

UEPOPS349B - Operate Local H.V. switchgear ASSESSMENT

CLASS WORK and PRACTICAL OBSERVATION

Instruction to assessor

The assessor needs to select the appropriate questions and tasks from the following questions, ask the students, assess the oral answers as well as assess the practical activities

Then the observation result is to be graded.

Q1. Describe the risks and dangers in power station and outline the recommended safety

Q2. equipments and emergency procedures.

Q3. Outline the process of maintenance work in substation.

1.1 OHS risk control measures and procedures in preparation for the work are followed

Ref-Advanced Diploma in Electrical Engineering Exercises Page 3 -Q17+18 Page 4 Q21+22

Q4. Write down the check list to perform the tasks in substation.

Q5. Write down the safety procedures and methods to assess the risk and to reduce the risk.

Q6..Write down the code of practice for working near exposed main and apparatus.

Q7. Which precautions are to be emphasized when working in substation?

1.3 The likely extent of work to be undertaken is envisaged from reports and/or discussions with appropriate person(s)

Q8. Write down the risk reduction procedures in maintenance work to discuss with work manager. (Ref-Advanced Diploma in Electrical Engineering Exercises Page 2 Q12)

1.4 Advice is sought from the work supervisor to ensure the work is coordinated effectively with others.

Answer the following questions to seek the advice from work supervisor in the following aspects.

Q9. What are the risks?

Q10. How are the risks classified?

Q12. How can the risk be evaluated?

Q12. How will you manage the risk? [Ref-Advanced Diploma in Electrical Engineering Exercises Page 2 Q8 to 11\)](#)

1.5 Sources of materials that may be required for the work are established in accordance with established procedures.

Submit the following assignment questions

[Ref-Advanced Diploma in Electrical Engineering Exercises Page 123\)](#)

The practice questions are organized to find out the protection system equipments and materials together with relevant theory

15) Over current and earth fault protection

Slide 1+2

Q1. Sketch three phase over current protection.

Q2. Sketch three phase earth fault relay protection.

Slide 3+4+5

Q3. Explain the operation of directional element with sketch.

Slide 6

Q4. Locate the position of reverse power relay in power line.

Slide 7

Q5. Sketch the connection of combined protection scheme that contains two over current relays & one earth fault relay to provide phase to phase and earth protection.

Q6. How does directional element of relay perform?

Slide 8

Q7. Locate directional and non directional element in a ring circuit.

1.6 Tools, equipment and testing devices needed to take measurements are obtained in accordance with established procedures and checked for correct operation and safety.

[Ref-Advanced Diploma in Electrical Engineering Exercises Page 128\)](#)

.Testing of protection current & potential transformer and relevant questions are arranged to provide this competency component.

Slide 5

Q52. Explain (a) AC ratio check (b) DC polarity check (c) Three phase polarity test for three phase CT

Slide 6

Q53. How will you interpose & sum CT & PT?

2 Solve problems in energy supply network protection equipment and system.

2.1 OHS risk control measures and procedures for carrying out the work are followed.

As per 1.1 to 1.3

2.2 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures.

Ref-Advanced Diploma in Electrical Engineering Exercises Page 126)

Live testing of protective relay system and determination of characteristics and relevant questions are arranged to provide this competency component.

(25) Distance protection scheme

Slide 1

Q30.Explain the distance protection scheme with sketch.

Slide 2

Q31.Explain the operation and construction of distance relay with sketch.

Slide 3

Q32.Explain the characteristics of distance relay.

Slide 4

Q33.Describe the directional distance relay with sketch.

Slide 5

Q34.What is the relation between maximum reach & relay characteristics.

Slide 6+7

Q35.Explain the zones for distance protection scheme.

Slide 8

Q36.Explain the operation of three phase distance relay.

Slide 9

Q37.Explain maximum reach and maximum reach angle.

2.3 Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures

As per 1.3

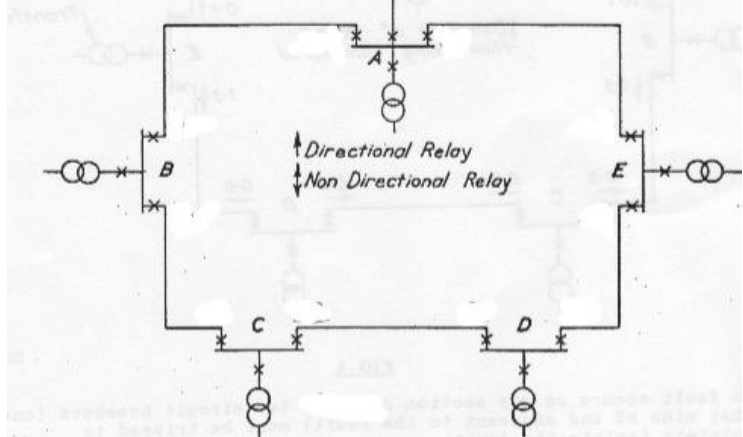
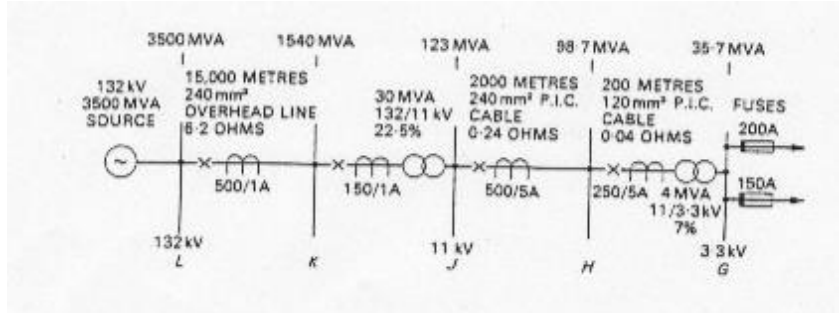
2.4 Safety hazards resulting from the reports and risk control measures devised and implemented in consultation with appropriate personnel.

