

Doc. No.: DCE/0/15

Lecture Plan -1

Revision :00

Semester:-6th

Course Code:- EE-312-F

Subject: - Power System II

Section: A

S. No.	Topic :- INTRODUCTION TO POWER SYSTEM	Time Allotted:-
1.	<p><u>Introduction</u></p> <p>Modern electric power systems have three separate components - generation, transmission and distribution. Electric power is generated at the power generating stations by synchronous alternators that are usually driven either by steam or hydro turbines.</p>	<u>5 min</u>
2.	<p><u>Division of the Topic</u></p> <p>-Introduction to generation,transmission,distribution -Description of generating stations -Description of Transmission Lines -Description of Distribution System</p>	<u>35 min</u>
3.	<p><u>Conclusion</u></p> <p>In this lecture, a brief idea of generation, transmission and distribution of electrical power is Given. Nonetheless, it gives a reasonable understanding of the system for a beginner going to undertake the course on power system.</p> <p>Questions / Answers</p>	<u>5 min</u>
4.	<p>Q1. What are the important conventional methods of power generation in our country?</p> <p>A1.(a) Coal based thermal plants, (b)Hydel plants © nuclear plants.</p>	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -2

Semester:-6th

Course Code:- EE-312-F

Subject:-Power SystemII

Section: A

S. No.	TOPIC :- TRANSIENTS ON A TRANSMISSION LINE	Time Allotted:-
1.	<p><u>Introduction</u> A transient fault is a fault that is no longer present if power is disconnected for a short time and then restored.</p>	<u>5 min</u>
2	<p><u>Division of the Topic</u> Description of Symmetrical Faults Description of Unsymmetrical Faults Transient fault on transmission lines</p>	<u>35 min</u>
3	<p><u>Conclusion</u> When a fault occurs, equipment used for power system protection operate to isolate the area of the fault. A transient fault will then clear and the power-line can be returned to service</p>	<u>5 min</u>
4	<p><u>Questions / Answers</u> Q1..What are the examples of Transient faults include? A1. momentary tree contact bird or other animal contact lightning strike conductor clashing Q2..What are the Symmetrical Faults? A2. In a polyphase system, a fault may affect all phases equally which is a "symmetrical fault".</p>	<u>5min</u>

Assignment to be given:- Nil

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao

Lecture Plan -3

S. No.	TOPIC: SYMMETRICAL COMPONENT TRANSFORMATION	Time Allotted:-
1.	<p><u>Introduction</u></p> <p>A system of n vectors may be resolved,when n is prime,into n different symmetrical group,one of which consist of n equal vectorsand the remaining (n-1) systems consist of n equi spaced vectors.</p>	<u>5 min</u>
2	<p>Division of the Topic</p> <ul style="list-style-type: none"> -Description of 3-phase system vectors -Description of Positive Sequence component - Description of negative Sequence component - Description of zero Sequence component 	<u>35 min</u>
3.	<p>Conclusion</p> <p>Positive sequence system of vectors are equal in magnitude and 120 degree,if the direction of rotation of the stator field is opposite to the rotor is called negative sequence and the zero sequence voltages are single phase voltages.</p>	<u>5 min</u>
4	<p>Questions / Answers</p> <p>Q1. What are the positive sequence voltages? A1.If the direction of rotation of stator field is the same as that of the rotor ,the set of voltages are positive sequence voltages.</p> <p>Q2. What are the negative sequence voltages? A2. If the direction of rotation of stator field is opposite to that of the rotor,the set of voltages are negative sequence voltages.</p>	<u>5min</u>

Assignment to be given:- Numerical related to positive ,negative and zero sequence.

