description of each equipment Single bus scheme	L30	T2-Ch25, T1-Ch15 R3-Ch17, R5-Ch3.3.5	
		Sectionalized bus bar scheme Main and transfer bus bar system	L31	T2-Ch25, T1-Ch15 R3-Ch17, R5-Ch3.3.5	
15	Gas insulated substations (GIS): Advantages of gas insulated substations, Different types of gas insulated substations, Single line diagram of gas insulated substations	Introduction to GIS Advantages of GIS Types of GIS Single line diagram of GIS	L32	R3-Ch5	
16	Construction aspects of GIS, Installation and maintenance of GIS, Comparison of air insulated substations and gas insulated substations	GIS-Construction GIS installation and maintenance	L33	R3-Ch5	
		Comparison between air and gas insulated substations	L34	R3-Ch5	
		UNIT- IV			
17	Causes of low PF, Methods of improving PF, Phase advancing and generation of reactive KVAR using static capacitors.	Objectives, Introduction Power factor, its significance and causes Disadvantages of low PF	L35	T2-Ch16	GATE
		Methods of improving PF: Phase advancers Static capacitors and synchronous condensers	L36	T2-Ch6	GATE
		Numerical problems	L37	T2-Ch6	GATE

Self-pity is our worst enemy and if we yield to it, we can never do anything good in the world.

- Helen Keller

Sl. No.	Topics in JNTU Syllabus	Modules and Sub modules	Lecture No.	Suggested Books	Remarks
18	Most economical PF for constant KW load and constant KVA type loads, Numerical problems.	Derivation of PF for constant KW and KVA loads	L38	T2-Ch6	GATE
		Numerical problems	L39	T2-Ch6	GATE
19	Dependency of voltage on reactive power flow: Methods of voltage control shunt capacitors, series capacitors, Synchronous capacitors	Voltage imbalance due to reactive power Voltage control methods	L40	T2-Ch15, R2-Ch10	GATE IES
		Series capacitors Shunt Capacitor Synchronus condensers	L41	T2-Ch15, R2-Ch10	GATE IES
		Numerical problems	L42	T2-Ch15, R2-Ch10	GATE IES
20	Tap changing and booster transformers	Tap changing transformer Numerical problems	L43	T2-Ch15, R2-Ch10	GATE IES
		Booster transformer Numerical problems	L44	T2-Ch15, R2-Ch10	GATE IES
		UNIT-V			
21	Load Curve, Load duration and integrated load duration curves - load, demand, and diversity.	Objectives, Introduction Load curves Load duration curves integrated load duration curve demand and diversity factors	L45 L46	T1-Ch7, R5-Ch2	GATE IES
22	Capacity, Utilization and plant use factors, Numerical problems.	Plant capacity factor Utilization factor Plant use factor	L47	R5-Ch2	GATE IES
		Numerical problems	L48	R5-Ch2	GATE IES
		Numerical problems	L49	R5-Ch2	GATE IES
23	Cost of generation and their division in to fixed, Semi fixed and running costs	Objectives, Introduction Generation cost: Fixed Semi fixed Running cost	L50	T2-Ch5, R3-Ch4 R5-Ch2	
24	Desirable characteristics of a tariff method, Tariff methods: Flat rate, Block rate, Two part, Three part.	Types of tariff: Simple tariff Flat rate tariff.	L51	T2-Ch5, R3-Ch4 R5-Ch2	
		Block rate Two part tariff Three part tariff Maximum Demand tariff	L52	T2-Ch5, R3-Ch4 R5-Ch2	
25	Power factor tariff methods and numerical problems.	Power factor method tariff Numerical problems	L53	T2-Ch5, R3-Ch4 R5-Ch2	
		Numerical problems	L54	T2-Ch5, R3-Ch4 R5-Ch2	

Smell is a potent wizard that transports you across thousand of miles and all the years you have lived.

- Helen Keller

ii. TUTORIAL

Sl. No.	Topics Schedule	Topics to be covered in the Tutorial
T1	Thermal power station-working, functions of each components	Different types of questions which are coming in the examinations on each sub topics and how to attempt these questions. Assignment questions discussions.
T2	Nuclear power station- working, different controls, functions of each components, types of reactors	Different types of questions which are coming in the examinations on each sub topics and how to attempt these questions. Clarification of doubts on the topics covered in which they are facing difficulty.
T3	DC distribution-types, requirements, design features	Discussion on distribution design aspects Clarification of doubts, Assignments questions discussions
T4	Voltage drop calculations in DC distributions-Radial and ring	Voltage drop calculations in D.C distributors fed at one end. Voltage drop calculations in D.C distributors fed at both ends with equal voltages Numerical problems, assignment questions discussion
T5	Voltage drop calculations in AC distributions-Referred to receiving end	Voltage drop calculations in A.C distributors with respect to the power factor referred to the receiving end voltage. Numerical problems, assignment questions discussion
T6	Substations types, layouts, bus-bar arrangements	Discussions on single bus-bar sectionalized single bus-bar, main and transfer bus-bar. Assignment questions discussion
T7	Gas insulated substations-Types, working principle, different components	Discussions on constructions, operations, maintenance of GIS Doubts clarification and assignments questions discussions
T8	Power factor improvement-Different methods, causes	Generation of reactive power using different methods Methods of improving power factor Doubts clarification and assignments questions discussions
T9	Economical power factor for constant kW load and constant KVA loads	Finding most economical power factor Numerical problems Doubts clarification
T10	Dependency of voltage control on reactive power flow, voltage control methods.	Necessity of reactive power flow Dependency of voltage on reactive power flow Numerical problems and assignment questions discussions
T11	Load curve, load duration and integrated load duration curves, demand and diversity factor	Doubts clarification and assignments questions discussions
T12	Different types of cost of generation, different types of tariffs	Numerical problem solutions and discussions

7.4.11 STUDENT SEMINAR TOPICS

1. Distribution automachine in urban systems "IEEE power and energy magzine volumes", July/Aug. 2007.
2. "Power Generation Retrofitting: Optimising Power Plant Performance" edited by Paul Winkle - Technology - 148 pages, 2005.
3. Policy frame work and electricity tariff in India "IEEE power and energy magzine volumes", July/Aug. 2007.
4. "Environmental Impact of Power Generation: Issues in Environmental Science and Technology" edited by R. E. Hester, R.M. Harrison - Science, Page 11- 1999.
5. Micro grids "IEEE power and energy magzine volumes", July/Aug. 2007.
6. Two stage pattern recognization of load curves for classification of electricity customers "IEEE transaction on power system" Vol. 22, August 2007.
7. "Economic load dispatch: An evolutionary programming Approach" by S. Prabakaran, G.Baskar at NACPED -05, Govt. College of Engineering, Thirunelveli, TN, PP 109, 20th April, 05.

7.4.12. QUESTION BANK

UNIT - I

5. Draw a general layout of a modern thermal power plant and explain the working of different circuits. **(May 09, 08, 07)**

30. With neat diagrams explain the working of
    i. Economizer
    ii. Super heater
    iii. Electro static precipitator
    iv. Condensor
    v. Cooling tower **(May 09)**

1. i. What are the types of chimneys and discuss each type in thermal plants. **(Sep 08)**
   ii. Explain the super heaters.

2. i. What are the types of super heaters and explain the convection type super heater. **(Sep 08)**
   ii. Discuss function of condenser and where it is located.

3. i. What are the requirements of a boiler being used for a power station? How do you classify them?
   ii. Explain briefly horizontal straight water tube boiler. What are its merits against fire tube boiler? **(Sep 08, Sep, May 07, Apr 04, 03)**

4. i. Explain the function of chimney and precipitator. **(Sep 08, Apr 04, Nov, Apr 03)**
   ii. Discuss the need of cooling towers and list out various types of cooling towers.

6. Draw the complete schematic diagram of a coal fired thermal power plant. Label each component. Discuss briefly the function of each component. **(May 08, 07)**

7. i. What is meant by fire tube boilers and what are the types as well as demerits of fire tube boilers?
   ii. Explain the super heater in thermal plants. **(May 08)**

8. Draw a typical layout of a thermal power plant and describe the function of the following components.
   i. Coal and ash handling
   ii. Steam generating plant

The price good men pay for indifference to public affairs is to be ruled by evil men.

- Plato

iii. Steam turbines
iv. Feed water circuit
v. Cooling tower circuit. **(May 08)**

9. i. What are the methods for arresting ash from flue gasses ? Explain any one method in detail,
ii. Discuss the natural and forced draughts and list out the difference between them. **(May 07, Apr 05)**

10 Describe the schematic arrangement of a thermal power station and explain the function of each briefly. **(Sep, May 07, Apr 05)**

11. i. What is the use of an electron precipitator along with the modern boilers? Explain its working. **(May 07)**
ii. What is 'feed water'? What are the problems due to impurities in feed water? How they can be eliminated?

12. Draw the one line diagram of a thermal station indicating the various circuits and also briefly discuss the main components of station. **(May 07)**

13. Explain the functions of Economizer and super heater in a thermal power plant with neat diagrams. **(Apr 05, 04, Nov, Apr 03)**

14. What do you understand by dry bottom furnace and wet bottom furnace? Explain with relevant diagrams. **(Apr 04, Apr 03)**

15. What are the systems used in firing of the boilers? Explain by giving sketches. Also mention the advantages and disadvantages of pulverizing the fuel used in boilers? **(Apr 04, Nov 03)**

16. i. Explain with neat diagram the concept of regenerative heating and mention its advantages.
ii. Discuss the natural and forced draughts and list out the difference between them. **(Apr 04, Nov 03)**

17. Describe working of PWR (pressurized water reactor). What are its advantages and disadvantages? **(Nov 03)**

18. Discuss steam station controls with reference to boiler control, turbine control and electrical control. **(Apr 03)**

19. Write notes on auxiliaries of boilers. **(Apr 03)**

20. What is the function of air preheaters in a steam power plant? Where are they located? **(Apr 03)**

21. What is the function of an economizer, air pre hectors in a thermal plant. **(Nov 04 O.U)**

22. Name any four main auxiliary equipment used in thermal plants **(Nov 04 O.U)**

23. Write down any two considerations that govern the selection of site of a thermal plant. **(Nov 04 O.U)**

24. What is the function of electrostatic precipitator in thermal plant? Briefly explain **(Mar 04 O.U)**

25. Discuss coal handling and ash disposal methods in modern thermal plant **(Mar 04 O.U)**

26. Briefly explain why pulverized coal is used in modern thermal power plant **(Mar 04 O.U)**

27. Explain the working of following with neat diagram **(Mar 04 O.U)**
i. Super heater
ii. Air preheater
iii. Coal

28. Explain why super preheater is used in thermal power station **(Nov 03 O.U)**

It was such a lovely day I thought it was a pity to get up.