As per 1.3

2.5 Problem solving is approached methodically drawing on knowledge of energy supply network protection equipment and systems using measured and calculated values of circuit/apparatus parameters.

2.12 Problem solving activities are carried out without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices.

EKAS COMPONENT	Question No	Questions
KS01-TIS68A Electrical power system protection Evidence shall show an understanding of protection methods and devices for electrical power systems to an extent indicated by the following aspects: T1 Protection fundamentals encompassing: <input type="checkbox"/> purpose of protection <input type="checkbox"/> features of a protection scheme T2 Instrument transformers for protection encompassing: <input type="checkbox"/> Operating principles <input type="checkbox"/> Applications of current transformers <input type="checkbox"/> Applications of voltage transformers T3 Feeder protection encompassing: <input type="checkbox"/> fuse protection <input type="checkbox"/> overcurrent & earth fault <input type="checkbox"/> sensitive earth fault <input type="checkbox"/> unit schemes <input type="checkbox"/> distance protection <input type="checkbox"/> trip/close sequences for feeders <input type="checkbox"/> recloser/sectionaliser systems T4 Transformer protection encompassing: <input type="checkbox"/> overheating protection <input type="checkbox"/> overcurrent protection <input type="checkbox"/> restricted earth fault protection <input type="checkbox"/> differential protection <input type="checkbox"/> oil and gas devices T5 Busbar protection encompassing: <input type="checkbox"/> types of fault <input type="checkbox"/> requirements of busbar protection	1	What is power system protection scheme? (5 marks)
	2	What equipments are included in power system protection scheme? (5 marks)
	3	Explain the functions of the following devices included in a power system protection Scheme. CT, PT, Fault Detector, Tripping Circuit (10 marks)
	4	Sketch the construction of <ul style="list-style-type: none"> Balanced Beam Relay Connection Diagram of Relay Tripping Circuit (10 marks)
	5	Sketch the connection diagram of combination protection scheme that contains two Over current relays and one earth fault relay to provide phase to phase and phase to earth protection.. (10 marks)
	6	

<p> <input type="checkbox"/> system protection <input type="checkbox"/> frame-earth protection T6 Surge protection encompassing: <input type="checkbox"/> voltage surges <input type="checkbox"/> surge diverters <input type="checkbox"/> arcing horns </p>	<p>7</p> <p>Total 70 marks</p>	 <p>Locate relay protection scheme for given system when fault occurs at point F.</p> <p>(20 marks)</p> <p>8</p> <p>Sketch curve for discrimination by both time and current of the following power system..</p>  <p>(20 marks)</p> <p>How will you adjust Definite Minimum Time point on relay curve?</p> <p>(5 marks)</p>
	<p>9</p> <p>10</p> <p>Total 100 marks</p>	

		<p>What is “Pick Up” of relay? (5 marks)</p> <p>Sketch the vector diagram for primary, secondary main windings of Star Delta Power Transformer . (10 marks)</p>
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2.6 Circuit/apparatus components are dismantled where necessary and parts stored to protect them against loss or damage

Ref-Advanced Diploma in Electrical Engineering Exercises Page 128)

To convert the analog relaying system to digital relay system, the dismantling of origin components and assembly of new system components are to be done. The following questions and activities provide this competency component.

(29) Digital relay+ Telecommunication for protection

Slide 1

Q54.What is digital relay?

Slide 2+4

Q55.Sketch the flow diagram of digital relay operation.

Slide 3+4

Q56.Sketch DAC system

Slide 5

Q57.Explain busbar protection with sketch

Slide 6

Q58.Write line & busbar protection with sketch.

Slide 7

Q59.Sketch the operation of digital relay.

2.7 Circuits/components are rechecked and their operational status is confirmed.

Ref-Advanced Diploma in Electrical Engineering Exercises Page 129)

To determine the operational status of protection system, it needs to ensure relay operation sequence, the sequential relay protection system and characteristics are to be investigated. The following activities and questions provide this competency.

(32)Over current & earth fault protection , Directional protection, operating characteristics

Slide 1

Q64.Sketch the diagram of over current protection

Slide 2

Q65.Sketch earth fault relay protection diagram.

Slide 3

Q66.Sketch the combined over current and earth fault protection and explain it's operation.

Slide 4

Q67.Explain the operation of directional relay with diagram.

Slide 5+6+7+8

Q68.Locate directional & non directional elements in ring system.

Slide 9+10

Q69.Sketch the connection diagram of combinational protection scheme that contains two over current relays and one earth fault relay to provide phase to phase and phase to earth protection.

Slide 11

Q70.How will you adjust definite minimum time point on relay curve?

2.8 Materials/replacement parts required to solve problems are sourced and obtained in accordance with established procedures.