Reference Reading:-

1. Electrical Power System – C.L.Wadhwa

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Lecture Plan -4

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Subject:-POWER SYSTEM II

Section: A

S. No.	TOPIC: SEQUENCE IMPEDANCES	Time Allotted:-
1.	Introduction The sequence impedance of an equipment of power system are the positive, negative and zero sequence impedances.	<u>5 min</u>
2.	<u>Division of the Topic</u> -Revision of Diagram of positive,negative & zero sequence components -Description of positive sequence impedance - Description of negative sequence impedance - Description of zero sequence impedance	<u>35 min</u>
3.	<u>Conclusion</u> Symmetrical systems there is no mutual coupling between the sequence Network .The three sequence systems can then be considered Separately and phase currents and voltages determined by superposing Their symmetrical component of current and voltage.	<u>5 min</u>
4.	<u>Questions / Answers</u> Q1. What are the positive sequence impedance? A1. The positive sequence impedance of an equipment is the impedance Offered by the equipment to the flow of positive sequence currents	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

Lecture Plan -5

Semester:-6th

Course Code:-EE-312-F

Subject:-POWER SYSTEM II

Section: A

S. No.	TOPIC Single line to ground fault	Time Allotted:-
1.	<p><u>Introduction</u> A fault in a circuit is a failure that interferes with the normal flow of current. Faults in which the balanced state of the network is disturbed are called unsymmetrical or unbalanced faults. The unsymmetrical Faults can be classified as: i) Shunt faults ii) Series faults</p>	<u>5 min</u>
2.	<p>Division of the Topic -Description of single line to ground faults -Derivation of single line to ground faults -Numerical on L-G faults</p>	<u>35 min</u>
3.	<p>Conclusion From the Derived equation is clear that to simulate a L-G fault all the three sequence networks are required and since the currents are equal in magnitude And phase angle, therefore, the three sequence networks must be connected in Series.</p>	<u>5 min</u>
4.	<p>Questions / Answers Q1. What are the shunts faults? A1. Shunt types of faults involve power conductor or conductors to ground or short circuit between conductors. Q2. What are the series faults? A2. When circuits are controlled by fuses or any device Which does not open All three phases.these are called series type of faults.</p>	<u>5min</u>

Assignment to be given:-Numerical based on L-G faults

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -6

Semester:-6th

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Subject:-POWER SYSTEM II

Section: A

S. No.	TOPIC: LINE TO LINE FAULT	Time Allotted:-
1.	<u>Introduction</u> A line-line fault is an accidental low-resistance connection established between two points of different potential in an electric network or system.	<u>5 min</u>
2	Division of the Topic Description of line to line faults -Derivation of line to line faults -Numerical on L-L faults	<u>35 min</u>
3.	Conclusion Derived equation shows that zero sequence current will be Absent.	<u>5 min</u>
4	<u>Questions / Answers</u> Q1 . Define the Causes of Line-Line Faults. A1. Insulation failure of cables, i.e. an animal chewing through cable insulation; • Incidental short circuit between current carrying conductors, i.e. a nail driven through unprotected wirings; • Line-line faults within the DC junction box, caused by mechanical damage, water ingress or corrosion.	<u>5min</u>

Assignment to be given:- Assignment II given as enclosed

Reference:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

Lecture Plan -7

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Course Code:-EE-312-F

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Section: A

S. No.	TOPIC: Double line to Ground faults	Time Allotted:-
1.	<p><u>Introduction</u> With a double line-to-ground (DLG) fault two line conductors come in contact both with each other and ground. We'll assume these are phases b and c. The voltage and the current relationships are</p> $V_b = V_c$ $I_a = 0$	<u>5 min</u>
2.	<p><u>Division of the Topic</u> - Description of double line to ground faults - Derivation of double line to ground faults - Numerical on double line to ground faults</p>	<u>35 min</u>
3.	<p><u>Conclusion</u> All the three sequence networks are required to simulate L-L-G fault and also that the negative and zero- sequence networks are connected in parallel.</p>	<u>5 min</u>
4.	<p><u>Questions / Answers</u> Q1 What are the boundary conditions in L-L-G fault? A1 $I_a = 0$ $V_b = 0$ $V_c = 0$</p>	<u>5min</u>