- W. Somerset Maugham, "Our Betters", 1923

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29. Explain why air preheater is necessary and how air from atmosphere is heated **(Jun 03 O.U)**

30. i. Discuss various factors associated with rapid growth of nuclear power industry. **(May 09, Sep 08)**
ii. Explain clearly the various processes that can take place, when a neutron collides with a heavy atom.

31. i. Compare the performance of various materials used as moderator in a nuclear reactor. **(May 09, Sep 08)**
ii. Explain clearly how the operation of nuclear reactor is controlled for generation of electrical power.

32. State and explain the different nuclear reactors according to the basis of components. **(May 09, Sep 07)**

33. i. Define Half life period. Derive the expression for half life period. Mention the significance of it.
ii. Discuss various factors which affect the selection of site for a nuclear power plant. **(May 09, 05, 04)**

34. i. Describe the boiling water reactor. **(Sep 08)**
ii. What are the factors to be considered for selecting the location of site for nuclear power plant?

35. i. Discuss about the fuel materials of nuclear reactors. **(Sep 08)**
ii. Explain the moderators in nuclear plants.

36. i. What are the functions of moderator and control rods in a nuclear power plants. **(May 08)**
ii. Distinguish between thermal and fast reactors. Classify each according to moderator, coolant and fuel utilized

37. i. Discuss briefly the ratio-active pollution of environment by nuclear power plant. **(May 08)**
ii. Describe the different types of fuels used in a nuclear power plant and discuss the problems of nuclear waste disposal.

38. i. What is the need of nuclear power generation? **(May 08)**
ii. What are the merits and demerits of nuclear power plant?

39. i. Explain the function of moderator. How is a moderator selected? Why does a breeder reactor require no moderator? **(May 08)**
ii. Discuss the boiling water reactor, mentioning its merits and demerits.

40. i. Mention the advantages and disadvantages of Nuclear power plants.
ii. Name the different types of radiant's. Explain any two of them in detail? **(Sep 07, Apr 04)**

41. Describe working of PWR (pressurized water reactor). What are its advantages and disadvantages? **(Sep 07)**

42. What is the function of a moderator? What are the desirable properties of a Moderator? Compare the performance of various materials used as moderator in a nuclear reactor. **(Sep, May 07)**

43. Explain with neat diagram the function of BWR. Mention the advantages and disadvantages. **(May 07)**

44. What are the main parts of reactor ? Explain the function of each component. **(May 07)**

45. i. Describe the fast breeder reactor. **(May 07)**

ii. Briefly discuss the types of radiations.

16. What are the types of radiation hazards and clearly explain each type. **(May 07)**

17. What is a nuclear reactor? Explain in details the basic components of nuclear reactor. **(May 07, Nov 03)**

18. i. What are the advantages of a gas turbine plant? **(May 07)**
ii. Describe briefly a gas turbine plant.

19. Describe the construction and uses of nuclear reactor core. **(Apr 05)**

21. What is the function of a moderator? What are the desirable properties of a moderator? Compare the performance of various materials used as moderator in a nuclear reactor. **(Apr 05)**

22. i. Explain clearly how the operation of nuclear reactor is controlled for generation of electrical power.
ii. Compare the performance of different coolants used in nuclear reactor. **(Apr 04)**

23. i. Explain the structure of an atom. What is the difference between Atomic no. and Mass no. and Mention their relevance in nuclear reaction?
ii. Write shot notes on:
a. Isotopes with examples.
b. Rate of Radio-active decay (**Apr 04**, **03)**

24. Explain clearly with the suitable example the various processes that can take place, when a neutron collides with a heavy atom. **(Apr 04)**

25. Discuss the following:
i. Half life period
ii. Energy mass equivalence
iii. Binding energy **(Apr 04)**

26. Discuss various radiations that are emitted from a nuclear fission process? **(Apr 04)**

27. Explain with neat sketch the fast breeder reactor. Write its advantages and disadvantages. **(Nov 03)**

28. Name the different nuclear materials. Explain each of them with examples. **(Nov 03)**

29. Describe with neat sketch the construction and operation of a Heavy water cooled and Moderate Reactor? What are its advantages and disadvantages? **(Nov 03)**

30. Explain with neat sketch, the principle of operation of Nuclear Reactor. (**Nov, Apr 03)**

31. i. What is the use of an electron precipitator along with the modern boilers? Explain its working. **(Apr 03)**
ii. What is 'feed water '? What are the problems due to impurities in feed water? How they can be eliminated?

32. Why is shielding necessary for reactors? Explain various methods in use. **(Apr 03)**

33. i. Explain why the nuclear power plants are considered very useful for base load plants?
ii. Why is a site near a sea or river or lake and away from thickly populated area considered an ideal site for nuclear power plants? **(Apr 03)**

34. Differentiate between **(Apr 03)**
a. Fissile and fertile materials

b. Fission and Fusion
c. Natural and enriched uranium.

35. What is a fast breeders reactor. **(Nov 04 O.U)**

36. Name any two main parts of a nuclear power plant **(Nov 04 O.U)**

37. i. How are nuclear reactors classified? **(Nov 04 O.U)**
ii. Explain briefly the following
a. Fertile material
b. Fissile material
c. function of maderator

38. Distinguish between fissile & fertile materials **(Mar 04 O.U)**

39. Explain how gas turbine plant is started. **(Mar 04 O.U)**

40. Name commonly used control rods in a Nuclear plant. **(Mar 04 O.U)**

41. Explain the function of each part of Nuclear reactor **(Mar 04 O.U)**

42. Explain working principle of Gas based power plant **(Mar 04 O.U)**

43. Explain 'reactor control for constant power generation **(Nov 03 O.U)**

44. Match the following **(Nov 03 O.U)**

i. Fissile material	a. Reinforce concrete
ii. Coolaint	b. Pintonium-239
iii. Moderator	c. Liquid sodium
	d. Boron
	e. Graphite

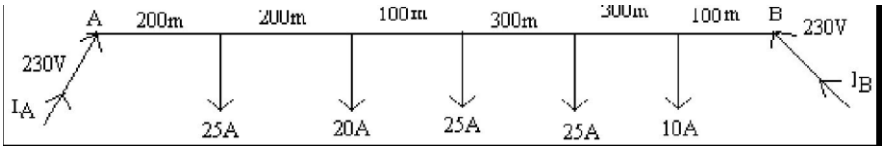
45. i. With the help of neat diagram, explain the principle of operation of gas turbine plant.
ii. With the help of relevant diagrams, explain reactor control and shielding **(Dec 02 O.U)**

UNIT-II

2. i. Discuss the relative merits and demerits of underground and over head systems. **(May 09, Sep 08)**
ii. An 800m distributor fed from both ends A and B is loaded uniformly at the rate of 1.2 A/m run, the resistance of each conductor being 0.05ohms per /km. Determine the minimum voltage and the point where it occurs if feeding points A and B are maintained at 255 V and 250V respectively. Find also the current supplied from feeding point A and B.

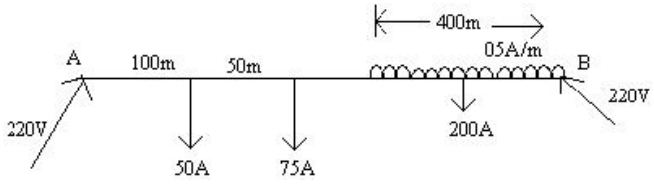
4. i. Name the different methods of distribution and the principle of distribution design. **(May 09, Sep 08)**
ii. A two wire distributor is loaded as shown in figure. The voltage at the two ends is 230V and 230V respectively. The distance between sections are given in meters. Determine the cross section of the conductor for a minimum consumer's voltage of 220V.

The time to repair the roof is when the sun is shining.
- John F. Kennedy



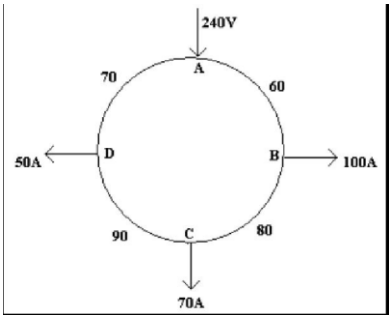
1. i. Draw the single line diagram of radial primary feeder and mention the factors that influence the selection of primary feeder. **(Sep 08)**
   ii. A.D.C. two wire distributors are fed at F_1 and F_2 at 220 V and 225 V respectively. The total length of the distributor is 250 m. The loads tapped off from fed end F_1 are
   Load in ampere: 20 40 25 35
   Distance in metre : 50 75 100 200
   The resistance per km of one conductor is 0.3 ohms. Determine the current in various sections of the distributor and the voltage at the point of minimum potential.

3. i. Explain different types of distribution systems with the help of neat sketches. **(Sep 08)**
   ii. A DC 2 wire distributor 600m long is fed at both ends A and B at 220V shown in figure. The load consists of 50A at 100m from A, 75A at 150m from A and a uniform loading of 0.5A per meter for the last 400m. The resistance of each conductor is 0.05ohms/Km. Determine the location and magnitude of minimum voltage.



