Registration No.: ....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

3rd Semester, 2nd In-Sem. Examination

B. Voc. Program, Winter Semester (2018-19)

Course Code: ELE1301 **Time: 1 Hour**

Course Name: Electrical Assembly Operator Control Panel **Max. Marks: 20**

Instructions: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

1. What are the basic requirements of a protective relaying?

   (a) Reliability (b) Selectivity (c) Speed (d) All of These

2. Power factor of a pure inductive load is:

   (a) 0 (b) 1 (c) range from 0 to 1 (d) None of These

3. Two or more faults may occur simultaneously on a system. Such faults are known as:

   (a) multiple faults (b) simultaneous faults (c) both a and b (d) none of these.

4. Faults are automatically detected by -----------and faulty section is isolated by -------.

   (a) Relay, Circuit breaker (b) Circuit breaker, Relay

   (c) Relay, Relay (d) Circuit breaker, Circuit breaker.

5. The main causes of failure of the primary protection is:

   (a) Failure of relay (b) failure of auxiliary devices

   (c) Loss of DC control supply (d) All of These

Section – B

03X02 = 06 Marks

1. Briefly explain the following:

   (A) Selectivity (B) Reliability of a protective relay?

2. Explain the main objectives of power system protection.
3. Explain the nature, cause and consequences of faults.

Section – C

03X03 = 09 Marks

1. What do you mean by power factor? Explain it.
2. What is a zone of protection? Discuss various zones of protection for a power system with the help of a line diagram.
3. What are the different types of faults?

Answer Key

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

3rd Semester, 2nd In-Sem. Examination

B. Voc. Program, Summer/Winter Semester (2019-20)

Course Code: ELE 1301 **Course Name: Electrical Assembly Operator Control Panel**

Section – A

05X01 = 05 Marks

1. What are the basic requirements of a protective relaying?
   (a) Reliability (b) selectivity (c) speed (d) All of These
   Ans. (d)
2. Power factor of a pure inductive load is:
   (a) 0 (b) 1 (c) range from 0 to 1 (d) None of These
   Ans. (a)
3. Two or more faults may occur simultaneously on a system. Such faults are known as
   (a) multiple faults (b) simultaneous faults
   (c) both a and b (d) none of these.
   Ans. (c)
4. Faults are automatically detected by ----------and faulty section is isolated by ---------.
   (a) Relay, Circuit breaker (b) Circuit breaker, Relay
   (c) Relay, Relay (d) Circuit breaker, Circuit breaker.
   Ans. (a)
5. The main causes of failure of the primary protection is:
   (a) Failure of relay (b) failure of auxiliary devices
   (c) Loss of DC control supply (d) All of These
   Ans. (d)

Section – B

03X02 = 06 Marks

1. **Briefly explain a. Selectivity b. Reliability of a protective relay.**

Ans.

Reliability

Reliability is a measure of the degree that the protective system will function properly in terms of both *dependability* (that is, performing correctly when required) and *security* (that is, avoiding unnecessary operation).

Selectivity (or Discrimination)

Selectivity is the quality whereby a protective system distinguishes between the conditions for which it is intended to operate and those conditions for which it must not operate. In other words, the selectivity of a protective system is its ability to recognize a fault and trip a minimum number of circuit breakers to clear the fault. A relay system should provide maximum possible continuity of supply with minimum system disconnection.

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Section – C

03X03 = 09 Marks

1. What do you mean by power factor, Explain.

Ans.

In AC circuits, the power factor is the ratio of the real power that is used to do work and the apparent power that is supplied to the circuit.

The power factor can get values in the range from 0 to 1.

When all the power is reactive power with no real power (usually inductive load) - the power factor is 0.

When all the power is real power with no reactive power (resistive load) - the power factor is 1.

Power factor definition

The power factor is equal to the real or true power P in watts (W) divided by the apparent power |S| in volt-ampere (VA):

PF = P(W) / |S(VA)|

PF - power factor.

P - real power in watts (W).

|S| - apparent power - the magnitude of the complex power in volt·amps (VA).

