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Lecture Plan -1

Semester: V **Class:-EEE** **Course Code: EE-315-F**

Subject: - **POWER SYSTEM I** Section-A

S. No.	Topic: - STRUCTURE OF A POWER SYSTEM	Time Allotted:-
1.	**Introduction** The syllabus comprises four units. A major portion of the syllabus is related load analysis, voltage control .	10 min
2	**Division of the Topic** ➢ Representation of components ➢ One line diagram	30 min
3.	**Conclusion** A **substation** is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. Between the generating station and consumer, electric power may flow through several substations at different voltage levels. Substations may be owned and operated by an electrical utility, or may be owned by a large industrial or commercial customer. Generally substations are unattended, relying on SCADA for remote supervision and control. Single line diagram is made to know the impedances on transmission lines.	5 min
4		5 min

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher

2. Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3. Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -2

Semester: - **V** **Class:-EEE** Course Code: **EE-315-F**
Subject:-**POWER SYSTEM I** Section-A

S. No.	**Topic** : **DISTRIBUTION SYSTEM AND NUMERICALS BASED ON TRANSMISSION LINES**	**Time Allotted:-**
1.	**Introduction** The input for a distribution substation is typically at least two transmission or subtransmission lines. Input voltage may be, for example, 115 kV, or whatever is common in the area. The output is a number of feeders. Distribution voltages are typically medium voltage, between 2.4 kV and 33 kV depending on the size of the area served and the practices of the local utility. The feeders run along streets overhead (or underground, in some cases) and power the distribution transformers at or near the customer premises. In addition to transforming voltage, distribution substations also isolate faults in either the transmission or distribution systems. Distribution substations are typically the points of voltage regulation, although on long distribution circuits (of several miles/kilometers), voltage regulation equipment may also be installed along the line.	10 min 30 min
2	**Division of the Topic** ➢ Single line diagram ➢ Representation of different components ➢ Per Unit system	5 min
3.	**Conclusion** Per unit system simplifies the model of a transmission line system.	5 min
4		

Assignment to be gVen: - Draw single line diagram of any substation.
Reference Readings: - 1 Power system engineering by Nagrath TMH publisher
2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

Lecture Plan -3

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-A

S. No.	Topic :- LAYOUT, AUXILIARY SUPPLY	Time Allotted:-
1.	**Introduction** Early electrical substations required manual switching or adjustment of equipment, and manual collection of data for load, energy consumption, and abnormal events. As the complexity of distribution networks grew, it became economically necessary to automate supervision and control of substations from a centrally attended point, to allow overall coordination in case of emergencies and to reduce operating costs. Early efforts to remote control substations used dedicated communication wires, often run alongside power circuits.	10 min
2	**Division of the Topic** ➢ Power system components ➢ Electrical supply system ➢ Complex Power	30 min
3.	**Conclusion** The first step in planning a substation layout is the preparation of a one-line diagram, which shows in simplified form the switching and protection arrangement required, as well as the incoming supply lines and outgoing feeders or transmission lines. It is a usual practice by many electrical utilities to prepare one-line diagrams with principal elements (lines, switches, circuit breakers, transformers) arranged on the page similarly to the way the apparatus would be laid out in the actual station.	5 min
4		5 min

Assignment to be gVen:-

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -4

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-A

S. No.	Topic :- THE STEADY STATE MODEL OF SYNCHRONOUS MACHINE	Time Allotted:-
1.	**Introduction** Synchronous machines are commonly used as generators especially for large power systems, such as turbine generators and hydroelectric generators in the grid power supply. Because the rotor speed is proportional to the frequency of excitation, synchronous motors can be used in situations where constant speed drive is required.	10 min
2	**Division of the Topic** ➢ Synchronous generator ➢ Direct and quadrature axis ➢ Equivalent circuit model	30 min
3.	**Conclusion.** With power electronic variable voltage variable frequency (VVVF) power supplies, synchronous motors, especially those with permanent magnet rotors, are widely used for variable speed drives.	5 min
	Question /Answer **Q. How synchronous motor is used in power system?** **Ans.** Since the reactive power generated by a synchronous machine can be adjusted by controlling the magnitude of the rotor field current, unloaded synchronous machines are also often installed in power systems solely for power factor correction or for control of reactive kVA flow. Such machines, known as synchronous condensers, may be more economical in the large sizes than static capacitors	