5. i. Distinguish between primary and secondary distribution systems with suitable examples. **(May 08)**
   ii. A 2-wire DC distributor AB, 600m long as loaded as under:
   Distance from A (mts) : 150 300 350 450
   Loads (Amps) : 100 200 250 300
   The feeding point A is maintained at 440V and that of B at 430V. If each conductor has a resistance of 0.01ohms per 100m, calculate
   a. the currents supplied from A to B
   b. the power dispatched in the distributor.

6. i. Discuss the classification of distribution systems. **(May 08)**
   ii. A 300m ring distributor has loads as shown in figure, where distances are in meters. The resistance of each conductor is 0.2ohms per Km and the loads are tapped off at points B, C and D as shown. If the distributor is fed at A at 240V, find voltages at B, C and D.



7. i. What is meant by radial and loop systems of distribution. **(May 08)**
   ii. On what factors does the primary distribution voltage depend.

If you wish to be brothers, let the arms fall from your hands. One cannot love while holding offensive arms.

- Pope Paul VI

iii. A two wire distributors are fed at F_1 and F_2 at 230 V and 220 V respectively. Loads of 150 A and 100 A are taken at points P and Q. Resistance of both the conductors between F_1P is 0.03ohms, between PQ is 0.05ohms and between QF_2 is 0.02ohms. Determine the current in each section of the distributor and voltage at each load point.

8. i. Discuss briefly the requirements of a distribution system **(May 08)**

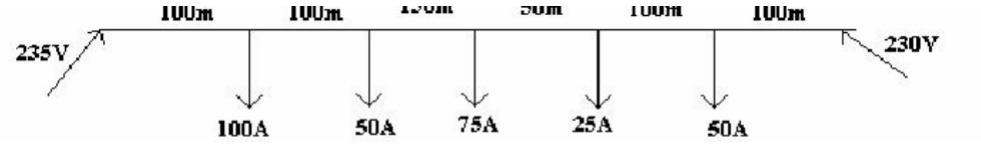
ii. A 2-wire DC ring distributor is 300m long and is fed at 240V at point A. At point B, 150m from A, a load of 120A is taken and at C, 100m in the opposite direction, a load of 80a is taken if the resistance per 100m of single conductor is 0.03ohms, find
a. current in each section of distributor
b. voltage at points B and C.

9. i. What is ring distributor? How many types of ring distributors are there? What are the advantages of providing inter connector in the ring Distributor.

ii. A 2-wire DC distributor 200m long is uniformly loaded with 2A/m. Resistance of single wire is 0.3/ Km. If the distributor is fed at one end, calculate:
a. the voltage drop upto a distance of 150m from the feeding point
b. the maximum voltage drop. **(May 07)**

10. i. What is the purpose of inter connection in a DC ring main distributor. **(May 07)**

ii. A two wire cable distributor is loaded as shown in figure. Determine the cross section of the conductor for a minimum consumers voltage of 220V.

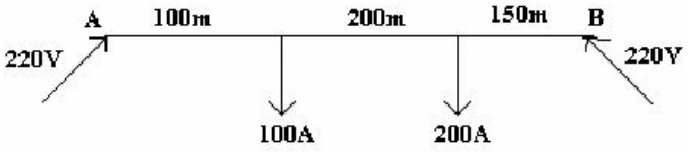


11. i. What are the important requirement for a good distribution system. **(May 07)**

ii. A distributor is fed at both ends at same voltage of 250V. The total length of the feeder is 250m and the loads the tapped off as follows: 60A at 50m from X, 50A at 80m from X, 40A at 120m from X and 30A of 160m from X. Find out
a. the point of minimum potential
b. the current in each section and
c. the voltage at minimum potential. The resistance per Km of the conductor for go and return is 0.9.

12. i. Describe briefly the different types of DC distribution **(May 07)**

ii. A 2-core cable distributor is loaded as shown in figure The cross section of each conductor is 0.6 cm2. Determine the currents fed at each end and the voltage at the load points.



13. i. Compare the copper efficiencies for an A.C 4 wire and 4 D.C 3 wire system on the basis of equal maximum potential difference between any two conductors.

ii. What is an inter connector? Discuss its advantages in a distribution system. **(Apr 04)**

14. i. Write short notes on various systems of D.C classify it?

I met a hundred men going to Delhi and everyone is my brother.

- Indian Saying

ii. Explain the following
a. Feeder
b. Distributor
c. Service mains **(Apr 03)**

15. Discuss briefly various electric distribution system. **(Apr 02)**

16. Discuss the advantage and ring mains system of distribution over the radial system. **(Apr 02)**

17. Why the D.C distribution is not in service? **(Apr 04, M.U)**

18. Compare the D.C 2 wire and 3 wire system with AC. **(Apr 04, M.U)**

19. What is a distribution system? **(Oct 02, M.U)**

20. What is a service main? **(Oct 02, M.U)**

21. State the classification of distribution system according to the type of construction. **(Oct 02, M.U)**

22. Give a single line diagram of a radial distribution system? **(Oct 02, M.U)**

23. What is an interconnected system. **(Oct 02, M.U)**

24. In a distributor fed at both ends, at the point of minimum potential, the current comes from both ends of the distributor. State true or false. **(Oct 02, M.U)**

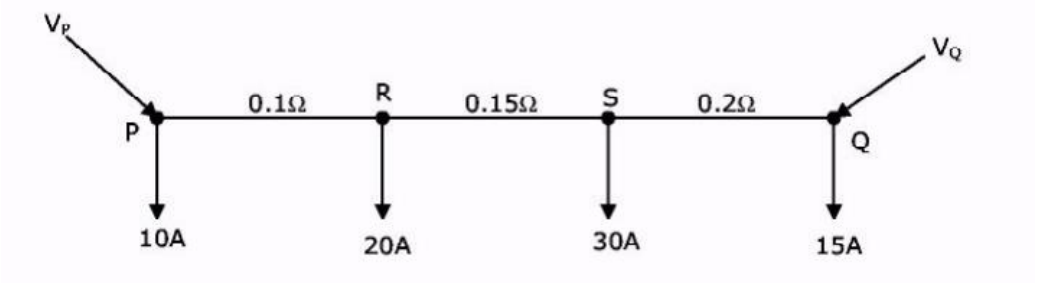
25. Give the conductor continuation used for 3 conductor bundles. **(Oct 02, M.U)**

26. i. Make a comparative study of radial and ring distribution system.
ii. A 2 wire D.C distributor AB, 700 m long in fed at A at 220v and load of 25A, 50A and 75A one tapped off from C, D and E which one at a distance of 150m, 300m, and 500m respectively from point A. If the resistance of distributor per mere (go and return) is 0.0001Ω, calculate the voltage at point D.**(Oct 02, M.U)**

27. What are the advantages and disadvantages of transmitting power by 3 phase AC system?**(Dec 01, O.U)**

28. The rated voltage of a 3-phase power system is given as **(GATE 04)**
i. rms phase voltage
ii. peak phase voltage
iii. rmp line to line voltage
iv. peak line to line voltage

29. A dc distribution system is shown in figure with load currents as marked. The two ends of the feeder are fed by voltage sources such that VP-VQ = 3V. The value of the voltage VP for a minimum voltage of 220 V at any point along the feeder is **(GATE 03)**



30. In a DC transmission line **(GATE 99)**
   i. it is necessary for the sending end and receiving end to be operated in synchronism.
   ii. the effects of inductive and capacitive reactances are greater than in an AC transmission line of the same rating.
   iii. there are not effects due to inductive and capacitive reactances
   iv. power transfer capability is limited by stability considerations.

31. The main creatural for selection the size of a distribution for a radial distribution system is
   i. Voltage drop
   ii. Corona loss
   iii. Temperature rise
   iv. Capital cost. **(GATE 95)**

32. The rated voltage of a 3 phase power system is given as
   i. Rms phase voltage
   ii. Peak to phase voltage
   iii. Rms line to line voltage
   iv. Peak line to line voltage **(GATE 95)**

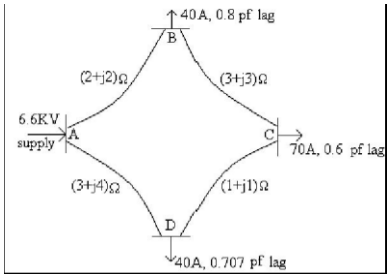
33. Ring main distribution system is preferred to a radial system, because
   i. It is less expensive.
   ii. Voltage drop in the feeder is less
   iii. Power factor is higher
   iv. Supply is more reliable. **(GATE 91)**

1. i. Contrast between AC and DC distributions. **(May 09, Sep 08)**
   ii. A single-phase distributor has loop resistance of 0.3 ohms and a reactance of 0.4 ohms. The far end of the distributor has a load current of 100A and a power factor 0.8 lagging at 220 V. The midpoint Q of the distributor has a load current of 50 A at power factor 0.9 lagging with reference to voltage Q. Determine the sending end voltage and power factor.

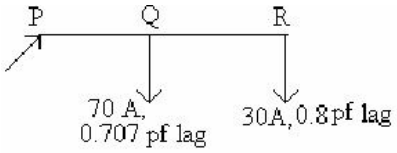
3. A 3-phase system is supplied at 6.6 kV at terminal 'A' as shown in figure. The load is balanced and the p.f. are lagging, calculate load current in each branch. **(May 09, Sep 08)**

No one would talk much in society if they knew how often they misunderstood others.