Assignment to be given:- Numerical based on L-L-G faults

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -8

Semester:-6th

Course Code:-EE-312-F

Subject:-Power System II

Section: A

S. No.	Topic:- OPEN CONDUCTOR FAULT	Time Allotted:-
1.	Introduction When one or two phases of a balanced three-phase line opens it creates an unbalance in the system and results in the flow of unbalanced currents. Such conditions occur in the system when one or two conductors of a transmission line are broken due to storm or if fuses, isolators or circuit breakers operate only on one or two phases leaving others connected.	<u>5 min</u>
2	Division of the Topic Description of open conductor fault -Derivation of open conductor fault -Numerical on open conductor fault	<u>35 min</u>
3.	Conclusion <u>Such open conductor faults can also be analysed with the help of [Z⁻ Bus] matrices of sequence networks.</u>	<u>5 min</u>
4	Questions / Answers Numerical	<u>5min</u>

Assignment to be given:- Nil

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -9

Semester:-6th

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Subject:-POWER SYSTEM II

Section: B

S. No.	TOPIC: Circuit Breaker	Time Allotted:-
1.	<u>Introduction</u> A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and interrupt current flow.	<u>5 min</u>
2	<u>Division of the Topic</u> Description of circuit breaker Fault Clearing process Classification of circuit breaker Operating Mechanism	<u>35 min</u>
3.	<u>Conclusion</u> The operating mechanism of the circuit breaker gives the necessary Energy for operating and closing of contacts of circuit breaker.	<u>5 min</u>
4	<u>Questions / Answers</u> Q1 Describe Triple pole circuit breaker. A1. A circuit breaker suitable for three phase system is called a 'triple Pole circuit breaker.' Q2 Describe the types of circuit breaker. A2.1)Air break circuit breaker 2) Oil circuit breaker 3) Air blast circuit breaker 4) SF6 circuit breaker 5) Vacuum circuit breaker	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Switchgear Protection and Power System-Sunil S.Rao

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Course Code:-EE-312-F

Subject:-POWER SYSTEM II

Section: B

S. No.	TOPIC: circuit breaker ratings, restriking voltage transients, current chopping, duties of switch gear, automatic switch	Time Allotted:-
1.	<p><u>Introduction</u></p> <p>The analysis of short-circuit current and transient recovery voltage is followed by circuit breaker ratings. Overvoltage can be generated while closing circuit breaker On capacitor banks or loaded transmission lines. These are minimized by pre-closing Resistors and surge suppressors.</p>	<u>5 min</u>
2	<p><u>Division of the Topic</u></p> <p>Arc interruption theory Restriking voltage when losses are included Restriking voltage when asymmetrical current is interrupted Description of current chopping Description of duties of switch gear Rating of circuit breakers</p>	<u>35 min</u>
3.	<p><u>Conclusion</u></p> <p>The breaking capacity of a breaker is the product of the breaking current and the recovery voltage. The symmetrical breaking capacity is the product of symmetric breaking current and the recovery voltage. Similarly, The asymmetrical breaking capacity is the product of asymmetric breaking current and the recovery voltage.</p>	<u>5 min</u>
4	<p>Questions / Answers</p> <p>Q1 Define Restriking voltage. A1. The resultant transient voltage which appears across the breaker contacts at the instant of arc extinction is known as the restriking voltage.</p> <p>Q2. Define recovery voltage. A2. The power frequency r.m.s. voltage that appears across the breaker contacts after the transient oscillation die out and final extinction of arc has resulted in all the poles is called the recovery voltage.</p>	<u>5min</u>