Assignment to be gVen:-

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -5

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-A

S. No.	Topic :- TRANSMISSION OF ELECTRIC POWER	Time Allotted:-
1.	**Introduction** Electric-power transmission is the bulk transfer of electrical energy, from generatingpower plants to electrical substations located near demand centers. This is distinct from the local wiring between high-voltage substations and customers, which is typically referred to as electric power distribution. Transmission lines, when interconnected with each other, become transmission networks.	10 min
2	**DVision of the Topic** ➢ Transmission line ➢ Components	30 min
3.	**Conclusion** The combined transmission and distribution network is known as the "power grid" .	5 min

Assignment to be gVen:-

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher
2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -6

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-A

S. No.	Topic : **POWER SYSTEM PROTECTION**	Time Allotted:-
1.	**Introduction** A switchgear or electrical switchgear is a generic term which includes all the switching devices associated with mainly power system protection. It also includes all devices associated with control, metering and regulating of electrical power system. Assembly of such devices in a logical manner forms a switchgear.	10 min
2	**DVision of the Topic** ➢ Introduction to switch gear ➢ Protection equipment's	30 min
3.	**Conclusion** Typically, switchgears in substations are located on both the high- and low-voltage sides of large power transformers. The switchgear on the low-voltage side of the transformers may be located in a building, with medium-voltage circuit breakers for distribution circuits, along with metering, control, and protection equipment. For industrial applications, a transformer and switchgear line-up may be combined in one housing, called a unitized substation (USS).	

Assignment to be gVen:-

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

3 Elements of power system analysis: W.D.Stevenson (MGH)

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Lecture Plan -7

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-B

S. No.	Topic :- LOAD FLOW STUDIES	Time Allotted:-
1.	**Introduction** In power engineering, the power-flow study, or load-flow study, is a numerical analysis of the flow of electric power in an interconnected system. A power-flow study usually uses simplified notation such as a one-line diagram and per-unit system, and focuses on various aspects of AC power parameters, such as voltages, voltage angles, real power and reactive power. It analyzes the power systems in normal steady-state operation.	10 min
2	**DVision of the Topic** ➢ Network model formulation ➢ Formation of Y BUS by singular transformation ➢ Load flow problem	30 min
4	**Question /Answer** **Q. what are the advantages of Y BUS system?** **Ans.** YBUS is used to study load flow of transmission lines .	5 min 5 min

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher
2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

Lecture Plan -8

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-B

S. No.	Topic : LOAD FLOW PROBLEM	Time Allotted:-
1.	**Introduction** An **alternating current** power-flow model is a model used in electrical engineering to analyze power grids. It provides a nonlinear system which describes the energy flow through each transmission line. The problem is non-linear because the power flow into load impedances is a function of the square of the applied voltages. Due to nonlinearity, in many cases the analysis of large network via AC power-flow model is not feasible, and a linear (but less accurate) DC power-flow model is used instead.	10 min
2	**Division of the Topic** ➢ Slack bus ➢ PV Bus ➢ PQ Bus	30 min
3.	**Conclusion** The solution to the power-flow problem begins with identifying the known and unknown variables in the system. The known and unknown variables are dependent on the type of bus. A bus without any generators connected to it is called a Load Bus. With one exception, a bus with at least one generator connected to it is called a Generator Bus. The exception is one arbitrarily-selected bus that has a generator.	5 min
4	**Question /Answer** **Q. what is slack bus?** **Ans.** For the Slack Bus, it is assumed that the voltage magnitude $\|V\|$ and voltage phase are known.	5 min

Assignment to be gVen:-

Reference Readings:- 1 Solid State Electronic Devices: Streetman & Banerjee;Pearson