- Johann Wolfgang Von Goethe



9. i. How does AC distribution differ from DC distribution?
   ii. A single phase distributor PQR fed at P is as shown in figure. The power factors are lagging and expressed relative to the voltage at the far end. The impedances between the sections PQ and QR is (0.1 + j 0.15) . If the voltage at the far end is 230 V, calculate the voltage at the supply end and also its phase angle with respect to the far end. **(May 09, 07)**



15. A single phase AC distributor 1km long has resistance and reactance per conductor of 0.1 and 0.15 ohm respectively. At the far the voltage VB = 200W and the current is 100 A at a power factor of 0.8 (lagging) at the mid point m of the distributor, a current of 100A is tapped at a power factor 0.6 lagging with reference to the voltage Vm at the mid point. Calculate
   i. Voltage at mid point
   ii. Sending end voltage V_A
   iii. Phase angle between V_A AND V_B. **(May 09, 04)**

2. i. Describe briefly how will you solve AC distribution problems. **(Sep 08)**
   ii. A 2-wire feeder ABC has a load of 120A at C and 60A at B both at p.f. 0.8 lagging. The impedance AB is (0.04 + j0.08)ohms and that of BC is (0.08 + j0.012)ohms. If the voltage at the far end C is to be maintain at 400V, determine the voltage.
   a. at A and b. at B.

4. A single phase line (ABC) of length 2.0 Km having resistance and reactance (go and return) as 0.06 and 0.1 ohms/Km. A is the feeding point, B is the mid point of the line taking a load of 100 A at 0.8 lead and C is the far end taking a load of 100A at Upf. The voltage at the 'C' is 220V. Find the voltage at the sending and the phase angle difference between the voltages of two ends. If
   i. Power factors of the loads are with reference to far end voltage
   ii. Power factors of the loads are with reference to the voltages at the load points.**(May 08, Sep 07, Apr 05)**

5. A three-phase distribution system power is supplied at 11 kV (line voltage) and balanced load of 50 A/ phase at 0.8 lagging p.f and 70 A at 0.9 lagging p.f are taken at Q and R respectively. The impedance of the feeders are PQ = (5+j9), QR = (6+j10) and RP = (4+j8). Calculate the voltage at Q and R and the current n each branch. Power factors are assumed with respect to voltage at P. **(May 08, 07)**

6. A 3-phase distribution system is shown in figure. Power is supplied at A at line voltage of 6.6 kV and balanced loads of 25A per phase at 0.8 lagging p.f and 35Aper phase at 0.9 lagging p.f are taken at B and C respectively. The impedances of the feeders are AB = (5 + j9) , BC = (6 + j10) and CA = (4 + j8) . Calculate the voltage at B and C and the current in each branch p.f.'s are assumed w.r. to voltage at A.**(May 08, 07)**

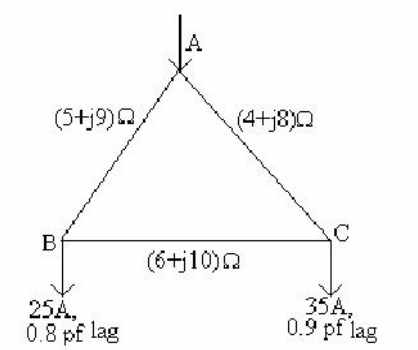
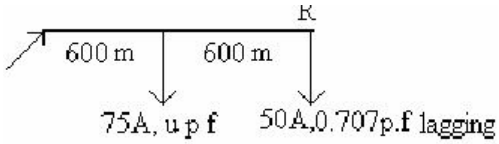


Figure 4

7. Explain the following with neat diagrams:
   i. AC 3 phase 3 wire distribution system
   ii. AC 3 phase 4 wire system **(Sep, May 07, Aug 06)**

8. i. Explain a method of solving single phase AC distribution system in which the power factors of loads are referred to respective load voltages.
   ii. A single phase distributor 2 km long supplies a load of 120 A at 0.8 power factor lagging at its far end and a load of 80 A at 0.9 power factor lagging at its mid-point. Both power factors are referred to the voltage at the far end. The resistance and reactance per km (go and return) are 0.05ohms and 0.1 ohms respectively. If the voltage at the far end is maintained at 230 V, calculate
   a. voltage at the sending end.
   b. Phase angle between the voltages at the two ends. **(Sep 07, Apr 04)**

10. i. What are the factors to be considered during the voltage drop calculation of an AC distributor?
   ii. A two-wire distributor 1200m long is loaded as shown in figure. The powerfactors at the two load points refer to the voltage at R. The impedance of eachline is (0.15 + j 0.2). Calculate the sending end voltage, current and power factor. The voltage at point R is 230V. **(May 07)**

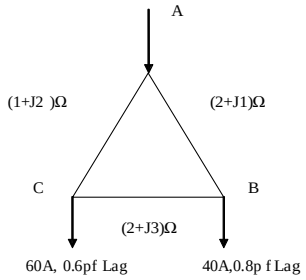


11. i. Indicate the advantages of ring mains systems **(Apr 05)**
   ii. Making the required assumptions compare the different types of power distribution system.

12. A 3 phase ring distributor ABCD fed at A at 11kV supplies balanced load of 40 A at 0.8P and lagging at B, 50A at 0.707 pf lagging at C and 30A at 0.8 pf lagging at D, the load currents being refereed to the supply voltage at A.
   The impedance per phase of the various sections are
   Section AB = (1+j2) ohms
   Section BC = (2+j3) ohms
   Section CD = (1+j1) ohms
   Section DA = (3+j4) ohms
   Calculate the currents in various sections and station bus bar voltages at B, C and D. **(Apr 04)**

13. A single phase ring distributor ABC is fed at point A. The impedance of sections AB, BC, AC one 2=j1, 2+j3 and 1+j2Ω respectively. Load at B is 40A at 0.8pf lagging, while that a C is 60 A at 0.6 pf lagging, both with

respect to voltage at A. **(Apr 04)**



14. Explain the differences between AC distribution and DC distribution. **(Apr 04)**

16. Compare the DC 2 wire and 3 wire system with AC. **(Apr 04)**

17. Single phase and 3 phase 4 wire distribution. **(Apr 04)**

18. i. How do you solve the single phase AC distribution system in which the power factors of the load currents are referred with respect to receiving end voltage.

ii. A single phase ac distributor AB 300 meters log is fed from end A and is loaded as follows:
a.100 A at 0.707 pf lagging 200 meters from point A.
b.200 A at 0.8pf lagging 300 meters from point A.
The total resistance and reactance of the distributor is 0.2 ohms and 0.1 ohms per km. calculate the total voltage drop in the distributor. The load power factors are refereed to the voltage at the end. **(Apr 03)**

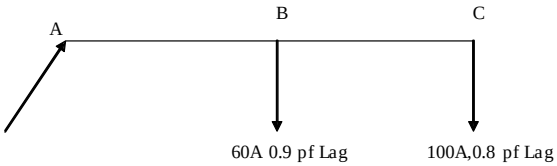
19. Explain a method of solving single phase AC distribution system in which the power factors of loads are refereed to respective load volt aged. **(Apr 03)**

20. A single phase A.C system supplies a load of 200 kW and if this system is converted to 3 phase, 3 wire A.C system by running a third similar conductor. Calculate the 3 phase load than can now be supplied if the voltage between the conductors is the same. Assume the pf and transmission efficiency to be the same in the two cases. **(Jan 03)**

21. A single phase AC distributor AB is fed from end A and has a total impedance of (0.2+j 0.3)Ω. At the far end the voltage V_B =240V and the current is 100 A at a pf. of 0.6 lag. At the mid point m, a current of 100A at a pf of 0.8 lag with ref to the voltage V_B at far end. Calculate the voltage V_A. **(Oct 01)**

22. A two wire distributor cable AB is 1km long and supplies loads of 100A, 40A and 25A situated at 300m, 500m and 800m respectively from A. The resistance of each conductor is 0.05Ω per km. If a voltage of 400v is maintained at B, calculate the potential difference at each load point. **(Apr 01)**

23. A two wire distributor 1200m long is loaded as shown in figure. B is mid point..



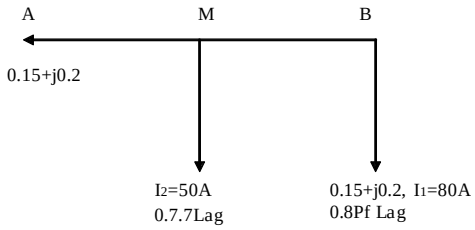
The power factors at the two load point refer to the voltage at C. The impedance of each line is (0.15+j 0.2) Ω calculate the sending end voltage, current and power factor. The voltage at point C is 220. **(Apr 01)**

It isn't the mountain ahead that wears you out; it's the grain of sand in your shoe.

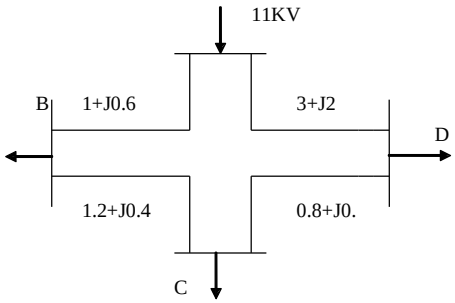
- Robert W. Service

24. What are the design considerations involved in a primary distribution system in the selection of voltage and size of feeders. **(Apr 01)**

25. What is the difference between 3 phase, 3 wire and 3-phase 4 wire distribution system.
A single phase distributor has loop resistance of 0.3 ohms and a distributor has loop resistance of 0.4ohms. The far end of the distributor has a load current of 80A and a power factor 0.8 lagging at 220V. The midpoint M of the distributor has a load current of 50A at power factor 0.707 lagging with reference to voltage M. Calculate the sending end voltage and power factor. **(Nov 04, OU)**

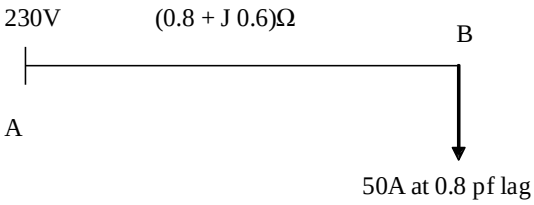


26.. A 3φ ring main ABCD is fed at A at 11kV and supplies balanced loads of 50A at 0.8 pf lag at B. 120 A at upf and at C and70 A at 0.866 pf lag at D. All power factors are with respect to the voltage at A. The diagram. Calculate the currents in the various sections and the bus bar voltage at B, C and D. **(Nov 04, OU)**