Assignment to be given:-Nil

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -11

Semester:-6th

Course Code:-EE-312-E

Subject:-POWER SYSTEM II

Section: B

S. No.	TOPIC: Bulk oil, minimum oil, air circuit breaker	Time Allotted:-
1.	Introduction A highvoltage circuit breaker in which the arc is drawn in oil to dissipate the heat and extinguish the arc; the intense heat of the arc decomposes the oil, generating a gas whose high pressure produces a flow of fresh fluid through the arc that furnishes the necessary insulation to prevent a restrike of the arc.	<u>5 min</u>
2.	<u>Division of the Topic</u> Plain break oil circuit breaker Controlled- break oil circuit breaker Minimum oil circuit breaker Air circuit breaker Arc chute air circuit breaker	<u>35 min</u>
3.	Conclusion In an oil circuit breaker with simple interruption under oil. the duration of arcing is 0.02-0.05 sec. To extinguish the arc more efficiently, arcquenching chambers are used.	<u>5 min</u>
4.	Questions / Answers Q1 Which has the better insulating property oil or air? Ans Oil	<u>5min</u>

Assignment to be given:-Nil

Reference Readings:-

1.Switchgear Protection and Power System-Sunil S.Rao

Lecture Plan -12

Semester:-6th

Course Code:-EE-312-F

Subject:-POWER SYSTEM II

Section: B

S. No.	TOPIC: Air blast, SF6 CB,	Time Allotted:-
1.	<p><u>Introduction</u> These types of air circuit breaker were used for the system voltage of 245 KV, 420 KV and even more, especially where faster breaker operation was required. Air blast circuit breaker has some specific advantages over oil circuit breaker. A circuit breaker in which the current carrying contacts operate in sulphur hexafluoride or SF₆ gas is known as an SF₆ circuit breaker.</p>	<u>5 min</u>
2.	<p><u>Division of the Topic</u> -Axial blast circuit breaker -Cross blast circuit breaker -Advantages & disadvantages of Air blast circuit breaker -construction of SF6 breaker -Operation of SF6 breaker -Advantages of SF6 breaker</p>	<u>35 min</u>
3.	<p><u>Conclusion</u> SF₆ has excellent insulating property. SF₆ has high electro-negativity. That means it has high affinity of absorbing free electron. Whenever a free electron collides with the SF₆ gas molecule, it is absorbed by that gas molecule and forms a negative ion.</p>	<u>5 min</u>
4.	<p><u>Questions / Answers</u> Q1 What are the advantages of air blast circuit breaker over oil circuit breaker? A1. 1) There is no chance of fire hazard caused by oil. 2)The breaking speed of circuit breaker is much higher during operation of air blast circuit breaker. 3)Arc quenching is much faster during operation of air blast circuit breaker. 4)The duration of arc is same for all values of small as well as high currents interruptions.</p>	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

Lecture Plan -13

Semester:-6th

Course Code:-EE-312-F

Subject:-POWER SYSTEM II

Section: B

S. No.	Topic: vacuum and DC circuit breakers.	Time Allotted:-
1.	<p>Introduction</p> <p>Vacuum circuit breakers have minimal arcing (as there is nothing to ionize other than the contact material), so the arc quenches when it is stretched a very small amount (less than 2–3 mm (0.079–0.118 in)). Vacuum circuit breakers are frequently used in modern medium-voltage switchgear to 38,000 volts.</p>	<u>5 min</u>
2	<p><u>Division of the Topic</u></p> <p>The vacuum arc Vacuum arc stability Current chopping Vacuum arc-recovery phenomenon Construction of vacuum breaker Application of vacuum breaker</p>	<u>35 min</u>
3.	<p><u>Conclusion</u></p> <p>A vacuum circuit breaker is such kind of circuit breaker where the arc quenching takes place in vacuum. The technology is suitable for mainly medium voltage application. For higher voltage vacuum technology has been developed but not commercially viable</p>	<u>5 min</u>
4	<p>Questions / Answers</p> <p>Q1 What is vacuum interrupter? A1. The operation of opening and closing of current carrying contacts and associated arc interruption take place in a vacuum chamber in the breaker which is called vacuum interrupter.</p> <p>Q2. Which material is used for making VCB? A2. CuCr is the most ideal material to make VCB contacts.</p>	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -14