Power factor calculations

For sinusuidal current, the power factor PF is equal to the absolute value of the cosine of the apparent power phase angle φ (which is also is impedance phase angle):

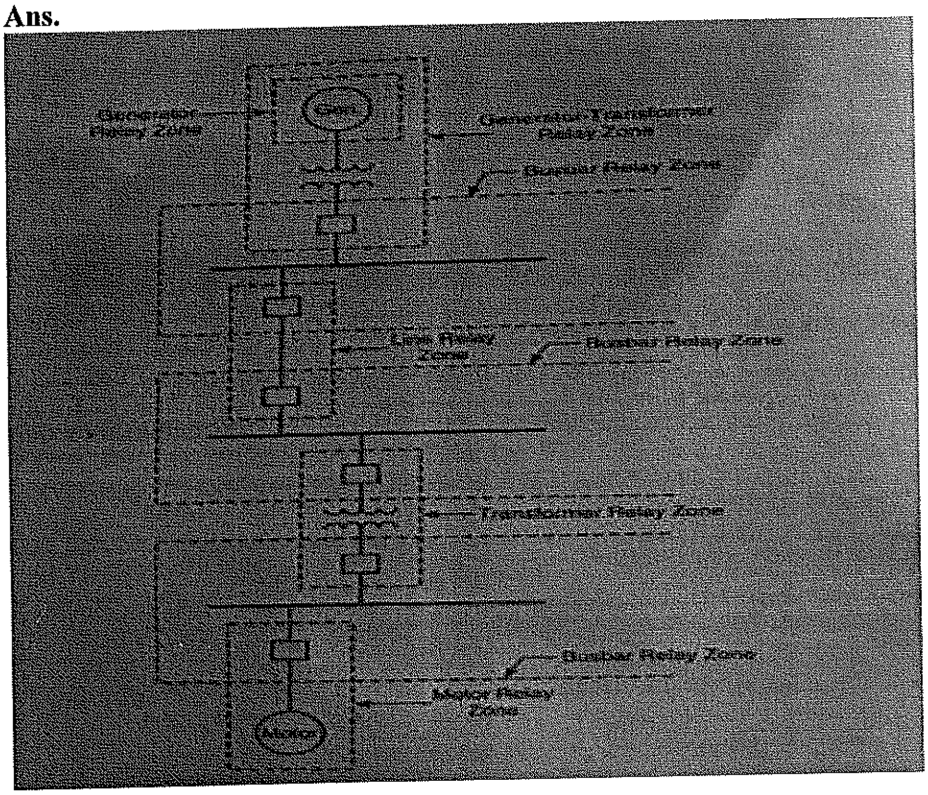
PF = |cos φ|

PF is the power factor.

φ is the apprent power phase angle

2. What is a zone of protection? Discuss various zones of protection for a power system with the help of a line diagram.

Ans.



Relays usually have inputs from several current transformers (CTs), and the zone of protection is bounded by these CTs. The CTs provide the ability to detect a fault inside the zone of protection and the circuit breakers (CBs) isolate the fault by disconnecting all of the power equipment inside the zone. Thus, a zone boundary is usually defined by a CT and a circuit breaker.

In order to cover all power equipment by protective systems, the zones of protection must meet the following requirements :

- All power system elements must be covered by at least one zone. More important elements should be included in at least two zones.
- Zones of protection must overlap to prevent any system element from being unprotected. The region of overlap should be finite and small.

An electric power system is divided into protective zones for

(1) generators (generator - transformer),
(2) transformers,
(3) bus bars,
(4) transmission and distribution circuits, and
(5) loads(motors).

The division is such that zones are given adequate protection while keeping service interruption to a minimum. Each zone has its own protective relays for detecting the existence of a fault in that zone, and each zone has its own circuit breakers to disconnect that zone from the rest of the system. Therefore, a protected zone can be defined as the portion of the power system protected by a given protective system or as part of the protective system. A single-line diagram of a part of a power system with its zones of protection is shown in Fig. 1.2.

3. What are different types of faults?

Ans.

Symmetrical Faults

In such type of faults all the three phases are short circuited to each other. There may be two situations. In one case, all the three phases are short-circuited to the ground. This type of fault is called ***three-phase to ground (LLLG) fault.*** In the other case, all the three phases are short-circuited without involving the ground. This type of fault is called ***three phase short-circuit (LLL) fault.*** Faults of the type LLL and LLLG are balanced and symmetrical in the sense that the system remains symmetrical, that is, balanced even after the fault. A three-phase short circuit occurs rarely, but it is the most severe type of fault involving largest currents. For this reason, the balanced short-circuit calculations are performed to determine these large currents to be used to determine the rating of circuit breakers.