2.9 Effectiveness of the repair is tested in accordance with established procedures.

2.10 Apparatus is reassembled, finally tested and prepared for return to service.

Ref-Advanced Diploma in Electrical Engineering Exercises Page 126)

When more power loads are connected to transmission line, the current protection system needs to be modified. The following questions and activities provide this competency component.

(23) Transmission line protection

Slide 1

Q23.Sketch transmission line differential protection

Slide 2+3

Q24.Sketch the modification diagram for transmission line protection with differential relay.

(24) Distance relay, pilot wire with differential three phase line protection

Slide 1

Q25.Explain the operation of distance relay

Slide 2

126

Q26.Explain the operation of distance relay with sketch

Slide 3+4

Q27.Sketch the characteristics curve of distance relay

Q29.Sketch the protection diagram of distance relay with operating & restraining voltage and current.

2.11 Unexpected situations are dealt with safely and with the approval of an authorised person.

As per 1.3

2.12 Problem solving activities are carried out without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices.

As per 2.5

Location of Evidences (Table 1)

3.Completion and report for problem solving in energy supply network equipment

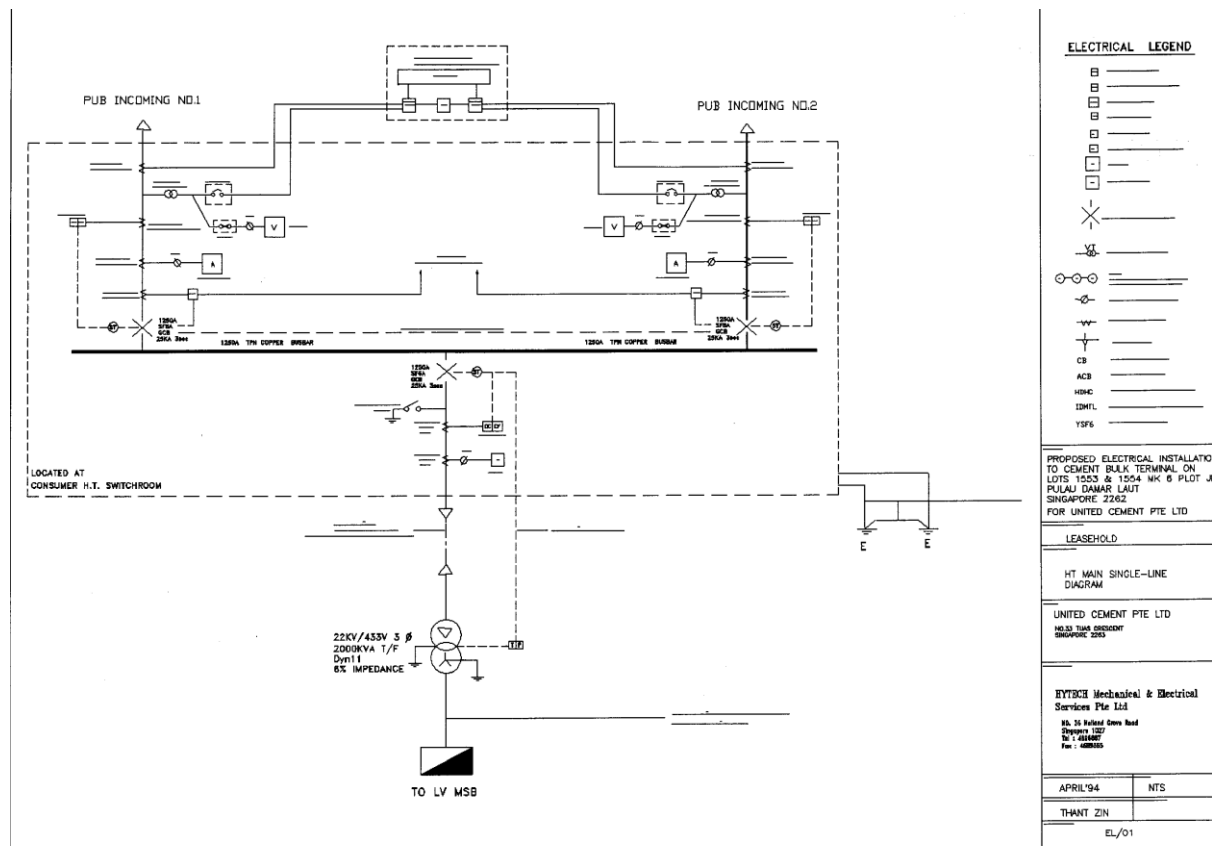
3.1 OHS work completion risk control measures and procedures are followed.

As per 1.3

3.2 Reusable, faulty or worn components are tagged and dispatched for repair to maintain adequate spares.

3.3 Maintenance work activities are documented in accordance with established procedures.

POWER SYSTEM PROTECTION COMMISSIONING PROJECT



The above diagram is Incoming HV supply system for a Cement Factory. It contains Star –Delta Transformer, Interchange switches for switching 2 supply, sketch of protective relay system with trip circuit and outline for measuring instruments.

- (1) Develop Detail installation diagram that contain appropriate protection instruments and measurement instruments
 - (2) Recommend appropriate specifications for protection and measuring instruments for power supply requiring 500Kw for the factory.
- By answering the following questions, the concepts for the above project can be highlighted

Ref-Advanced Diploma in Electrical Engineering Exercises Page 125)

- (19) Three phase differential relay

Slide 1

Q17. Sketch three phase star/ delta transformer protection with differential relay.