Semester:-6th

Course Code:-EE-312-E

Subject:-Power SystemII

Section: B

S. No.	TOPIC: Transformer, generator Protection	Time Allotted:-
1.	<p><u>Introduction</u></p> <p>The objective of power system protection is to isolate a faulty section of electrical powersystem from rest of the live system so that the rest portion can function satisfactorily without any severer damage due to fault current.</p>	<u>5 min</u>
2	<p><u>Division of the Topic</u></p> <p>- Ungrounded star-star transformer protection Grounded star-star transformer protection Transformer star/star grounded C.T delta connected protection Delta/star grounded transformer protection Rotor protection Overload protection Over Voltage protection Stator protection</p>	<u>35 min</u>
3.	<p><u>Conclusion</u></p> <p>Transformer are normally protected against short circuits and overheating.For short circuit Normally percentage differential protection is recommended for transformers rated for more than 1 MVA.For low rating overcurrent relaying is used.</p>	<u>5 min</u>
4	<p><u>Questions / Answer</u></p> <p>Q1 Define possible faults in stator faults. Ans 1)Phase to phase faults 2) Phase to ground faults 3) Inter-turn faults</p> <p>Q2 What are the abnormal conditions in generator protection A2:1)Unbalanced Loading 2) Overloading 3) overvoltage 4)Loss of excitation</p>	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -15

Semester:-6th

Course Code:-EE-312-E

Subject:-Power SystemII

Section: B

	<u>Section: B</u>	
S. No.	TOPIC: motor and bus zone protection	Time Allotted:-
1.	<p><u>Introduction</u></p> <p>In early days only conventional over current relays were used for bus bar protection. But it is desired that fault in any feeder or transformer connected to the bus bar should not disturb bus bar system. In viewing of this time setting of bus bar protection relays are made lengthy. So when faults occurs on bus bar itself, it takes much time to isolate the bus from source which may came much damage in the bus system.</p>	<u>5 min</u>
2	<p>Division of the Topic</p> <ul style="list-style-type: none"> -Instantaneous Over-current -Stall - Thermal Overload - Phase Unbalance - Ground 	<u>40 min</u>
3.	<p><u>Conclusion</u></p> <p>The second zone distance protection relays on incoming feeder, with operating time of 0.3 to 0.5 seconds have been applied for busbar protection.But this scheme has also a main disadvantage. This scheme of protection can not discriminate the faulty section of the busbar.</p>	<u>5 min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -16

Semester:-6th

Course Code:-EE-312-F

Subject:- Power System II

Section: C

S. No.	TOPIC: Nature and causes of faults, consequences, zone of protection, essential qualities	Time Allotted:-
1.	<u>Introduction</u> To limit the extent of the power system that is disconnected when a fault occurs, protection is arranged in zones. Ideally, the zones of protection should overlap, so that no part of the power system is left unprotected	<u>5 min</u>
2.	Division of the Topic -Description causes of faults -Description of zone of protection	
	<u>Conclusion</u>	<u>35 min</u>
3.	For practical physical and economic reasons, this ideal is not always achieved. accommodation for current transformers being in some cases available only on one side of the circuit breakers. This leaves a section between the current transformers and the circuit breaker A that is not completely protected against faults	<u>5 min</u>
4.	<u>Questions / Answers</u> Q1 Explain causes of faults. Ans 1) Insulation failure 2) Conducting path failure	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Switchgear protection-B.Ram
2. Electrical Power System – C.L.Wadhwa