Unsymmetrical Faults

The term unsymmetrical fault is used to mean unbalanced conditions. It is a connection or situation which causes an unbalance among the three phases.

An unsymmetrical *shunt fault* is an imbalance between phases or between phase and ground. A *series fault* is an imbalance in the line impedances. It does not involve any connection between lines, or between line and ground at fault point.

Shunt faults in a three-phase system can be classified as follows:

1. Single line-to-ground (LG) fault
2. Line to line (LL) fault
3. Double line-to-ground (LLG) fault
4. Three-phase short circuit (LLL) fault
5. Three-phase to ground (LLLG) fault

A ***single-line-to-ground (LG),*** fault occurs when one phase conductor breaks and falls to ground or when one phase conductor comes in contact with neutral conductor.

A ***line to line (LL)*** fault occurs when two phase conductors are short circuited.

A *double line-to-ground (LLG)* fault occurs when two conductors fall and connected through ground, or when two conductors come in contact with the neutral of a three-phase grounded system.

Open Conductor Faults

A break in one or two phase conductors in a 3-phase circuit leads to an open-conductor fault. Such faults may also be caused when circuit breakers or isolators open but fail to close one or more phases. Unbalanced currents flow in the system due to opening of one or two phases. This results in overheating of rotating machines.

All these types of faults may occur in the alternators, motors or transformers, or any part of the power system.

Two or more faults may occur simultaneously on a system. Such faults are known as *multiple* or *simultaneous faults*. In such faults, the same or different types of faults may take place at the same or different points of the system.

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BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

3rd Semester, 2nd In-Sem. Examination

B. Voc. Program, Winter Semester (2018-19)

Course Code: ELE1302 **Time: 1 Hour**

Course Name: Electrical Design Developer **Max. Marks: 20**

Instructions: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

1. Which of the following does not change in transformer?

   (a) Current (b) Voltage (c) Frequency (d) All of above

2. Which type of windings provides easy control over reactance for shell type transformer?

   (a) Crossover (b) Sandwich

   (c) Single helical (d) Disc helical

3. Alternators are rated in:

   (a) KVar (b) KW (c) KVA (d) Any of the above

4. Which type of rotor are not strong enough to withstand the mechanical stresses?

   (a) Salient (b) Cylindrical (c) Any of the above (d) Other

5. The armature windings on stator are connected in:

   (a) Star and neutral grounded (b) Star and neutral ungrounded

   (c) Delta and neutral grounded (d) Delta and neutral ungrounded

Section – B

03X02 = 06 Marks

1. Mention the factors that govern the design of field system of the alternator.
2. Distinguish between cylindrical pole and salient pole construction.
3. Determine the total number of slots in the stator of an alternator having 4 poles, 3 phase, 6 slots per pole per phase.

Section – C

03X03 = 09 Marks

1. A 5 KVA, 500/250V, 50Hz, single phase transformer gave the following readings

   OC Test: 500V, 1A, 50W (LV side open)

   SC Test: 25V, 10A, 60W (LV side shorted)

   Determine the efficiency on full load 0.8 lagging power factor.
2. What are the different types of windings used in transformer? Explain any one.
3. What is short circuit ratio? How the value of SCR affects the design of alternator?

Answer Key

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

3rd Semester, 2nd In-Sem. Examination

B. Voc. Program, Winter Semester (2018-19)

Course Code: ELE1302 **Course Name: Electrical Design Developer**

Section – A

05X01 = 05 Marks

Q.1. Which of the following does not change in transformer?