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -9

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-B

S. No.	Topic :- NEWTON RAPHSON METHOD	Time Allotted:-
1.	**Introduction** There are several different methods of solving the resulting nonlinear system of equations. The most popular is known as the Newton–Raphson method. This method begins with initial guesses of all unknown variables (voltage magnitude and angles at Load Buses and voltage angles at Generator Buses). Next, a Taylor Series is written, with the higher order terms ignored, for each of the power balance equations included in the system of equation.	10 min
2	**Division of the Topic** ➢ Rough Outline ➢ Jacobian Matrix	30 min
3.	**Conclusion** The above parameters are important to find the characteristics and voltage regulation of a transmission lines.	5 min
4		5 min

Reference Readings:- 1 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
2 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -10

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-B

S. No.	Topic :- NEWTON RAPHSON'S METHOD CONTD.	Time Allotted:-
1.	**Introduction** The linearized system of equations is solved to determine the next guess (m + 1) of voltage magnitude and angles based on: $\theta^{m+1} = \theta^m + \Delta\theta$ $\lvert V\rvert^{m+1} = \lvert V\rvert^m + \Delta\lvert V\rvert$	10 min
2	**Division of the Topic** ➢ Steps for solving equations ➢ Linearization ➢ Flow chart	30 min
3.	**Conclusion** The process continues until a stopping condition is met. A common stopping condition is to terminate if the norm of the mismatch equations is below a specified tolerance.	5 min
4		5 min

Assignment to be given:-Discuss Newton Raphson's method for load flow studies.

Reference Readings:-

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Electronic Devices And Ckt Theory :Boylested & Nashelsky ; Pearson

Lecture Plan -11

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-B

S. No.	Topic :- GAUSS SIEDEL METHOD	Time Allotted:-
1.	**Introduction** This is the earliest devised method. It shows slower rates of convergence compared to other iterative methods.	10 min
2	**DVision of the Topic** ➢ Flow chart ➢ Iterative	30 min
	Conclusion: It uses very little memory and does not need to solve a matrix system.	5 min
4		5 min

Assignment to be gVen:-

Reference Readings:- 1 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

Lecture Plan -12

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-B

S. No.	Topic :- DECOUPLED LOAD FLOW STUDIES	Time Allotted:-
1.	**Introduction** It is a variation on Newton-Raphson that exploits the approximate decoupling of active and reactive flows in well-behaved power networks, and additionally fixes the value of the Jacobian during the iteration in order to avoid costly matrix decompositions	10 min
2	**DVision of the Topic** ➢ Flow Chart ➢ Assumptions	30 min
3.	**Conclusion** Fast decoupled load flow can return the answer within seconds whereas the Newton Raphson method takes much longer. This is useful for real-time management of power grids.	5 min
4		5 min

Assignment to be given:- Differentiate between Newton Raphson and Fast Decoupled flow analysis

Reference Readings:- 1 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
2 Elements of power system analysis: W.D.Stevenson (MGH)

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Lecture Plan -13

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-C

S. No.	Topic :- OPTIMAL SYSTEM OPERATION	Time Allotted:-
1.	**Introduction** This chapter covers existing methodologies for solution of Optimal Power Flow (OPF) problem. They include formulation of OPF problem, objective function, constraints, applications and in-depth coverage of various popular OPF methods..	10 min
2	**Division of the Topic** ➢ OPF ➢ Objective ➢ Function ➢ Constraint	30 min
3.	**Conclusion** The OPF methods are broadly grouped as Conventional and Intelligent. The conventional methodologies include the well known techniques like Gradient method, Newton method, Quadratic Programming method, Linear Programming method and Interior point method. Intelligent methodologies include the recently developed and popular methods like Genetic Algorithm, Particle swarm optimization. Solution methodologies for optimum power flow problem are extensively covered in this chapter.	5 min
4	**Question /Answer** **Q.what are the factors which govern the performance of a transmission line** **Ans.** These are series R and L and shunt conductance and capacitance. **Q. How do you classify transmission lines** **Ans.** Transmission lines are classified depending upon the manner in which capacitance is taken into account.	5 min

Assignment to be gVen:-

Reference Readings:- 1 Solid State Electronic Devices: Streetman & Banerjee;Pearson
2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)