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Lecture Plan -17

Semester:-6th

Course Code:-EE-312-E

Subject:- Power SystemII

Section: C

S. No.	TOPIC: primary and backup protections	Time Allotted:-
1	<u>Introduction</u> Many factors may cause protection failure and there is always some possibility of a circuit breaker failure. For this reason, it is usual to supplement primary protection with other systems to 'back-up' the operation of the main system and ensure that nothing can prevent the clearance of a fault from the system.	<u>5 min</u>
2	<u>Division of the Topic</u> Description of Primary protection Description of backup protection	<u>35 min</u>
3.	<u>Conclusion</u> Primary relaying is the first line of defence for protecting the equipments whereas the backup protection relaying works only when the primary relaying equipment fails.	<u>5 min</u>
4	Questions / Answers Q1 What is Relay? A1 A relay is an automatic device which senses an abnormal condition in an electrical circuit and closes its contacts. Q2.What is Secondary relays? A2 The relays which are connected in the circuit to be protected through current and potential transformers.	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Switchgear protection – B.Ram
2. Electrical Power System – C.L.Wadhwa

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Lecture Plan -18

Semester:-6th

Course Code:-EE-312-F

Subject:- Power System II

Section: C

S. No.	TOPIC: relay classification, principal types of electromagnetic relays, i.e. attracted armature, induction disc, induction cup types.	Time Allotted:-
1.	<u>Introduction</u> A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays . A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core. an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts	<u>5 min</u>
2	Division of the Topic - attracted armature relay -Balanced beam relay -Induction disc relay -Induction cup relay	<u>35 min</u>
3.	<u>Conclusion</u> The operation of such relay depends on whether the operating torque /force is greater than the restraining force.	<u>5 min</u>
4	Questions / Answers Q1 Describe pick up level. A1 The value of the actuating quantity which is on the threshold above which the relay operates. Q2. Describe reset level. A2 The value of current and voltage below which a relay opens its contacts and comes to original position.	<u>5min</u>

Assignment to be given:- NIL

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -19

Semester:-6th

Course Code:-EE-312-F

Subject:- Power SystemII

Section: C

S. No.	Topic :- Over -current, instantaneous over current relays	Time Allotted:-
1.	<p><u>Introduction</u></p> <p>Overcurrent protection is that protection in which the relay picks up when the magnitude of current exceeds the pickup level. The basic element in overcurrent protection is an overcurrent relay.</p>	<u>5 min</u>
2	<p><u>Division of the Topic</u></p> <p>Description of Overcurrent relay Description of instantaneous Overcurrent relay</p>	<u>35 min</u>
3.	<p><u>Conclusion</u></p> <p>Instantaneous over current relay is one in which no intentional time delay is provided for the operation. The time of operation of such relays is approximately .1 sec.</p>	<u>5 min</u>
4	<p>Questions / Answers</p> <p>Q1 Classify the various types of overcurrent relays.</p> <p>A1 1)Instantaneous overcurrent relay 2)Inverse time current relay 3) Inverse definite minimum timeovercurrent relay 4)very Inverse current relay 5) Extremely Inverse relay</p> <p>Q2 Explain Reset time.</p> <p>A2 The time which elapses between the instant when the actuating quantity Becomes less than the reset value to the instant when the relay contact returns to its normal position.</p>	<u>5min</u>

Assignment to be given:- Nil

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -20

Semester:-6th

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Subject:- ~~Power~~ SystemII

Section: C

S. No.	Topic :- directional and differential relays	Time Allotted:-
1.	<u>Introduction</u> The differential relay is one that operates when the vector difference of two or more similar electrical quantities exceeds a pre determine value this means for a differential relay,	<u>5 min</u>
2	<u>Division of the Topic</u> - Description of directional relay - Description of differential relay	<u>35 min</u>
3.	<u>Conclusion</u> The differential relays are known as current balance relays. Another class of relays are the voltage balance relays. The C.T at the two ends are connected in opposition.	<u>5 min</u>
4	Questions / Answers Q1 What is percentage differential relay? A 1 The ratio of the differential operating current to the average restraining current in a fixed percentage. Q2 What is Merz-Price protection? A2 A current will flow through the operating coil of the relay and it will operate. This form of protection is known as Merz-Price protection.	<u>5min</u>