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Slide 2

Slide 1+2+3

Q19.Sketch the combined earth fault and differential protection for three phase star/ delta transformer.

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Refer Power System Practical

Part 1: Operational Study

Lab No	Name of Practical	Equipments	Assessment
	<u>Group 1 Power & Line</u>		
EP1	Receiving end voltage comparison between short/ medium and long transmission lines	distribution system types	Circuit interpretation, connection, data collection, calculation, graph sketch, report presentation, conclusion
EP2	Long transmission line PI equivalent circuit	overhead systems	As above
EP3	Long transmission line T equivalent circuit	distribution system types	As above
EP4	Transmission line efficiency/ Transformer effect on line efficiency	energy metering • demand meters	As above
EP5	Reactive power and power factor improvement	energy metering • demand meters	As above
EP6	PF effect on line current	energy metering	As above

		<ul style="list-style-type: none"> • demand meters 	
EP7	Corona Video	<ul style="list-style-type: none"> • surge protection 	Report presentation, conclusion
EP8	Phase sequence measurement		Competency assessment
	<u>GROUP 2- Protection equipments</u>		
EP9	Connection of relay protection scheme & protective equipments by using one line diagram (Circuit interpreting & connection competency development without electrical supply)	protection equipment and systems	Competency assessment
EP10	Current transformer & potential transformer connection & ratio test	current transformers <ul style="list-style-type: none"> • potential transformers 	Circuit interpretation, connection, data collection, calculation, graph sketch, report presentation, conclusion
EP11	Over current relay characteristics	protection equipment and systems <ul style="list-style-type: none"> • over-current protection 	Circuit interpretation, connection, data collection, calculation, graph sketch, report presentation, conclusion
EP12	Electronic relay test	conventional relays <ul style="list-style-type: none"> • electronic relays 	As above
EP13	Study of various protective relays used in industry through trade references	<ul style="list-style-type: none"> • earth fault protection • differential protection busbar protection • surge protection • conventional relays 	Research, report presentation
	Group 3- Supply System		
EP19	Underground cable capacitance test	underground	Circuit interpretation, connection, data collection, calculation, graph

		systems	sketch, report presentation, conclusion
EP20	High tension line design	<ul style="list-style-type: none"> • overhead systems 	Design project
EP21	Line insulator test & capacitance grading	<ul style="list-style-type: none"> • overhead systems 	Circuit interpretation, connection, data collection, calculation, graph sketch, report presentation, conclusion
EP22	Voltage profile chart of distribution system	<ul style="list-style-type: none"> • voltage regulation equipment • on load tap changers 	As above
EP23	Load centre-Power loss comparison	<ul style="list-style-type: none"> • distributor equipment 	As above
EP30	Transformer polarity test	<ul style="list-style-type: none"> • distributor equipment 	As above
EP42	Maximum power transfer theorem with power circuit	<ul style="list-style-type: none"> • load control 	As above
EP43	Load flow study	<ul style="list-style-type: none"> • load control 	As above
EP45	Trade reference study, switch board, busbar, insulator, circuit breakers	reclosers / sectionalisers.	As above

2.10 Methods for dealing with unexpected situations are selected on the basis of safety and specified work outcomes.

2.11 Diagnosis and rectification activities are carried out efficiently without unnecessary waste of materials or damage to system and the

surrounding environment or services and using sustainable energy practices.

General faults including: open-circuit; short-circuit; incorrect connections; insulation failure; unsafe condition; apparatus/component failure; related mechanical failure for the equipments in the range

(2) Explore some of the faults in power system/ energy supply that can be rectified only by utilizing para-professional knowledge background and how the arranged simulated practical can provide the hand on experience and work performance for the students and how it is different from the performance only based on trade level activities.

In range of performance, it outlines the real equipments used in the industry. There will be the arguments that the setting of practical in lab room only includes rheostat, resistor, varic, capacitor etc. How it meets the outlined competencies?

To exactly find out and rectify the faults in energy supply system , the tasks and complexity level more than the trade level- (check the continuity, check the connection, visual inspection, testing and measurement)will be included.

The following is the various power system faults which I draw out from my power engineer work records that the technical knowledge higher than trade level is required to successfully rectify the fault and determine the appropriate solutions. In the table, I summarize how the fault is , caused, background theory, how the person who knows the theory will do, how the person who does not know the theory will do and how my simulated practical / and practical related background theory will assist to develop the fault finding skill.

Typical fault	Cause	Related Theory	How the person who does not know the theory will do	How the person who knows theory will do	Name of simulated practical	How to develop the skill
(1)In reticulation system, there is abnormally different in	Abnormal resistance. Wrong cable selection. Abnormal circuit	Voltage profile chart.	May give he other idea to change the load	Measure voltage, sketch the voltage profile chart. Then identify the portion of	EP 23 Voltage profile chart	Develop the analytical skills to identify the fault point