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Lecture Plan -14

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-C

S. No.	Topic :- OPTIMAL OPERATION	Time Allotted:-
1.	**Introduction** In an OPF, the values of some or all of the control variables need to be found so as to optimise (minimise or maximize) a predefined objective. It is also important that the proper problem definition with clearly stated objectives be given at the onset. The quality of the solution depends on the accuracy of the model studied. Objectives must be modeled and its practicality with possible solutions.	10 min
2	**Division of the Topic** ➢ Problem ➢ Objective	30 min
3.	**Conclusion** OPF aims to optimise a certain objective, subject to the network power flow equations and system and equipment operating limits. The optimal condition is attained by adjusting the available controls to minimise an objective function subject to specified operating and security requirements.	5 min
4		5 min

Reference Readings:-

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)

Doc. No.: DCE/0/15
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Lecture Plan -15

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-C

S. No.	Topic :- OPTIMAL LOAD FLOW SOLUTION	Time Allotted:-
1.	**Introduction** The controllable system quantities are generator MW, controlled voltage magnitude, reactive power injection from reactive power sources and transformer tapping. The objective use herein is to minimize the power transmission loss function by optimizing the control variables within their limits. Therefore, no violation on other quantities (e.g. MVA flow of transmission lines, load bus voltage magnitude, generator MVAR) occurs in normal system operating conditions. These are system constraints to be formed as equality and inequality constraints as shown below.	10 min
2	**Division of the Topic** Power flow through transmission lines	30 min
3.	**Conclusion** A key limitation of electric power is that, with minor exceptions, electrical energy cannot be stored, and therefore must be generated as needed. A sophisticated control system is required to ensure electric generation very closely matches the demand.	5 min

Assignment to be gVen:-

Reference Readings:- 1 Solid State Electronic Devices: Streetman & Banerjee;Pearson
2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)
4

Lecture Plan-16

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-C

S. No.	Topic :- OPTIMAL UNIT COMMITTMENT	Time Allotted:-
1.	**Introduction** The problem of unit commitment involves finding the least-cost dispatch of available generation resources to meet the electrical load.	10 min
2	**DVision of the Topic** ➢ Key decisions ➢ Variable sources of generation **Conclusion :** Generating plants are subject to a number of complex technical constraints, including: 1. Minimum stable operating level 2. Maximum rate of ramping up or down 3. Minimum time period the unit is *up* and/or *down* These constraints are amenable to mathematical programming as linear or mixed-integer constraints.	30 min
4	**Question /Answer** **Q. What is goal of transient stability?** **Ans.** The goal of transient stability simulation of power systems is to analyse the stability of a power system in a time window of a few seconds to several tens of seconds. Stability in this aspect is the ability of the system to quickly return to a stable operating condition after being exposed to a disturbance such as for example a tree falling over an overhead line resulting in the automatic disconnection of that line by its protection systems.	5 min

Reference Readings:-

1Electrical power: J.B.Gupta (S.K.Kataria & Sons).
2Elements of power system analysis: W.D.Stevenson (MGH)

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Lecture Plan -17

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-C

S. No.	Topic :-POWER CIRCLE DIAGRAM	Time Allotted:-
1.	**Introduction** The circle diagram drawn with receVing end true and reactVe power components as the horizontal and vertical ordinates is called the power circle diagram.	10 min
2	**DVision of the Topic** ➢ Power circle diagram ➢ Receiving end Power circle diagram ➢ Sending end Power circle diagram ➢ Universal Power circle diagram .	30 min
4	**Question /Answer** **Q. what is surge impedance loading?** **Ans.** The SIL or natural load is the load that can be delVered by a line having no resistance and the loading being drVen at unity power factor. **Q. How does synchronous phase modifier differ from a synchronous motor?** **Ans**. synchronous phase modifier differ from a synchronous motor as they are built for the highest economical speeds, and provided with smaller shafts and bearings.	5 min

Assignment to be gVen:-

Reference Readings:- 1 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
2 Elements of power system analysis: W.D.Stevenson (MGH)

Doc. No.: DCE/0/15
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Lecture Plan -18