Assignment to be given:- Nil

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao

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Subject:- Power System II

Section: C

S. No.	Topic :- distance relays, plain impedance	Time Allotted:-
1.	<p><u>Introduction</u></p> <p>Whenever over-current relaying is found slow or is not selective distance protection should be used. Since the fault currents depend upon the generating capacity and system configuration, the distance relays are preferred to the overcurrent relays.</p>	<u>5 min</u>
2	<p><u>Division of the Topic</u></p> <p>-3-zone protection -Impedance relay protection -reactance relay protection -Mho relay protection</p>	<u>35 min</u>
3.	<p><u>Conclusion</u></p> <p>In an distance relay, the torque produced by a current element is balanced against the torque of a voltage element. The current element produces positive (pickup) torque, whereas the voltage element produces negative (reset) torque. In other words, an distance relay is a voltage-restrained overcurrent relay</p>	
	<p><u>Questions / Answers</u></p> <p>Q1 What are the types of distance relay? A1 1) Definite distance relay.</p> <p>2) Time distance relay.</p>	<u>5 min</u>
4	<p>Q2 What is Time Distance Impedance Relay?</p> <p>A2 This delay automatically adjusts its operating time according to the distance of the relay from the fault point. The time distance impedance relay not only be operated depending upon voltage to current ratio, its operating time also depends upon the value of this ratio.</p>	<u>5min</u>

Assignment to be given:- Nil

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -22

Semester:-6th

Course Code:-EE-312-F

Subject:- Power SystemII

Section: C

S. No.	Topic :- transmission line & feeder protection	Time Allotted:-
1.	Introduction The word feeder means the connecting link between two circuits. The feeder could be in the form of a transmission line, short, medium, or long, or this could be a distribution circuit. <u>Division of the Topic</u>	<u>5 min</u>
2	Description of feeder Time graded system Current graded system Time current grading Protection of parallel feeder Protection of ring main feeder Conclusion	<u>35 min</u>
3.	Feeder protection, or more exactly protection for overhead lines and cables, is the most commonly used type of protection. The protection has to ensure that the power grid continues to supply energy. In case of a fault, it must be prevented from spreading to healthy parts of the network. The relays also have to minimize damage to the cables and other connected equipment and to ensure safety for everyone.	<u>5 min</u>
4	Questions / Answers Q What is the parallel feeder? Ans In radial feeder, the power flows in one direction only, that is from source to load. This type of feeders can easily be protected by using either definite time relays or inverse time relays.	<u>5min</u>

Assignment to be given:-Nil

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao

Lecture Plan -23

Semester:-6th

Course Code:-EE-312-F

Subject:-Power System II

Section:C

S. No.	Topic:- over current, distance, pilot wire Protection	Time Allotted:-
1.	<u>Introduction</u> Pilot relaying is an adaptation of the principles of differential relaying for the protection of transmission-line sections. Differential relaying is not used for transmission-line protection because the terminals of a line are separated by too great a distance to interconnect the CT secondaries in the manner. Pilot relaying provides primary protection only; back-up protection must be provided by supplementary relaying.	<u>5 min</u>
2	<u>Division of the Topic</u> 1)Description of overcurrent protection 2) Description of distance protection 3)pilot wire protection	<u>35 min</u>
3.	<u>Conclusion</u> The term “pilot” means that between the ends of the transmission line there is an interconnecting channel of some sort over which information can be conveyed. Three different types of such a channel are presently in use, and they are called “wire pilot,” “carrier-current pilot,” and “microwave pilot.”	<u>5 min</u>
4	<u>Questions / Answers</u> Q1 What is operating time? Ans The time which elapses between the instant when the actuating quantity Exceeds the pick up value to the instant when the relay contacts close. Q2 Explain Reset time. A2 The time which elapses between the instant when the actuating quantity Becomes less than the reset value to the instant when the relay contact returns to its normal position.	<u>5min</u>