voltages	configuration			the circuit.		
(2)Line conductor slips from the pin insulator	Line deviation is too high, combination of wind, conductor tension will take away the conductor from pin insulator	Line deviation angle calculation	Will reinstall the line. After some period, he same thing will happen again	Will examine line deviation angle. Tension, wind force. Will rearrange the line or provide shackle insulator	Theory instruction. Line deviation	Develop the problem solving skill on line construction.
(3)Conductor sag too low. Hit by traffic and then broken	Sag calculation. Wrong tension, safety factor, weight	Sag/ line design	Pull up the cable. After some time, it will fall again	Will examine the related parameters and find the way	EP 20 High Tension Line Design	Develop the skill on line design and to know the technical factors for sag.
(4)Discharge current flows out from underground insulator and cause the injury	UG cable capacitance. Charging current	UG Cable capacitance test	Will think about current flow, leakage etc.	Will examine the UG cable capacitance and produce the procedure for discharging	EP 19 Underground cable capacitance test	Develop the skill in UG cable testing focus on capacitance and estimate the amount of charging current
(5)Line pole broken without natural disaster	In appropriate pole strength	Pole mechanical design	Will erect the pole. Some time after, broken gain	Will examine he tension, wind force, conductor weight, then will calculate the pole strength and select appropriate diameter of pole and appropriate pole material	Pole mechanical design lesson + EP 20 High tension line design	Develop the skill on line design and to know the technical factors for pole.

2 Complete and report fault diagnosis and rectification activities.

3.1 OHS work completion risk control measures and procedures are followed.

3.2 Work site is made safe in accordance with established safety procedures.

As per 1.3

3.3 Rectification of faults is documented in accordance with established procedures.

3.4 Appropriate person or persons notified, in accordance with established procedures, that the system faults have been rectified.

Fault	Reason	Related theory	The person who does not know the theory will do	The person who knows the theory will do	Related Practical	Development of skill
(6) There are too much power loss. Line efficiency is poor	If all connected loads are all right, wrong location of power station/ load centre	Load centre study	Will not take account on load centre	Will take account on load centre	EP23 Load centre power loss comparison	How the location of supply source affect line losses/ efficiency and % voltage regulation
(7) Problem with UG cable joint	Wrong method in UG cable joining	UG cable joining methods. Theory study			UG cable joining method in my prepared 7762 AA Electrical Distribution textbook	UG cable joining methods. Theory PLUS photographs
(8) Generator got motor action. Reverse power relay cuts off	Out of synchronism. Up to 180 degree out of phase	Synchronizing	Will neglect synchronism. Just run and switch on	Will focus on synchronizing process. Avoid reverse power relay operation	Synchronizing	Synchronism, generator parallel operation requirement practical knowledge development.
(9) Generator vibration/ hunting	Stability concept	System stability	Do not care on machine hunting. Will continue to run . As consequence, face the short life of bearing/ shaft	Will take care on transient and steady state system stability and prevent the hunting	Moment of inertia/ machine stability	Moment of inertia/ machine stability practical knowledge development.
(10) Relay operates on fault. But the system loss the synchronism	System stability/ critical fault clearing angle aspect.	System stability/ critical fault clearing angle	Do not care on the relay setting to provide both fault protection and maintain the system stability. Re-synchronize the generators when ever the relay operates	Will set the proper relay setting to maintain the stability	Critical fault clearing angle. Equal area criteria	Critical fault clearing angle. Equal area criteria practical knowledge development.
(11) Line reactive power too much. The equipment capacity is unnecessarily increased	Problem related to load flow	Load flow study	Will not take account on load flow concept.	Take account on load flow and optimize the loading	EP 42 Maximum power transfer theorem EP43 Load flow study	Develop the load flow concept and practical optimizing skill
(12) There is nothing wrong with the line but	Switching surge	Switching voltage surge	Just replace the transformer. After	Take account on switching voltage	Switching voltage surge	Switching voltage surge practical

the transformer placed near the switch heat up and cooked			some time, the same problem will be faced	surge and plan to install the surge diverter.		knowledge development.
(13) Light radiated from the power line. Too much power loss and high interference to telecom line	Corona	Corona study	Will consider the ACT OF GOD	Will find the way to reduce corona such as application of hollow conductor to increase diameter of conductor to raise the critical voltage level	EP 7 Corona video	How corona occurs and find the way to prevent.
(14) Control telecommunication for power line down, no relay operates	Application of telecommunication system in power system operation	Application of telecommunication system in power system operation 7762AG Power System Operation	Will not be aware of the role of telecommunication system	Will check the function of telecom equipment for power system control and protection and perform the preventive maintenance	Application of telecommunication system in power system operation	Web based control/ IP based control and telecomm: concepts practical knowledge development.
(15) Too much flickering of lamps	Harmonics	Harmonics in power system	Will not know what happens	Will check the harmonics source/ increase the size of neutral wire to allow the harmonics current flows	Harmonic source scope observation	Development of identifying the harmonics
(16) Lightning strike	Lightning arrester	Lightning arrester	Will reinstall LA. But not sure it will be safe or not.	Will check the coverage provided by lightning arrester	Lightning arrester study	Lightning arrester practical knowledge development.
(17) Earth fault/ earth leakage can not be protected	Grounding in power system	Grounding in power system 7762AE Power System Protection	--	Will measure the ground resistance, will implement the additional ground connections	Power system grounding study	Power system grounding practical knowledge development.
(18) Occurrence of over current	Over current protection	Over current relay 7762AE Power System Protection	Will not exactly know how to set/ adjust the over current relay	Will set/ adjust the over current relay	EP11 Over current relay characteristics	Practical skill development in over current relay
(19) Earth leakage fault	Earth leakage protection	Earth leakage protection 7762AE Power System Protection	Will not exactly know how to set/ adjust the earth leakage relay	Will set/ adjust the earth leakage relay/ CT arrangement	CT arrangement for earth leakage fault & fault in protected zone	Practical skill development in earth leakage fault protection
(20) Transformer	Differential relay	Differential relay	Will not exactly know	Will set/ adjust the	CT arrangement for	Practical skill