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-C

S. No.	Topic :-OPTIMAL GENERATION SCHEDULING	Time Allotted:-
1.	**Introduction** A simple method to optimize generation scheduling for thermal power plant using artificial neural network is presented. The optimal generation of generators is achieved considering operational and load constraints. The B- Coefficients are used to evaluate transmission loss in the system. The fuel cost of each unit in a plant is computed. The effectiveness of methodology is tested with six thermal power plants. A result of proposed method is compared with classical method. The artificial neural network method is quick. Hence, artificial neural network technique can be used in central load dispatch center.	10 min
2	**Division of the Topic** . ➢ Economic Dispatch ➢ Optimum generation method	30 min
	Conclusion : With the large interconnection of the electric networks, the energy crisis in the world and continuous rise in prices, it is very essential to reduce the running charges of the electric energy. In developing countries like India, the cost of fuel is rapidly increasing. The main economic factor in power system planning, operation and control is the cost of generating real power.	
4		5 min

Assignment to be given:- Describe optimal generation scheduling of hydro thermal station.

Reference Readings:-

3 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
4 Elements of power system analysis: W.D.Stevenson (MGH)

Doc. No.: DCE/0/15
Revision :00

Lecture Plan -19

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-C

S. No.	Topic :- REALIABILITY CONSIDERATIONS	Time Allotted:-
1.	**Introduction** Good power system operation requires that there be no "reliability" violations (needing to shed load, have cascading outages, or other unacceptable conditions) for either the current condition or in the event of statistically likely contingencies.	10 min
2	**Division of the Topic** ➢ Contigency problem ➢ Power flow problem	30 min
	Conclusion : Reliability requires as a minimum that there be no transmission line/transformer limit violations and that bus voltages be within acceptable limits (perhaps 0.95 to 1.08)	
4		5 min

Reference Readings:-

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -20

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-D

S. No.	Topic :- AUTOMATIC GENERATION AND VOLTAGE CONTROL	Time Allotted:-
1.	**Introduction** In an electric power system, automatic generation control (AGC) is a system for adjusting the power output of multiple generators at different power plants, in response to changes in the load. Since a power grid requires that generation and load closely balance moment by moment, frequent adjustments to the output of generators are necessary.	10 min
2	**Division of the Topic** ➢ Load Frequency Control ➢ Turbine generator control	30 min
3.	**Conclusion** Where the grid has tie interconnections to adjacent control areas, automatic generation control helps maintain the power interchanges over the tie lines at the scheduled levels.	5 min
4		5 min

Assignment to be given:-

Reference Readings:- 1 Solid State Electronic Devices: Streetman & Banerjee;Pearson
2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -21

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-D

S. No.	Topic :- LOAD FREQUENCY CONTROL	Time Allotted:-
1.	**Introduction** It is employed to allow an area to first meet its own load demands, then to assist in returning the steady-state frequency of the system, Δf, to zero	10 min
2	**Division of the Topic** ➢ Single area control ➢ Two area control .	30 min
3.	**Conclusion** Load-frequency control operates with a response time of a few seconds to keep system frequency stable.	5 min
4		5 min

Assignment to be gVen:-

Reference Readings:-

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -22

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-E

S. No.	Topic :- TURBINE GOVERNOR CONTROL	Time Allotted:-
1.	**Introduction** Turbine generators in a power system have stored kinetic energy due to their large rotating masses. All the kinetic energy stored in a power system in such rotating masses is a part of the grid inertia. When system load increases, grid inertia is initially used to supply the load. This, however, leads to a decrease in the stored kinetic energy of the turbine generators. Since the mechanical power of these turbines correlates with the delivered electrical power, the turbine generators have a decrease in angular velocity, which is directly proportional to a decrease in frequency in synchronous generators.	10 min
2	**Division of the Topic** . ➢ Governor control	30 min
3.	**Conclusion** The purpose of the turbine-governor control is to maintain the desired system frequency by adjusting the mechanical power output of the turbine.	5 min

Assignment to be gVen:-

Reference Readings:- Electrical power: J.B.Gupta (S.K.Kataria & Sons).