27. A single phase distributor has a resistance of 0.2Ω and a reactance of 0.3Ω. At far end the voltage V_B is 240v and the current is 100 A at 0.8 pf lagging. At mid point A the current 100 A 0.6 pf lag with respect to voltage VA at A. Find the supply voltage and phase angle between V_A and V_B. **(Apr 04, MU)**

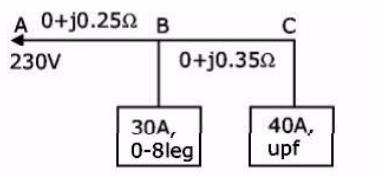
28. Find voltage at the consumer terminates for the system shown in Fig. **(Nov 03, OU)**



29. A 250m, 2 wire mains fed from both ends A and B is loaded uniformly at the rate of 1.5 A/m. The resistance of each conductor is 0.2 Ω/km. Find the voltage at A and B for a minimum of 240 v at consumers terminals assume $V_A = V_B + 6$. **(Nov 03, OU)**

30. A single phase AC distributor supplies two single phase loads as shown in figure. The voltage drop from A to C is:

a) 4.5V b) 31.5V c) 30V d) 20V **(GATE 99)**



31. A 200km, 3 Phase, 50 Hz transmission line has the following data
A= D= 0.938"1.2°, B= 131.2"72.3 Ohms/ phase
C= 0.001"90o Siemens/Phase Sending end voltage is 230kv .Determine
   i. The receiving end voltage when the load is connected.
   ii. The line charging current.
   iii. The maximum power that can be transmitted.
   at a receiving end voltage of 220kv and the corresponding load reactive power required at the receiving end. **(GATE 92)**

UNIT-III

15. Draw the layout of a typical 11kV/400V indoor sub-station and explain the Equipments in detail. **(May 09, Nov 04)**

1. Explain the following with circuit diagrams. **(Sep 08)**
   i. Single bus bar arrangement with sectionalization
   ii. Main and transformer bus bar arrangements.

2. i. Explain the classification of sub-stations. **(Sep, May 08, 07, Aug 06, Apr 05)**
   ii. Explain the advantages of outdoor sub-station as compared to the indoor sub-station.

3. i. What is a sub-station? Name the factors that should be taken care of while designing and erecting a sub-station.
   ii. Compare the indoor and outdoor sub-station. **(Sep 08, Apr 05, 03)**

4. i. Explain the main and transfer bus bar system with circuit diagram. **(May 08, 07)**
   ii. What is the difference between single bus bar with and without sectionalization arrangement?

5. i. What are the factors to be considered for selecting location of substations? **(May 08)**
   ii. What are the merits and demerits of indoor substations over outdoor substations?

6. i. What are the different types of bus bar arrangements? **(May 08)**
   ii. Explain the single bus bar system with sectionalization and what its merits are as well as demerits.

7. i. What is sub-station ? Discuss the different ways of classifying the sub-stations. **(May 07, Nov 03)**
   ii. Write explanatory note about the sub-station equipments

8. i. Briefly discuss the installation and maintenance of gas insulated substations. **(May 07)**
   ii. Explain the single phase GIS with circuit diagram.

9. i. List out the differences between sectionalized single bus bar and Sectionalized double bus bar.
   ii. What is group switching? Explain its operation in detail with a help of suitable diagram.**(May 07, Sep 06)**

10. i. Explain the role of sub-station in a power system

ii. Draw and explain the layout of 11 kV /440 kV substation **(Aug 06)**

11. i. Draw and explain the sectionalized double bus bar system.
ii. With suitable diagrams explain the main and transfer bus arrangement. **(Apr 05)**

12. Write short notes on sectionalized single bus bar system. **(Nov 04)**

13. Draw and explain the main and transfer bus bar system. **(Nov 04)**

14. Discuss various bus bar arrangements in a sub-station. **(Nov 04)**

16. What are the different types of bus-bar arrangements used in sub-station? Illustrate your answer with suitable diagram. **(Apr 04)**

17. i. Explain the procedural steps that should be adopted for designing a sub-station
ii. What are the equipments present in typical sub-station ? Explain them in detail. **(Apr 04)**

18. i. Explain Ring main and list its advantages and disadvantages.
ii. Draw and explain the sectionalized double busbar system. **(Apr 04)**

19. List out the difference between sectionalized single busbar and sectionalized double busbar. **(Apr 04)**

20. Define and differentiate indoor and outdoor sub stations. **(Nov 03)**

21. What is the need of Sub-station in a power system. **(Apr 03)**

22. i. With the help of a single line diagram, explain the layout of an outdoor substation.
ii. Explain the different bus bar arrangements in a substation and their relative merits. **(Jan 03)**

23. With a neat schematic, explain a typical outdoor substation indicating various Parts. **(Apr 01)**

UNIT-IV

19. i Why the improvement of power factor is very important for both common and generating stations?
ii List the various causes of low power factor and explain.
iii List the power factor improvement requirement and briefly explain. **(May 09, Nov 03)**

22. i Discuss why receiving end voltage of an unloaded long line may be move than the sending end voltage.
ii A single phase transmission line 100 km long has the following constants. Resistance per km is 0.25 ohms and reactance per km is 0.8 Ohms. Susceptance per km is 14 micro mho. Receiving end voltage is 66 kV. Assuming that the total capacitance of the line is localized at the receiving end alone, determine sending end voltage, sending end current, regulation efficacy and supply power factor the line is delivering 15mw at 0.8 logging power factor. Draw the vector diagram to illustrate your calculations. **(May 09, June 03)**

24. i Explain the method of improving power factor by using synchronous condenser.
Discuss the merits and demerits of the above method.
ii A synchronous motor improves the power factor of a local of 200 kW from 0.8 logging to 0.9 logging. Simultaneously the motor carriers a local of 60 Kw. Find
a. The leading kVAR supplied by the motor.
b. The power factor at which motor operates. **(May 09, June 03)**

If you make every game a life and death proposition, you're going to have problems. For one thing, you'll be dead a lot.
- Dean Smith

1. Explain the disadvantages of low power factor ? **(Sep 08)**

2. i. What do you understand by power factor? Explain the necessity of improving power factor. **(Sep 08)**
   ii. A consumer takes a steady load of 300 kW at a lagging p.f. of 0.7 for 3,000 hours a year. The tariff is Rs. 1,300 per kVA of maximum demand per annum plus Rs. 0.8 per kWh. The annual cost of the phase advancing is Rs. 130 per kVAR. Determine the annual saving if the p.f. of the load is improved.

3. i. Explain one method of voltage control in detail giving a neat connection diagram. **(Sep 08)**
   ii. A consumer has an average demand of 400 kW at a p.f of 0.8 lagging and annual load factor of 50%. The tariff is Rs.50 per kVA of maximum demand per annum plus 5 paise per kWh. If the power factor is improved to 0.95 lagging by installing phase advancing equipment, calculate
   a. the capacity of phase advancing equipment,
   b. the annual saving effected. The phase advancing equipment costs Rs. 100 per kVAR and the annual interest and depreciation together amount to 10%.

4. i. What are the different methods used for voltage control of a power system? **(Sep, May 08)**
   ii. A 12kV, 500kVA load is supplied at a p.f. of 0.8 lagging by a 3-phase transmission line whose voltage is to be maintained at 33 kV at both ends. Determine the capacity of the synchronous condenser to be installed for voltage regulation. Given that the line resistance and reactance per phase are 4ohms and 12ohms respectively.

5. i Compare the merits and demerits of various methods of power factor improvement methods.
   ii A single phase motor connected to a 240V, 50Hz supply takes 20A at a power factor of 0.75 (log). A capacitor is shunted across the motor terminals to improve the power factor to 0.9(log). Determine the capacitance of the capacitor to be used. **(Sep 08, June 03)**

6. i. Why Voltage control and p.f. correction are necessary in power systems? What are the disadvantages of low voltage and low p.f. of the system. **(May 08)**
   ii. A 400V, 50 cycles, three phase line delivers 207 kW at 0.8 p.f.(lag). It is desired to bring the line p.f. to unity by installing shunt capacitors. Calculate the capacitance if they are
   a. star connected
   b. delta connected.

7. i Why the improvement of power factor is very important for both consumer and operating station?
   ii List the various causes of law power factor and explain.
   iii List the power factor improvement equipment and briefly explain. **(May 08, June 03)**

8. i. What factors determine the economical limit of p.f. correction? Show that the economical limit to which the p.f. of a lagging p.f. load can be raised is independent of the original value of the p.f. if the tariff consists of a fixed charge per kVA of maximum demand plus a flat rate per kWh. **(May 08)**
   ii. Calculate the value of the new p.f. when the tariff is Rs. 1,350 per kVA of maximum demand plus a flat rate paise 80 per kWh. Assume additional cost of condensers etc. at Rs. 1,050 per kVA of such plant. Rate of interest and depreciation together is taken as 10%.

9. i. State whether the tap changes in transformer is provided on HV side or LV side? Explain the reason for its location and elaborate how lowering or raising the output voltage is actually done.
   ii. It is provided to control the voltage of a 3-phase, 3.3 MVA feeder varying between 3 kV and 3.5 kV about 3.3 kV. Determine the minimum turn ratio of the regulator. Find also its rating. **(May 07)**

10. i. Explain one method of voltage control in detail giving a neat connection dia-Gram. A consumer has an average demand of 400 kW at a p.f of 0.8 lagging and annual load factor of 50%. The tariifff is Rs.50 per kVA

of maximum demand per annum plus 5 paise per kWh. If the power factor is improved to 0.95 lagging by installing phase advancing equipment, calculate **(May 07)**

11. i. Explain the method of improving power factor by the method of using phaseadvancers.
    ii. A single circuit 3-phase, 220kV line runs at no load, voltage at the receiving end of the line is 210kV. Find the sending end voltage, if the line has resistance 20.5ohms, reactance of 81.3 ohms and the total succeptance as 5.45×10-6mho.The transmission line is to be represented by ?-model. **(May 07)**

12. i. What is the effect of low power factor in a system? **(May 07)**
    ii. A 3 phase, 50 Hz, 400 V motor develops 100 H.P., the p.f. being 0.75 lag and effciency 93%. A bank of capacitors is connected in delta across the supply terminals and p.f. is raised to 0.95 lag. Each of the capacitance units is built of 4 similar 100 V capacitors. Determine the capacitance of each capacitor.