protection			how to set/ adjust the differential relay	differential relay	fault in protected zone	development in differential protection
(21)Line is protected by differential/ over current relay. But it is not effective when the load are fed from some part of the line	Distance relay	Distance relay	Will not exactly determine the reason why and how to change the protection system	Will change the protection system and will calculate earth fault impedance	Earth fault calculation	Problem solving skill development in earth fault calculation
(22)Fault happens but the relay can not provide the effective protection	CT/ PT ratio for relay	Relay protection scheme	Will not exactly determine the reason why and how to change the protection system	Will adjust CT PT ratio at the simulated fault situation and will adjust the relay setting appropriately	EP9 Connection of relay protection scheme & protective equipments by using one line diagram (Circuit interpreting & connection competency development without electrical supply) EP10 Current transformer & potential transformer connection & ratio test	Practical skill development in CT PT ratio adjustment
(23) I accidentally open the CT secondary and it got explosion	Current transformer	Current transformer		Will make sure not to open circuit the CT secondary	EP10 Current transformer & potential transformer connection & ratio test	Develop the skill on CT/ PT connection & applications.
(24) we use old type gravity relay, it does	Restraining system of relay	Relay types & characteristics		Will make sure to correctly arrange the	EP13 Study of various protective	Knowledge development on

not provide the effective protection				relay position	relays used in industry through trade references	various protective relays used in industry through trade references
(25) Relay operates at wrong current	Operation/ setting of relay	Relay types & characteristics	Trial error approach will be used	Will make sure to correctly arrange the relay setting	EP11 Over current relay characteristics	Practical skill development in over current relay
(26) In power transformer protection. Transformer is Star/Delta connection. All relay settings are correct. But relay wrongly operates. I checked all continuity. Every thing all right	Transformer Star Delta & relay star/delta matching	Star delta vector diagram. Transformer star side –Relay delta & transformer delta— Relay star	Will not know what happens and how to rectify the fault	Will check the connection and will consider the vector difference causes the wrong operation	EP10-CT & PT connection/ ratio check	Practical skill development in CT/PT Connection
(27) Regulator is set to meet the system voltage condition. But later time, it is blown out	Voltage ratio/ regulator setting	Voltage regulator	Will emphasize in solving the problem for a short moment. Will not consider the long term impact	Will consider whether the setting to upgrade the voltage will impact on future system voltage change	EP22 Voltage profile chart of distribution system	The skill training to develop the judgment of voltage level and future impact
(28) Fault spread from one busbar to another busbar	Busbar arrangement/ sectionalization	Busbar arrangement	Will assemble the busbar to install the equipment, will not consider how the arrangement can contribute the spread of fault	Will consider the way to insert section circuit breakers	Busbar layout/ arrangement study	Busbar arrangement sketch/ plan practice development
(29) Equipment suffers over voltage and blown out after the capacitor value is changed for PF improvement	Inappropriate capacitor setting. Cause of overvoltage. Vector diagram	PF improvement/ Capacitive reactance effect on load	Will only see the way to improve the PF. Will not know the consequences	Will possess the knowledge of capacitor impact on load voltage and will take account on optimal setting of capacitor value	EP5-capacitance effect on line EP6-PF Improvement	PF improvement method is judgment with capacitor effect causes over voltage. This skill is trained.
(30) Directional relay does not work to	Directional relay operation	Study on directional relay.		Wrong connection to direction coil will be	EP 13 Protective relays used in industry	Guide to acquire the relevant technical

protect the reverse power flow				identified		knowledge
(31)Voltage flashing over capacitor string	Capacitor string	Study on capacitor string	Will change the capacitor string	Will provide the preventive protection such as arcing horns OR take account on line capacitor grading	EP21 Line insulator capacitance test	Develop the skill to measure line capacitor value . Capacitance grading.
(32)Circuit Breaker itself is blown out	Circuit Breaker capacity	Study on capacity of circuit breaker	Will change CB. After sometime, it will blow up again.	Will consider the CB capacity & possible over current developed in line fault	EP13 Relay & CB used in system Fault current	Develop the skill in fault current estimate and choosing CB capacity
(33)CB too hot and meltdown	CB capacity/ Arc development	Study on capacity of circuit breaker/electric arc	Will change CB. After sometime, it will blow up again.	Will consider the CB capacity & possible over current developed in line fault Will consider the arc extinguishing methods	EP13 Rely & CB used in system Fault current	Develop the skill in fault current estimate and choosing CB capacity
(34)Need to expand the line in emergency. I am only in-charge	Line design	Line design project	Will not know how to design a line	Will utilize references/ methods to design and construct the line	7762AA Project-Over head line design	Line electrical & mechanical design practice development
(35)HV current flows into LV line	Separation between HV & LV line	Rules & regulations related to line	Will not know the regulation	Will apply the regulation in real wok	7762AA Line pole/ cross arm design and conductor arrangement	Line electrical & mechanical design practice development
(36) Line wire fracture	Sag calculation	Sag calculation/ minimum cable size	Reinstall the line wire. Like part to like part replacement is applied, will use the same size of cable. After sometime, line will break gain	Will consider allowable tension/ minimum conductor size	7762AA Project-Over head line design	Line electrical & mechanical design practice development
(37)Electronics equipment used for line protection is blown up	Voltage surge	Signal condition sub system. Surge filter	Will replace the electronic board. But the same fault happens again	Will consider the cause of surge. Surge filter / absorber/ diverter will be installed	7762AE Line surge/ application of electronic control system	Develop the skill in line surge/ electronic control.
(38) Receiving end voltage is greater than the sending end	Capacitance effect on long line	Long line 7762AG Power System Operation	Will think that the equipments are designed to operate at	Will consider the line configuration and will provide the	EP2/EP3 Long Line PI & TEE equivalent circuits	Develop the practical skill in determination of possible voltage