Assignment to be given:-NilReference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

Lecture Plan -24

Semester:-6th

Course Code:-EE-312-F

Subject:-Power System II

Section:C

S. No.	Topic:- carrier current protection, neutral grounding.	Time Allotted:-
1.	<p>Introduction</p> <p>Each carrier-current receiver receives carrier current from its local transmitter as well as from the transmitter at the other end of the line. In effect, the receiver converts the received carrier current into a d-c voltage that can be used in a relay or other circuit to perform any desired function. This voltage is zero when carrier current is not being received.</p>	<u>5 min</u>
2.	<p><u>Division of the Topic</u></p> <p>Block diagram Principle of carrier phase comparison scheme</p>	<u>40 min</u>
3.	<p>Conclusion</p> <p>Traps are used to keep the carrier currents in the desired channel so as to avoid interference with or from other adjacent carrier-current channels, and also to avoid loss of the carrier-current signal in adjoining power circuits for any reason whatsoever, external short circuits being a principal reason. Consequently, carrier current can flow only along the line section between the traps.</p>	<u>5 min</u>

Assignment to be given:-Nil

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

Lecture Plan-25Semester:-6thCourse Code:-EE-312-FSubject:-POWER SYSTEM II

Section:D

S. No.	Topic :- Classification of static relays	Time Allotted:-
1.	<p>Introduction:-</p> <p>The conventional relay type of <u>electromagnet relays</u> can be replaced by static relays which essentially consist of electronic circuitry to develop all those characteristics which are achieved by <u>moving parts</u> in an electro-magnetic relay. For example, in an induction type relay, the operating time can be adjusted by adjusting the distance travelled by the disc whereas in a static relay it can be achieved by adjusting the value of the resistance in the R-C time delay circuit.</p> <p>Division of the Topic</p>	<u>10 min</u>
2	<p>-Overcurrent relay -Direction relay</p> <p>Conclusion:</p> <p>In a static relay it can be achieved by adjusting the value of the resistance in the R-C time delay circuit. In other words static relays are capable of performing the same functions with the use of electronic circuit control as an electro-magnetic relay performs with the use of moving parts or elements.</p>	<u>30 min</u>
3.	<p>Question / Answer</p> <p>Q1 What are the advantages of static relay?</p>	<u>5 min</u>
4	<p>Ans 1)Fast operation 2) low maintenance 3)low C.T and P.T burden</p> <p>Q2 What are the Tranducer Relay?</p> <p>Ans Transducer relays are magnetic amplifier relays which consist of a control and operating winding.</p>	<u>5 min</u>

Assignment to be given:- NilReference Readings:-

1. Electrical Power System – C.L.Wadhwa
- 2.Switchgear Protection and Power System-Sunil S.Rao

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Lecture Plan -26

Semester:-6th

Course Code:-EE-312-F

Subject:- Power System II

Section:D

S. No.	Topic:- DIGITAL PROTECTION	Time
	<p>Introduction: In utility and industrial electric power transmission and distribution systems, a digital protective relay uses a microcontroller with software-based protection algorithms for the detection of electrical faults. Such relays are also termed as microprocessor type protective relays. They are functional replacements for electromechanical protective relays and may include many protection functions in one unit, as well as providing metering, communication, and self-test functions.</p>	5 min
2	<p>Division of the Topic Transmission lines Generator protection Transformer protection</p>	35 min
3	<p>Conclusion: The digital protective relay is the most or numeric relay. is a protective relay that uses a microprocessor to analyze power system voltages, currents or other process quantities for the purpose of detection of faults in an industrial process system.</p>	5 min
4.	<p>Question / Answer Q1 What are the advantage of digital protection? A 1) Flexibility 2) lower cost 3)self checking capability 4)digital communication</p>	5 min

Assignment to be given:-

Reference Readings:-

1. Electrical Power System – C.L.Wadhwa
2. Switchgear Protection and Power System-Sunil S.Rao