13. An industrial organization takes a steady load of 2 MW at a p.f. of 0.75 lagging and pays Rs. 125 per annum per kVA of maximum demand. Determine the capacity of the phase advancing equipment required for minimum overall annual expenditure if the phase advancing equipment costs Rs. 200 per kVAR. An interest and depreciation charge on phase advancing equipment is 10%. Also, determine the new p.f. of the supply. **(May 07)**

14. Discuss the need for voltage control in the modern power system and explain them with suitable examples along with neat sketches. **(Nov 04)**

15. Describe the construction and working of a tap changing TF with the aid of a neat sketch and specify its advantage and disadvantages. **(Nov 04)**

16. Why does a tap changing in a transformer generally preferred on load. Explain its merits over off load tap changing transformer **(Nov 04)**

17. What is synchronous phase shifter. How a synchronous phase shifter does helps a system to control the voltage. What are its limitation? **(Nov 04)**

18. Discuss the effect of local power factor on voltage regulation and efficiency of a transmission line. **(Nov 03)**

20. Write short on the following:
    i Power factor improvement by synchronous condenser
    ii Importance of power factor improvement.
    iii Economics of power factor improvement. **(Nov 03)**

21. i What is most economical power factor? Why it is needed?
    ii List the methods to improve power factor and explain briefly
    iii Show that the most economical power factor depends upon the relative costs of supply and power factor correction equipment. **(Nov 03)**

23. i List and explain any four disadvantages of low power factor.
    ii Derive an expression for most economical power factor for constant kVA – method. **(June 03)**

25. i What is the importance of power factor in the supply system? What is the effect of low power factor on the generating stations?
    ii Why is unity power factor not the most economical power factor? Suggest themost economical value of power factor for a particular customer by deriving appropriate derivation with suitable assumptions Kw of load is maintained constant. **(June 03)**

How can they beat me? I've been struck by lightning, had two back operations, and been divorced twice.

- Lee Trevino

26. i Explain the method of improving power factor by the method of using phase Advancers.
    ii A 3 – Phase, 50Hz, 400V motor develops 80HP, the power facto being 0.7 (log) and efficiency 93%. A bank of capacitors is connected in delta across the supply terminals and power factor is raised to 0.95 (log). Each of the capacitance units is built of 4 similar 100 V capacitors. Determine the capacitance of each capacitor. **(June 03)**

27. i Explain the concept of power factor
    ii Explain any three cases of low power factor of supply system.
    iii Discuss the disadvantages of low power factor and list methods to improve power factor. **(June 03)**

28. i Derive the equation for most economical power factor for a constant kVA type load.
    ii A star connected 400H.P (metric), 2000V, 50HZ motor works at a power factor of 0.7 logging . A bank of mesh connected condensers are used to vise the power factor to 0.93 logging. Calculate the capacitance of each unit and total number of units required; if each is rated 500V, 50Hz. This motor efficiency is 85^0 b. **(Nov 02)**

29. Discuss why receiving end voltage of an unloaded long line may be more than the sending end voltage. **(Nov 02)**

30. Discuss the disadvantages of low power factor and methods for improving the same. **(Aug 02)**

31. i What are the disadvantages of low power factor.
    ii A star connected 400HP (metric), 2000V, 50Hz induction motor works at a power factor of 0.7 log. A bank of mesh corrected condenser are used to raise the power factor to 0.93 lag. Calculate the capacitance of each unit and total number of units required. If each is rated 500V, 50Hz. The motor efficiency is 85%. **(Apr 02)**

32. Discuss the causes of low power factor of the supply system. **(Nov 01)**

33. Write short notes on power factor improvement by synchronous condenser. **(Nov 01)**

34. i What is line compensation? Why is it necessary? Compensation static capacitors and synchronous compensations.
    ii A 3-phase 400V star connected induction motor draws a current of 30A at 0.8 Pf lag under full load condition. It is desired to install a bank of capacitors to raise the full load over all power factor to 0.9 lag. Final the kVAR rating of the star connected capacitor bank and the value of each capacitor. **(Aug 01)**

35. Emirate the various methods that an employed for controlling the receiving end voltage of a transmission line. **(Dec 02, Jan 01 O.U)**

36. Explain working of the following for voltage control.
    i Synchronous phase modifiers
    ii Induction regulators. **(Nov 04 O.U)**

37. What are the benefits of reactive power compensation? **(Apr 04 O.U)**

38. Mention the application of induction regulator. **(Apr 04 O.U)**

39. At a industrial sub-station with a 4 MW load, a capacitor of 2 MVAR is installed to maintain the load power factor at 0.97 lagging if the capacitor goes out of service, the load power factor becomes
    i. 0.85
    ii. 1.00
    iii. 0.80 lag
    iv. 0.90 lag **(GATE 05)**

40. The power factor of an industrial three phase load of 490 kW is to be improved from 0.7 lagging to 0.97 lagging by connecting loss free delta connected capacitors across the 6.6 kV, 50 Hz supply. The cost of suitable capacitors and control gear is Rs. 200 per kVAR and the annual tariff charge is Rs. 120 per kVA maximum demand. The annual interest and depreciation charge are 15% calculate.
   i. The total kVAR rating of capacitors required.
   ii. The required value of capacitance required
   iii. That net annual saving. **(GATE 92)**

41. When a fixed amount of power is to be transmitted, the efficiency of transmission increases when
   i. Voltage decrease, power factor remains constant
   ii. Voltage increase, power factor increases
   iii. Voltage decreases, power factor decrease
   iv. Voltage constant, power factor decrease **(GATE 91)**

UNIT-V

1. i. Discuss the role of load factor on the cost of electrical energy.
   ii. From a load duration curve, the following data are available: the maximum demand on the system is 25 MW. The load supplied by two units is 15 MW and 12.5 MW. Unit no.1 acts as a base load unit and No.2 as a peak load unit. The base load unit works for 100% of the time and peak load unit for only 40% of time the energy generated by unit No.1 is 1×10^8 units and that by No.2 is 1×10^7 units. Determine the load factor, plant capacity factor and plant use factor of each unit and load factor of the total plant. **(May 09, 08, Sep 08)**

11. What are the uses of integrated load duration curve? **(May 09, 07)**

25. Explain the terms load factor and diversity factor and discuss their effect on the cost of generation of electrical energy. **(May 09, 04, Nov 03, 02)**

32. Explain how a load duration curve is plotted. What is its use? **(May 09, Nov 03)**

2. i. Define the load factor? What is it importance? **(Sep 08)**
   ii. A central station supplied energy to two substations A and B, four feeders take off from each of the sub-stations the maximum demand are as given below
   Central station : 10MW Feeders on substation A : 1.5, 2, 5, 3 MW
   Substation A : 6 MW Feeders on substation B : 2, 4, 5, 1 MW
   Substation B : 8 MW
   Calculate the diversity factors between
   a. substations
   b. feeders on substation A and
   c. Feeders on substation B.

3. i. Explain the load curve and factors that can deduced from the curve **(Sep 08)**
   ii. The annual load duration curve of a certain power station can be considered as a straight line from 20MW to 4MW. To meet this load, three turbine-generator units, two rated at 10 MW each and one rated at 5MW are installed. Determine
   a. installed capacity
   b. plant factor
   c. units generated per annum and
   d. utilization factor.

4. i. Define the diversity factor? What is its importance? **(Sep 08)**
   ii. A generating station supplied the following loads: 150MW, 120MW, 85MW, 60MWand 5MW. The station has a maximum demand of 220 MW. The annual load factor of the station is 48%, calculate
   a. the number of units supplied annually
   b. the diversity factor and
   c. the demand factor.

5. i. Define the terms: plant capacity factor and plant use factor and explain their importance in an electric supply system
   ii A generating station has the following daily load cycle:

Time (hour)	0-6	6-10	10-12	12-16	16-20	20-24
Load (MW)	40	50	60	50	70	40

   Draw the load curve and find the (i) maximum demand (ii) units generated per day (iii) average load and (iv) load factor. **(May 08, Apr 04, Nov 03)**

6. i. Explain clearly how a good load factor and a good diversity factor help to keep overall cost of generation low. **(May 08, 07)**
   ii. The peak load on a 50MW power station is 39 MW. It supplies power throughfor transformers whose connected loads are 17, 12, 9 and 10 MW. The maxi-mum demands on these transformers are 15, 10 8 and 9 MW respectively. If the annual load factor is 50% and the plant is operating for 65% of the period in the year, find out
   a. average load on the station
   b. energy supplied per year
   c. demand factor
   d. diversity factor and
   e. use factor for the power station.

7. i. Define the following: **(May 08, 07)**
   a. Connected load
   b. maximum demand
   c. demand factor.
   d. Average load
   ii. A power supply is having the following loads.

Type of load	max.demand (kW)	Diversity of group	Demand factor
Domestic	15,000	1.25	0.7
Commercial	25,000	1.2	0.9
Industrial	50,000	1.3	0.98

   If the overall system diversity factor is 1.5, determine
   a. the maximum demand
   b. connected load of each type

8. i. What do you understand by the load curve? What information is conveyed by a load curve?
   ii. Describe the desirable characteristics of a tariff. **(Sep, May 07)**

9. i. Define and explain the importance of the following terms in generations. **(Sep 07)**
   a. connected load
   b. maximum demand
   c. demand factor and
   d. average load.
   ii. Discuss the various methods of determining the depreciation of the equipment.