			the sending end voltage level, it will be enough	appropriate arrangement for over voltage caused by capacitance effect on long line.		rise in simulated line model.
(39) Can not run the generators in parallel	Synchronism problem	Synchronizing	Will not properly know the synchronism	Will consider the synchronism	Alternator parallel operation- Procedure	Develop the knowledge in synchronizing
(40) Over current relay is provided to protect the system but it does not work when the ground fault occurs	Characteristics of relays	Relay types and characteristics	Will think that one relay will protect everything	Will select the appropriate relay for appropriate place and protection task	EP13 Study of various protective relays used in industry through trade references	Knowledge development on various protective relays used in industry through trade references

Method of delivery	Method of collection of evidence
7-Face to face 6-Electronic <u>Key for delivery mode</u> 1-On the job 2-Simulated 3-Blended 4-Self paced 5-Distance 6-Electronic 7-Face to face 8-Other	A,B,D,E,F,G,L Key for Methods for Collecting Evidence: A-Assignment B-Written Task C-Role play D-Exam E-Oral questioning F-Simulation G-Observation H-Work based I-Portfolio

<p style="text-align: center;"><u>Detailed explanation</u></p> <p>Face to face class teaching + Online supplement multimedia notes</p> <p><u>Evidence</u></p> <p><u>Part 1- Evidence of teaching & learning</u></p> <p><u>Plan for concurrently delivery</u></p> <p>www.powerlearning1.zoomshare.com</p> <p>Both digitised notes + multimedia notes including audio files</p> <p>Notes in USB (Available on request)</p> <p>Part 2- Evidence of lesson planning</p> <p>(1) Delivery & assessment matrix excel form (2) Semester plan</p>	<p>J-Self assessment K-Case study L-Practical demonstration M-Project N-Training Record O-Other</p> <p><i>Detailed explanation</i></p> <p>A+B-Test 1, 2, 3, 4 E-Oral question in practical class F-Simulated practical for line & power system comprising mathematical equations & functions G-Observe the student's performance in practical class L-Student practical performance result + report preparation</p> <p><i>Evidence Attached</i></p> <p>Part (1)- Test questions</p> <p>2 tests</p>
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<p>(3) Students study progress plan</p> <p>(Available on request)</p>	<p>Part (2)-Evidence of students participation</p> <p>(1) Signed attendance sheet</p> <p>(2) Signed Test attendance sheet</p> <p>(3) Sample answer paper & practical report Either hard or scanned copy (Will be available on request within 6 months of the assessment event</p> <p>(4) EBS attendance & grade record</p>
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<p>1 On the job</p> <p>5 Distance</p>	<p>2 Simulated</p> <p>6 Electronic</p>	<p>3 Blended</p> <p>7 Face to Face</p>	<p>4 Self-paced (facilitated)</p> <p>8 Other (Please specify)</p>
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Key for Methods for Collecting Evidence:			
A Assignment	B Written task	C Role play	D Exam
E Oral questioning	F Simulation	G Observation	H Work based
I Portfolio	J Self assessment	K Case study	L Practical demonstration
M Project	N Training Record Book	O Other (Please specify)	

Location of Evidences (Table 1)

ASSESSMENT SCHEDULE

Performance Criteria	Assessment 1 Practical		Assessment 2 Theory
	Continuous Observation	Written Assessment as part of Practical	Written Assessment
1.1		X	

1.2		X	
1.3		X	X
1.4		X	X
1.5		X	X
1.6		X	X
2.1		X	
2.2		X	X
2.3		X	X
2.4		X	X
2.5		X	X
2.6		X	X
2.7		X	X
2.8		X	X
2.9		X	X
2.10		X	X
2.11		X	X
2.12		X	X
3.1	X	X	
3.2	X		
3.3	X		
EKAS Assessment		X	X

POWER SYSTEM Youtube video Lessons to provide the sufficient EKAS

G015/ IS67+68+ IS74

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Power System (1)

[G015\(AA\)Lesson 1-Distribution system.zip](#)

<http://youtu.be/VuzjXkRx4UI>

[G015\(AA\)Lesson 2-Demand factor.zip](#)

<http://youtu.be/cUGbxhBT-Dc>

<http://youtu.be/DCCI4cO3Vu8>

[G015\(AA\)Lesson 3-Sag.zip](#)

<http://youtu.be/1s496h-luu8>

[G015\(AA\)Lesson 4-OH Line mechanical design.zip](#)

<http://youtu.be/T0BnyqV9T6E>

http://youtu.be/hu1TrUv2_OY

[G015\(AA\)Lesson 5-UG Cable.zip](#)

<http://youtu.be/hHCLzMnVmT0>

<http://youtu.be/A5AieaBBZHo>

[G015\(AA\)Lesson 6-Voltage control.zip](#)