(a) Current (b) Voltage (c) Frequency (d) All of above

Ans. (c)

Q.2. Which type of windings provides easy control over reactance for shell type transformer:

(a) Crossover (b) Sandwich

(c) Single helical (d) Disc helical

Ans. (b)

Q.3. Alternators are rated in

(a) KVar (b) KW (c) KVA (d) Any of the above

Ans. (c)

Q.4. Which type of rotor are not strong enough to withstand the mechanical stresses

(a) Salient (b) Cylindrical (c) Any of the above (d) Other

Ans. (a)

Q.5. The armature windings on stator are connected in

(a) Star and neutral grounded (b) Star and neutral ungrounded

(c) Delta and neutral grounded (d) Delta and neutral ungrounded

Ans. (a)

Section – B

03X02 = 06 Marks

Q.1. Mention the factors that govern the design of field system of the alternator.

Ans 1:

1. Number of poles and voltage across each field winding
2. Amp-turn per pole
3. Copper loss in the field coil
4. Dissipating surface of field coil
5. Specific loss dissipation and allowable temperature rise.

$I_m = I_0 \sin(\Phi_0) = 0.9949A$

$R_0 = V_0/I_c = 500/0.1 = 5000\ \Omega$

$X_0 = V_0/I_m = 500/0.9949 = 502.52\Omega$

From SC Test: $V_{sc} = 25V$, $I_{sc} = 10A$ and $W_{sc} = 60W$

$R_{e1} = (W_{sc}/I_{sc}^2) = 60/(10)^2 = 0.6\ \Omega$

$Z_{e1} = V_{sc}/I_{sc} = 25/10 = 2.5\ \Omega$

$X_{e1} = \sqrt{(2.5)2 - (0.6)2} = 2.4269$

FL= VA Rating/V_1= 10

$I_{sc} = I_1 * FL$

$W_{sc} = P_{cu} * FL = 60W$.

Efficiency on full load at cos= 0.8 lagging

Efficiency= $[(VA\ rating) \cos \Phi_2 / (VA\ rating) \cos \Phi_2 + P_i + (P_{cu})FL] * 100$

Efficiency= $[5*10^3*0.8/5*10^3*0.8+50+60]*100$

97.32%

Q.2 **What are the different types of windings used in transformer? Explain any one.**

Ans 2: Types of Winding used for Core Type Transformer

Helical Windings

Cylindrical Windings

Crossover Winding

Disc and Continuous Disc Winding

Windings for Shell Type Transformer

Sandwich Type Winding

Sandwich Type Winding

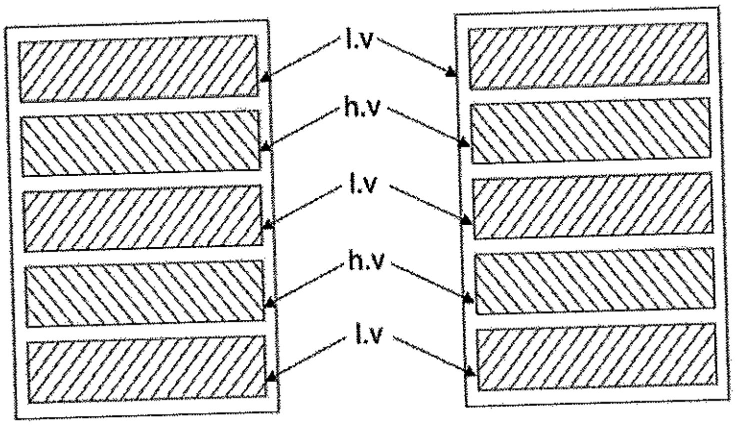
Allow easy control over the reactance the nearer two coils are together on the same magnetic axis, the greater is the proportion of mutual flux and the less is the leakage flux. Leakage can be reduced by subdividing the low and high voltages sections. The end low voltages sections contain half the turns of the normal low voltage sections called half coils.

In order to balance the magnetomotive forces of adjacent sections, each normal section whether high or low voltage carries the same number of ampere-turns. The higher the degree of subdivision, the smaller is the reactance.

Advantages of Shell Type Windings in Transformers

- High short-circuit withstand capability
- High mechanical strength
- High dielectric strength
- Excellent control of leakage magnetic flux
- Efficient cooling capability

- Flexible design
- Compact size.
- Highly Reliable Design



Sandwich Type Windings

Q.3. **What is short circuit ratio? How the value of SCR affects the design of alternator?**

Ans 3: The short circuit ratio is defined as the ratio of field current required to produce rated voltage on open circuit to field current required to circulate the rated current on short circuit. It is also given as the reciprocal of synchronous reactance.