3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -23

Semester:-**V** Class:-EEE Course Code:**EE-315-F**

Subject:-**POWER SYSTEM I** Section-D

S. No.	Topic :-OPTIMAL LOAD FREQUENCY CONTROL	Time Allotted:-
1.	**Introduction** With the primary LFC loop a change in the system load will result in a steady state frequency deviation , depending on the governor speed regulation. In order to reduce the frequency deviation to zero we must provide a reset action by introducing an integral controller to act on the load reference setting to change the speed set point. The integral controller increases the system type by 1 which force the final frequency deviation to zero. The integral controller gain must be adjusted for a satisfactory transient response.	10 min
2	**Division of the Topic** ➢ AGC in single area ➢ AGC in multi area **Conclusion:** It is a technique applied in the control system design that is executed by minimizing the performance index of the system variables. In this section we discuss the design of the optimal controllers for the linear systems with quadratic performance index, which is also referred to as the linear quadratic regulator.	30 min
4		5 min

Assignment to be gVen:-

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher
2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan-24

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-D

S. No.	Topic :- AUTOMATIC VOLTAGE CONTROL	Time Allotted:-
1.	**Introduction** An Automatic voltage control is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components.	10 min
2	**Division of the Topic** ➢ AVR. ➢ Excitation System ➢ Block Diagram	30 min
3.	**Conclusion** For the alternators, the excitation is provided by a device (another machine or a static device) called exciter. For a large alternator the exciter may be required to supply a field current of as large as 6500A at 500V and hence the exciter is a fairly large machine. Depending on the way the dc supply is given to the field winding of the alternator (which is on the rotor), the exciters are classified as: i) DC Exciters; ii) AC Exciters; and iii) Static Exciters.	5 min

Assignment to be gVen:-

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -25

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-D

S. No.	Topic :AUTOMATIC LOAD FREQUENCY CONTROL	Time Allotted:-
1.	**Introduction** The ALFC is to control the frequency deviation by maintaining the real power balance in the system. The main functions of the ALFC are to i) to maintain the steady frequency; ii) control the tie-line flows; and iii) distribute the load among the participating generating units	10 min
2	**Division of the Topic** ➢ ALFC ➢ Block Diagram ➢ Steady state performance	30 min
3.	**Conclusion** It achieves the primary goal of real power balance by adjusting the turbine output ΔPm to match the change in load demand ΔPD. All the participating generating units contribute to the change in generation.	5 min

Assignment to be gVen:-

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -26

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-D

S. No.	Topic :- AGC IN SINGLE AREA SYSTEM	Time Allotted:-
1.	**Introduction** In a single area system, there is no tie-line schedule to be maintained. Thus the function of the AGC is only to bring the frequency to the nominal value. This will be achieved using the supplementary loop which uses the integral controller to change the reference power setting so as to change the speed set point.	10 min
2	**DVision of the Topic** ➢ AGC in single area ➢ Block Diagram ➢ Parameter discussion	30 min
3.	**Conclusion** The integral controller gain KI needs to be adjusted for satisfactory response (in terms of overshoot, settling time) of the system. Although each generator will be having a separate speed governor, all the generators in the control area are replaced by a single equivalent generator, and the ALFC for the area corresponds to this equivalent generator.	5 min

Assignment to be given:-

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher

2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).

3 Elements of power system analysis: W.D.Stevenson (MGH)

Lecture Plan -27

Semester:-**V** Class:-EEE Course Code: **EE-315-F**

Subject:-**POWER SYSTEM I** Section-D

S. No.	Topic: - AGC IN MULTI AREA SYATEM	Time Allotted:-
1.	**Introduction** In an interconnected (multi area) system, there will be one ALFC loop for each control area (located at the ECC of that area).	10 min
2	**DVision of the Topic** ➢ Multi area system ➢ Block diagram	30 min
3.	**Conclusion** An important secondary function of the AGC is to allocate generation so that each generating unit is loaded economically. That is, each generating unit is to generate that amount to meet the present demand in such a way that the operating cost is the minimum.This function is called Economic Load Dispatch (ELD).	5 min

Assignment to be given:- Discuss ELD in detail

Reference Readings: - 1 Power system engineering by Nagrath TMH publisher
2 Electrical power: J.B.Gupta (S.K.Kataria & Sons).
3 Elements of power system analysis: W.D.Stevenson (MGH)