<http://youtu.be/y1vTM5fvfyU>

<http://youtu.be/Z9HBGsVgymA>

[G015\(AE\)Lesson 1-Power system protection scheme.zip](#)

<http://youtu.be/ihpd3cDAhBU>

<http://youtu.be/EGXkLRM2L9M>

<http://youtu.be/zOIUYQ7OJfs>

[G015\(AE\)Lesson 2-Differential relay.zip](#)

<http://youtu.be/2iW0oEScMsw>

[G015\(AE\)Lesson 3-Over current & earth fault protection.zip](#)

<http://youtu.be/hvGjdO9jEhk>

[G015\(AE\)Lesson 4-Three phase differential relay.zip](#)

<http://youtu.be/2iW0oEScMsw>

<http://youtu.be/VuzjXkRx4UI>

<http://youtu.be/2iW0oEScMsw>

[G015\(AE\)Lesson 5-Current time grading.zip](#)

<http://youtu.be/r0qkLrmkKsM>

G015AE Lesson 6

http://youtu.be/InsTLh7_N5k

[G015\(AE\)Lesson 7-CT_PT.zip](#)

[G015\(AE\)Lesson 8-Distance relay.zip](#)

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[G015\(AE\)Lesson 9-Telecom in power protection.zip](#)

<http://youtu.be/9C6ogqZAKRg>

http://youtu.be/XRpffA6hU_U

<http://youtu.be/X-kz3cyL9fU>

[G015\(AG\)Lesson 1-Stability.zip](#)

<http://youtu.be/fUyNqcXtBXg>

[G015\(AG\)Lesson 2-Generator load sharing.zip](#)

<http://youtu.be/A-t7XH4rK4M>

http://youtu.be/OTsis_KIRuk

<http://youtu.be/8j1nD9nY2hU>

[G015\(AG\)Lesson 3-Power Flow.zip](#)

<http://youtu.be/0OzT4Pol-Jc>

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[G015\(AG\)Lesson 4-IP based system.zip](#)

[G015\(AG\)Lesson 5-Surge in power system.zip](#)

<http://youtu.be/6WkezTcOzX4>

[G015\(AG\)Lesson 6-CTPT Harmonic filter.zip](#)

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G037+G038+G039 Part 1/2/3+IS69

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Power System (2)

[G037+G038+G039 Lesson 1-Power Flow.zip](#)

<http://youtu.be/mzwGGXRTtw>

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[G037+G038+G039 Lesson 5-Harmonic.zip](#)

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[G037+G038+G039 Lesson 8-Turbine Control+Power Line Earthing.zip](#)

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[G037+G038+G039 Lesson 9-Insulator.zip](#)

<http://youtu.be/l4jqs8MLBFA>

<http://youtu.be/TiQezIA9Z-c>

[G037+G038+G039 Lesson 10-Reliability of Power System.zip](#)

[G037+G038+G039 Lesson 11-Harmonic Reduction.zip](#)

<http://youtu.be/8dYX-11kRcc>

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[G037+G038+G039 Lesson 12-Grounding + Power Quality.zip](#)

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[G037+G038+G039 Lesson 13-Power Quality.zip](#)

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[G037+G038+G039 Lesson 14-Harmonic Model.zip](#)

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[G037+G038+G039 Lesson 15-Harmonic Losses in Transformer.zip](#)

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[G037+G038+G039 Lesson 17-Preparation for emergency.zip](#)

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[G037+G038+G039 Lesson 18-Harmonic problems.zip](#)

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http://youtu.be/zM_Xcwckicw

[G037+G038+G039 Lesson 19-Synchronous machine problems.zip](#)

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[G037+G038+G039 Lesson 20-Power Generation + Generator Control.zip](#)

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[G037+G038+G039 Lesson 21-Turbine Control+ Digital Excitation.zip](#)

<http://youtu.be/uCsvgv18qKwQ>

<http://youtu.be/l4vCDI2CZS0>

[G037+G038+G039 Lesson 22-Power System Protection.zip](#)

<http://youtu.be/DDpbzgNYTiM><http://youtu.be/2cl-nOdBNro>

G040 + IS73

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Power transformer

[G040 Lesson 1 Power transformer rating 1.zip](#)

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[G040 Lesson 1 Power transformer rating 2.zip](#)

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[G040 Lesson 2 Open circuit short circuit test.zip](#)

<http://youtu.be/Ru-KIKv40OY>

[G040 Lesson 3 Transformer regulation.zip](#)

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[G040 Lesson 4 Power transformer connection.zip](#)

<http://youtu.be/iig8PISDN1I>

[G040 Lesson 6 Transformer parallel operation.zip](#)

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<http://youtu.be/Sz5QY727w-8>

[G040 Lesson 7 Harmonic in transformer.zip](#)

http://youtu.be/_YOIWb3e574

[G040 Lesson 8 Transformer problem + auto transformer.zip](#)

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[G040 Lesson 9 Transformer rating cooling connection tap changing.zip](#)

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G042+IS71

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Transmission Line

[G042 Lesson 1-Transmission line introduction.zip](#)

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[G042 Lesson 5-Time value of money+Line reflection.zip](#)

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[G042 Lesson 6-Line matching+Wave guide.zip](#)

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[G042 Lesson 11-Smith chart.zip](#)

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<http://youtu.be/5qBwLsbtfTA>

http://youtu.be/ViamcvqAy_I

http://youtu.be/j_nx9n7mGec

<http://youtu.be/d53B3-zV2ec>

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Power References

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