We didn't get great goals. We just scored no-fear goals. Heart goals.

- Rich Pilon

10. i. Write notes on Sinking found method of depreciation calculation. **(May 07)**
    ii. A power station has to meet the following demand.
    Group A : 200 kW between 8 am and 6 pm.
    Group B : 100 kW between 6 am and 10 am.
    Group C : 50 kW between 6 am and 10 am.
    Group D : 100 kW between 10 am and 6 pm and then between 6 pm and 6 am.
    a. diversity factor
    b. units generated per day
    c. load factor

12. i. What do you understand by the load curve? What information is conveyed by a load curve? A consumer has a maximum demand of 200 kW at 40 % load factor. If the tariff is Rs.1000 per kW of maximum demand plus Rs.2 per kWh, find the overall cost per kWh.
    ii. Define the following terms:
    a. Connected load
    b. Maximum demand
    c. Demand factor
    d. Load factor. **(Apr 05, Nov 03)**

13. Discuss the important points to be taken into consideration while selecting the size and number of units. **(Apr 05, 04, Nov 03)**

14. Write short notes on the following:
    i. Condenser
    ii. Mass curve
    iii. Load duration curve **(Apr 04)**

15. A residential consumer has a connected load of 10 lamps each of 100 W at his premises. His demand is as follows: From midnight to 5 am, 100 W; from 5 am to 6 pm, no load; from 6 pm to 7 pm, 800 W; from 7 pm to 9 pm, 900 W; from 9 pm to midnight, 400 W. (i) Plot the load curve, (ii) Find the energy consumption during 24 hour and (iii) Calculate the demand factor, average load, maximum load and load factor. **(Apr 04)**

16. Define and explain the importance of the following terms in generations:
    i. Connected load
    ii. Maximum demand
    iii. Demand factor and
    iv. Average load. **(Apr 04)**

17. Define the term "Diversity factor" and prove that the load factor of a supply system is improved by increase in diversity of load. **(Apr 04)**

18. A generating station has a maximum demand of 20 MW, load power factor of 60%, a plant capacity of 48% and a plant use factor of 80%. Find
    i. the daily energy produced
    ii. the reserve capacity of the plant and
    iii. the maximum energy that could be produced daily if the plant running all the time. **(Apr 04)**

19. A power supply is having the following loads: -

Type of load	Max. demand (kW)	Diversity of group	Demand factor
Domestic	1500	1.2	0.8
Commercial	2000	1.1	0.9
Industrial	10000	1.25	1.0

Who walks the fastest, but walks astray, is only furthest from his way.

- Matthew Prior

If the overall system diversity factor is 1.35, determine (i) the maximum demand and (ii) connected load of each type. **(Apr 04)**

20. Write short notes on the advantages of high load factor. **(Apr 04)**

21. Explain how load curves help in the selection of size and number of generating units. **(Apr 04)**

22. Write short notes on the following:
    i. Load curves
    ii. Load factor
    iii. Plant capacity factor
    iv. Mention their practical significance. **(Apr 04)**

23. It has been desired to install a diesel power station to supply power in a suburban area having the following particulars: (i) 1000 houses with average connected load of 1.5 kW in each house, the demand factor and the diversity factor being 0.4 and 2.5 respectively, (ii) 10 factories having overall maximum demand of 90 kW. (iii) 7 bore-wells of 7 kW each and operating together in the morning. The diversity factor among above three types of consumers is 1.2. What should be the minimum capacity of the power station? **(Apr 04)**

24. A generating station is to supply four regions of load whose peak loads are 10 MW, 5 MW, 8 MW and 7 MW. The diversity factor at the station is 1.5 and the average annual load factor is 60%. Calculate: (i) The maximum demand on the station. (ii)Annual energy supplied by the station. Suggest the installed capacity and the number of units. **(Apr 04)**

26. A diesel station supplies the following loads to various consumers: Industrial consumer=1500 kW; commercial establishment = 750 kW; Domestic power = 100 kW; Domestic light = 450 kW. If the maximum demand on the station is 2500 kW and the number of kWh generated per year is 45x I 05, determine (i) the diversity factor and (ii) the annual load factor. **(Apr 04, Nov 03)**

27. Explain the following terms
    i. Load factor
    ii. Capacity factor
    iii. Maximum demand
    iv. Plant factor
    v. Utilization factor **(Nov 03)**

28. Define the term "Diversity factor" and prove that the load factor of a supply system is improved by increase in diversity of load. **(Nov 03)**

29. i. What do you understand by (i) base load and (ii) peak load of a power station?
    ii. Explain how load curves help in the solution of size and number of generating units. **(Nov 03)**

30. i. Explain how load curves help in the selection of size and number of generating units.
    ii. A factory has a maximum load of 240 kW at 0.8 pf lagging with an annual consumption of 50 000 units. The tariff is Rs. 350 per kVA maximum demand plus Rs. 2 per unit. Calculate the flat rate of energy consumption. What will be the annual saving if pf is raised to unity? **(Nov 03)**

31. A power station has a daily load cycle as under: 260 MW for 6 hour; 200 MW for 8 hour; 160 MW for 4 hour; 100 MW for 6 hour. If the power station is equipped with 4 sets of 75 MW each, calculate
    i. Daily load factor

ii. Capacity factor and
iii. Daily requirement of fuel if the calorific value of oil used were of 10,000 kcal/kg and the average heat rate of station were 2860 kcal/kWh **(Nov 03)**

33. i. Enlist the effects of high load factor on the operation of power plants.
ii. The tariff in force is Rs. 550 per KVA of maximum demand and Rs. 2.5 per unit consumed. If the load factor is 40%, find the overall cost per unit at
a. Unity pf and b. 0.7 pf **(Nov 03)**

34. Write notes on the advantages of high load factor**.** **(Nov 03)**

35. i. Discuss the various methods of determining the depreciation of equipment.
ii. A 100 MW power station delivers 100 MW for 2 hour, 75 MW for 6 hour and is shut down for the rest of each day. It is also shut down for maintenance for 20 days each year. Calculate its annual load factor. **(Nov 03)**

36. What do you understand by the load curve? What information is conveyed by a load curve? **(Nov 03)**

37. A 20,000 kW generating station has the following generating cost
a) Capital cost = Rs. 150×10^5
b) Annual taxation = Rs. 10×10^5
c) Annual salaries and wages = Rs. 30×10^5
The calorific value of the coal burnt is 55×10^5 cal/kg. The cost of fuel is Rs.150 per tone.
Assume plant heat rates 29×10^5 cal/k.w.h. at 100% capacity factor and 38×10^5 cal/k.w.h. at 60% capacity factor. Calculate the generating cost at 60% and 100% capacity factor. Assume interest and depreciation is 15%. **(Nov 02)**

38. Write short notes on the following:
i. Load factor and Diversity factor
ii. Hydrograph and Mass Curve
iii. Radiation hazards and Safety precautions **(Apr 01)**

39. A power station has a maximum demand of 15,000 kW. The annual load factor is 50% and the capacity factor is 40%. Determine the plant capacity and reser4ve capacity in kW. **(Apr 01)**

40. i. Explain the procedure to be followed for finding the most economical size of conductor.
ii. A 500 MW reactor uses Natural Uranium as fuel. Assuming an overall efficiency of 31% and a 100% load factor throughout the year, find the fuel consumed in one year. Natural Uranium contains 0.712% U^{235}. **(Apr 01)**

41. i. Define the following :
a. Load factor
b. Demand factor
c. Diversity factor
d. Maximum demand
e. Connected load
ii. Discuss the economic feasibility of a pumped storage plant. **(Apr 2000)**

42. A power system has two generators with the following cost curves:

$$G1:\text{-}\ C1\ (P_G1) = 0.006P^2g1 + 8P_G1 + 350 \quad (Rs\ 1000/Hour)$$

$$G2:\text{-}\ C2\ (P_G2) = 0.009P^2G2 + 7P_G2 + 400 \quad (Rs\ 1000/Hour)$$

The generator limits are:-

$$100mw \le PG1 \le 650\ mw$$

$$50mw \le PG2 \le 500\ mw$$

Honesty is for the most par less profitable than dishonesty.

- Plato

A load demand of 600 mw is supplied by the generators in an optimal manner. Neglecting losses in the transmission network, determine the optimal generation of each generator.

43. A power station has a maximum demand of 15,000 kW, the annual load factor is 50% and the capacity factor is 40%. Determine the plant capacity and reserve capacity in kW. **(Apr 2000)**

44. An industrial consumer has a daily load pattern of 2000 kW, 0.8 lag for 12 hours, and 1000 kW UPF for 12 hours. The load factor is: **(GATE 99)**
a) 0.5 b) 0.75 c) 0.6 d) 2.0

45. An Alternator has an Armature resistance of 0.3Ω and leakage reactance of 1.22 Ω.The Alternator supplies 100A current to a feeder of resistance 1.5Ω and reactance 2.0Ω .The voltage at the far end of the feeder is 3000v .The load current having a p.f of 0.8 lagging with respect to this voltage .Find the terminal voltage of the alternator and the emf generated. **(IES 04)**

46. Define the following:-
i. Diversity Factor
ii. Load factor
iii. Plant capacity factor.
iv. Plant use factor. **(IES 04)**

1. i. What are the special features of two plant tariff? For which category of consumers is it used? Discuss the importance of encouraging customers to use electricity during off-peak hours. **(Sep 08)**
ii. The energy cost of a 100MW steam station working at 40% load factor comes out to be 12 paise / KWh of energy generated what will be the cost of energy generated if the load factor is improved to 60%? The fuel cost of the power station due to increased generation increase the annual generation cost by 5%.