For high stability and low regulation, the value of SCR should be high, which requires large air gap, when the length of air gap is large, the mmf requirement will be high so the field system will be large. Hence the machine will be costlier. For turbo alternators SCR is normally between 0.5 to 0.7 and that for salient pole alternator SCR varies from 1 to 1.5.

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BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

3rd Semester, 2nd In-Sem. Examination

B. Voc. Program, Winter Semester (2018-19)

Course Code: ELE1303 **Time: 1 Hour**

Course Name: Safety Electrical Installation Controller **Max. Marks: 20**

Instructions: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks. Scientific calculator is allowed.

Section – A

05X01 = 05 Marks

1. What are the causes of most accidents?
   (a) Electrocution (b) Poisoning (c) Slips, trips and falls (d) Suffocation
2. Everyone can help to prevent accidents by:
   (a) Doing the job they think is best (b) Reporting all unsafe working conditions
   (c) Knowing where the first aid kit is kept (d) learning to use a fire extinguisher
3. If you are the first person to discover a fire, what should you do?
   (a) Leave the building immediately (b) Pick up fire extinguisher and tackle the fire
   (c) Head to your locker and get your personal items (d) Activate the fire alarm
4. To operate a powered hand tool, you must be:
   (a) Over 16-year-old (b) Over 18-years old
   (c) 21-year-old or above (d) Trained and competent
5. It is safe to work close to an overhead power line if:
   (a) You are a wooden ladder (b) It is not raining
   (c) You don not touch the line for more than 30 seconds (d) The power is switched off

Section – B

03X02 = 06 Marks

Q.1. Why are lockout, isolation and tagging procedures established?

Q.2. Name five events that can cause arc fault.

Q.3. Define the following terms:
(a) Accident (b)Safety devices

Section – C

03X03 = 09 Marks

Q.1. What are the objectives of safety studies?

Q.2. Explain three categories of common electrical hazards.

Q.3. What are the four classification of voltage levels?

Solution

Course Name: Safety Electrical Installation Controller
Course Code: ELE1303

Section-A

1. Ans → (c)

2. Ans → (b)

3. Ans → (d)

4. Ans → (d)

5. Ans → (d)

Section-B

1. Ans:-

Lockout, isolation and tagging procedures are established to protect persons and property in a workplace location from any electrical hazard either energy or mechnical in nature while inspections, repairs or maintenance work are being carried out.

2. Ans:-

The arc fault can be caused by many different events including:-

i) Faulty insulation
ii) Improper earthing
~~iii) Unground.~~
iii) Unguarded live parts
iv) Unsafe work procedures
v) Dropped tools

3. Ans: —

(a) Accident: — It is an unexpected happening resulting from negligence, that result in injury, loss, damage etc. and is caused by a mistake or machine failure or natural disaster.

(b) Safety devices: — Devices which ensure safety against injury or loss.
e.g. safty belt, safety glasses, safety earthing etc.

Section-C

1. Ans:-

The main objectives of safety studies are as follows:-

i) To establish safety management system, safety audit system.

ii) To achieve 100% safety and 100% security of installations equipment, human life and animal life.

iii) To bring awarness about safety hazards and safety rules.

iv) To understand cause and effect relationships in accidents.

v) To minimize loss in case of accidents.

2. Ans:

Three categories of common electrical hazards are as follows:-

i) Electrical shock
ii) Arcing
iii) Toxic gases associated with the arcing hazard.

i) Electrical shock:- The electrical shock occures by direct contact with a live part, arcing or equipment leakage currents associated with appliances.

ii) Arcing: - A short ckt fault can cause arc in which electrical energy to be established within very small interval of time.

iii) Toxic gases: - The arcing, burning during electrical fault may cause toxic gases to be emitted which can have an adverse effect on a target organ.

3. Ans:

Four classification of valtage levels are as follows: -

i) Low valtage: - Where the valtage dosen't exceed 250 valts under normal conditions.

ii) Medium voltage: - Where normal valtage exceeds 250 valts but doesn't exceed 650 valts.

iii) High valtage: - Normal valtage exceeds 650V but doesn't exceed 33,000 V.

iv) Extra high valtage: - voltage that exceeds 33,000 valts.