2. i. What is tariff? Discuss and compare various tariffs used in practice. Also,explain the reasons why power factor tariff is imposed. **(Sep 08, May 07)**
ii. A generating station has the following data:
Installed capacity =300 MW, capacity factor =50%, Annual load factor =60%.
Annual cost of fuel, oil etc. = Rs. 9 × 107, capital cost = Rs. 109, annual interest and depreciation 10%.
Calculate
a. the minimum reserve capacity of the station and b. the cost per KWh generated.

3. Give the basis for expressing the cost of electrical energy as (a + b * kW + c * kWh) and explain the factors on which a, b and c depend. **(Sep 08, Apr 05, Nov 03)**

4. i. What are the factors to be considered in fixing up the tariff. **(Sep 08, May 07)**
ii. An industrial consumer having a maximum demand of 100 kW, maintain a load factor of 60%. The tariff rates are Rs. 900 per kVA of maximum demand per annum plus Rs. 1.8 per kWh of energy consumed. If the average p.f is 0.8 lagging, calculate the total energy consumed per annum and the annual electricity bill. Also workout the overall cost per kWh consumed.

5. i. Discuss the flat rate and block rate tariffs. **(May 08)**
ii. A power station has an installed capacity of 20,000 kW. The cost of the station is Rs. 1,200/kW. The fixed costs are 13% of the cost of investment on full load at 100% load factor, the variable costs of the station per year is 1.5 times the fixed costs. Assume that there is no reserve capacity of the plant and that are variable costs and proportional to energy production. Find the cost of generation per kWh at load factor

No one is wise or safe, but they that are honest.
- Sir Walter Raleigh

of 100% and 20%. Comment on the results.

6. i. Describe the desirable characteristics of a tariff. **(May 08)**
   ii. A steam station with an installed capacity of 120 MW has the following data:
   Maximum demand = 100 MW; Average Load factor = 0.75
   Capital cost = Rs. 800/ kW installed
   Interest and depreciation = 12%
   Operational cost = Rs. 1 × 106 per annum.
   Maintenance cost .(2/5fixed, 3/5variable) = Rs. 6.5×10^5 p.a.
   Cost of fuel = Rs. 35 per metric ton
   Calorific value of fuel = 6,500 k. cal / kg
   Generator efficiency = 96% Thermal efficiency of turbine = 28% Boiler efficiency = 75% Overall thermal efficiency = 20%
   Determine the total fixed costs, total variable costs and the cost / kW generated.

7. Describe the desirable characteristics of a tariff. **(May 08, 04, Nov 03)**

8. What are the factors influencing tariff design and explain the various types of tariffs in detail. **(May 08)**

9. i. Explain with examples : **(May 07)**
   a. Flat rate tariff b. Block rate tariff c. Two part tariff d. power factor tariff.
   ii. A 125 kVA transformer with a copper loss of 1.4 kW at full load an iron loss of 1.2 kW has the following operating schedule per year. Full load at 0.8 p.f for 2,000 hrs Half - full load at 0.8. p.f. for 2,500 hrs no-load for the remaining hours.Find the total annual electricity bill if the flat rate tariff is 60 paise / kWh.

10. i. What is the difference between flat rate tariff and block rate tariff. **(May 07)**
    ii. Obtain a two part tariff for the consumers of a supply undertaking which generates 390×106 kWh per annum and has a maximum demand of 130MW connected to it. The cost is distributed as follows:
    Fuel Rs. 5 × 106, generation Rs. 2.4 × 106, transmission Rs. 5 × 106 and distribution Rs. 3.4 × 106, of these items 90%, 10%, 5% and 7% respectively are allocated to running costs, the remainder being a fixed charge. The total loss between the station and the consumers is 10% of the generated energy. If the load factor of the station is raised to 40% for the same maximum demand, find the percentage saving in the overall cost per kWh.

11. Discuss the various methods of determining the depreciation of the equipment. **(Apr 05, 04)**

12. Calculate annual bill of a consumer whose maximum demand is 100 kW, pf = 0.8 lagging and load factor = 60%. The tariff used is Rs. 475 per kVA of maximum demand plus Rs. 2.5 per kWh consumed. **(Apr 05)**

13. An equipment in a power station costs Rs. 15 60 000 and has a salvage value of Rs. 60 000 at the end of 25 years. Determine the depreciated value of the equipment at the end of25 years on the following methods:
    i. Straight line method;
    ii. Diminishing value method. **(Apr 04)**

14. Sinking found method of depreciation. **(Apr 04)**

15. A factory has a maximum load of 240 kW at 0.8 pf' lagging with an annual consumption of 50 000 units. The tariff is Rs. 350 per kV A maximum demand plus Rs. 2 per unit. Calculate the flat rate of energy consumption. What will be the annual saving if pf is raised to unity? **(Apr 04)**

16. Write short notes on the following:
    i. Two - part tariff

In jealousy there is more of self-love than love.

- Francois De La Rochefoucauld

ii. Power factor tariff
iii. Three - part tariff. **(Apr 04)**

17. What do you understand by tariff? Discuss the objectives of tariff. **(Apr 04, Nov 03)**

18. Describe some of the important types of tariff commonly used. **(Apr 04, Nov 03)**

19. Explain the terms interest and depreciation as applied to economics of power generation. **(Apr 04)**

20. A distribution Transformer costs Rs. 4,00,000 and has a useful life of 20 years. If the salvage value is Rs. 20 000 and rate of annual compound interest is 8%, calculate the amount to be saved annually for replacement of the Transformer after the end of 20 years by sinking fund method. **(Apr 04)**

21. Discuss the different classifications of costs of electrical energy. **(Nov 03)**

22. The power generation equipment of a power station costs Rs. 60, 75, 000 and has a useful life of 30 years. If the salvage value of the equipment is Rs. 3, 00, 000 and annual interest rate is 6%, determine the annual amount to be saved by sinking fund method. **(Nov 03)**

23. Estimate the generating cost per unit delivered at the station, given the following data:

Capacity of the plant installed	=	50 MW
Annual load factor	=	40%
Capital Cost	=	Rs.3×10^6
Annual cost of fuel, oil, taxation, wages and salaries	=	Rs.4×10^6
Interest rate	=	5%;

Rate of depreciation is 5% of initial value. **(Apr 03)**

24. Discuss the various methods of determining the depreciation of the equipment. **(Apr 03)**

25. What is tariff? Discuss and compare various tariffs used in practice. **(Nov 02, 03, Apr 04)**

26. A 20,000 kW generating station has the following generating cost

a) Capital cost	=	Rs. 150×10^5
b) Annual taxation	=	Rs. 10×10^5
c) Annual salaries and wages	=	Rs. 30×10^5

The calorific value of the coal burnt is 55×10^5 cal/kg. The cost of fuel is Rs.150 per tone. Assume plant heat rates 29×10^5 cal/k.w.h at 100% capacity factor and 38×10^5 cal/k.w.h. at 60% capacity factor. Calculate the generating cost at 60% and 100% capacity factor. Assume interest and depreciation is 15%. **(Nov 02)**

27. Discuss various types of power tariffs. **(Apr 01)**

28. Explain what a two-part Tariff is. **(Apr 2000)**

29. A proposed factory is to have constant load of 200 kW at 0.8pf. The local electric supply company offers to supply energy at the following alternate rates.
i. High voltage supply at Rs 2/- per kVA of maximum demand per month plus 4 paise per kWh per kWh
ii. Low voltage supply at Rs 2.10 per kVA of maximum demand per month plus 4 paise per kWh
High voltage switchgear cost Rs 48/- per kVA and loss at full load is 4% in the switchgear. Interest, depreciation and other charges are 15% of capital cost. If the factory has to work 48 Hrs per week. Calculate which alternative is economical. **(OU-Nov 04)**

30. Explain two part tariff **(OU-July 04)**

The jealous are possessed by a mad devil and a dull spirit at the same time.

- Johann Kaspar Lavater

31. List the fixed costs of generated power. **(OU-Mar 04)**

32. Explain how two part tariff is devised. **(OU-Mar 04)**

33. List the fixed costs of electrical energy. **(OU-Mar 04)**

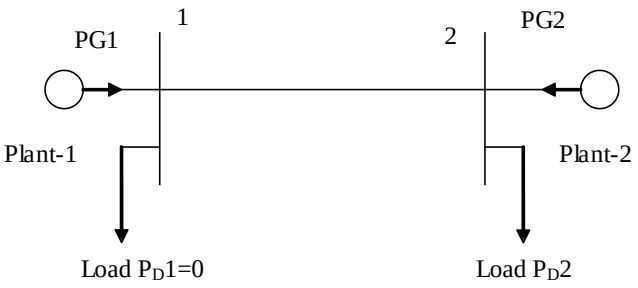
34. Explain the flat rate tariff **(OU-Mar 00)**

35. Find cost per unit of a 500 MW generating station from following data:
Maximum Demand=40,000 kW; Annual Load Factor=55%;
Capital Cost=Rs 1500 per kW; total annual cost of fuel, oil and taxation=Rs 250x 10^6
Interest and depreciation **(OU-Sept 99)**

36. What is two part tariff and which category of consumers are changed with this? **(OU-Oct 98)**

37. The fuel inputs of Plants 1 and 2 are given as
$F_1 = 0.2\ P1^2 + 40P1 + 120$ Rs/hr.
$F_2 = 0.25P22 + 30P2 + 150$ Rs/hr
Determine the economic operating schedule and the corresponding cost of generation if the maximum and minimum loading of each machine is 100 MW and 25 MW, the demand is 180 MW and transmission losses are neglected. If the load is equally shared by both units, determine the saving uptained by load the units as per incremental cost. **(IES 03)**

38. A two –bus system is shown in figure. If 100 MW is transmitted from plant 1 to the load ,a transmission loss of 10 kW is incurred. Find the required generation for eachplant and the power received by the load when the system λ is Rs 25/MWh. The incremental fuel cost of the plant are:
dF /dP = 0.02P + 16 Rs/ MWh.
dF /dP = 0.02P + 20 Rs/ MWh.



(IES 96)