higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

FAULT FINDING AND PROTECTIVE DEVICES N6

25 November 2024

This marking guideline consists of 5 pages.

Copyright reserved

QUESTION 1

1.1 Lead-acid batteries are the oldest form of rechargeable batteries. In the batteries, there are two types of plates, namely positive and negative plates. The positive one consists of lead dioxide, and the negative one consists of sponge metal. These two plates are separated using a separator that is an insulating material. This total construction is kept in a hard plastic case with an electrolyte. The electrolyte is water and sulphuric acid. (5)

1.2
- Portable source of power
- Can deliver a large amount of power over a short period
- Can be recharged at a low rate for an extended time
- Very reliable
- Source of pure DC for laboratories
- Robust
- Low internal impedance (5)

1.3 1.3.1 An open-circuit voltage test entails measuring the voltage across the terminals of the battery when no load is connected to the battery. The purpose of the open-circuit voltage test is to identify the battery's electrical potential capability. (3)

1.3.2 Load testing entails determining the maximum current that a battery can deliver for a maximum of 15 seconds without the terminal voltage dropping below 9,6 V. (2)
[15]

QUESTION 2

2.1 Assuming star-connection.

Base current corresponding to 30 MVA = $\frac{30\,000\,000}{\sqrt{3}\ \times 11{,}000}$
= 1,575 kA line and phase

p.u. X of transformer converted to a 30 MVA base = $\frac{30}{40} \times 0{,}1 = 0{,}075$

Since the alternator and transformer are in series,
total p.u. X = 0,25 + 0,075 = 0,325.

S/CI = base I × $\frac{1}{p.u.X} = 1{,}575 \times \frac{1}{0{,}325} = 4{,}845\ A$

S/C MVA = MVA base x $\frac{1}{p.u.X} \times 30 \times \frac{1}{0{,}325} = 92{,}3\ MVA$ (8)

2.2 2.2.1 Receives information from the protected circuit that specifies normal or abnormal conditions. If abnormal conditions, then contact A1 closes. (3)

2.2.2 During fault conditions, the relay will close contact A1 energising the trip coil which will release the latch. The compressed spring will then push the breaker switch open thus breaking the protected circuit. (3)

2.2.3 When there is a fault current, the current is too high to flow through the relay and the C.T. is used to provide currents proportional to the system's primary currents. (2)

2.2.4 Provides power for the relay and the breaker trip circuit. (2)

2.3
- Insulation can break down because of overvoltage during lightning strikes on the line.
- Insulation may deteriorate due to sea pollution.
- Cane fires underneath lines may cause ionisation of the air, breaking down insulation.
- Birds sitting on the wires and making their nests. (Any 3 × 2) (6)

[24]

QUESTION 3

3.1
- Closing coil
- Trip coil
- Voltage transformer
- Current transformer
- Overload protection
- Feeder protection
- On larger systems – bus zone protection
- Cable feeder
- Earthing links or switch position
- Auxiliary contacts for interlocking
- Remove operation (Any 10 × 1) (10)

3.2
- Trip button is closed or has faulty contacts
- Over-current contacts stuck in closed position
- Earth leakage contacts stuck in closed position
- Bucholtz device operated
- Over-heated contacts of transformer
- Earth fault on transformer
- 6 A fuse for spring-charging motor has blown
- Spring is not rewarded fully
- 6 A fuse on the closed coil has blown
- Faulty limit switch
- Faulty motor (6)

[16]

Copyright reserved

QUESTION 4

4.1
- High oil temperature alarm
- High winding temperature alarm
- Discolouration of insulation oil
- Gas accumulation in Buchholz relay
- Buchholz relay alarm
- Abnormal noise produced by the transformer
- Furan-analysis indicating deterioration of winding-paper insulation
- PD-analysis results indicating presence of PD activity inside transformer
- Spurious tripping (Any 5 × 1) (5)

4.2
- Operating temperature
- Atmospheric conditions
- Presence of moisture or fibres (3)

4.3 4.3.1 Rapid gas evaluation is a rate of gas evaluation that will instantaneously cause the alarm to operate.

4.3.2 Medium gas evaluation refers to the evolution rate that causes displacement of oil that operates a relay which activates the alarm.

4.3.3 Slow gas evaluation refers to a gradual collection of a gas, e.g. requiring days or weeks to accumulate.

(3 × 2) (6)

[14]

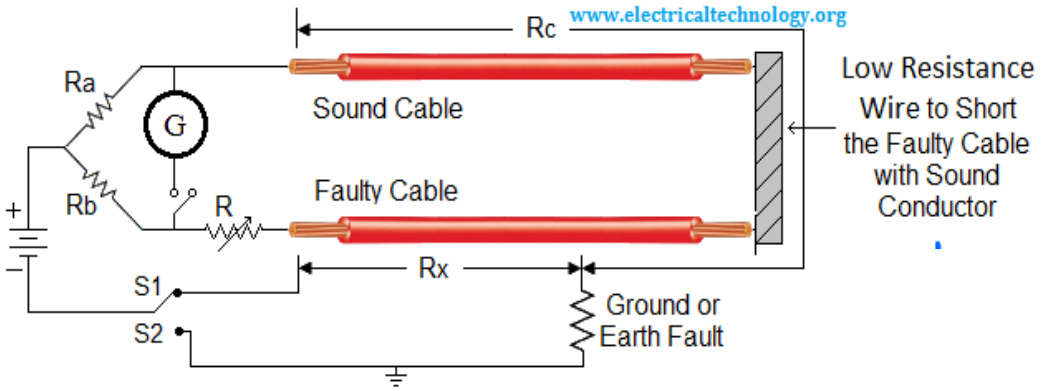
QUESTION 5

5.1
- Continuity test
- Phase-identification test
- Short-circuit test
- Insulation-resistance test (4)

5.2
- It is useful only for shunt faults and only if at least one healthy conductor is available.
- The fault resistance should be below 200 Ω.
- The test is not applicable for open-circuit faults.
- Only the approximate location of the fault can be identified.
- The other end of the cable should also be accessible for fixing a jumper. (5)

Copyright reserved

5.3



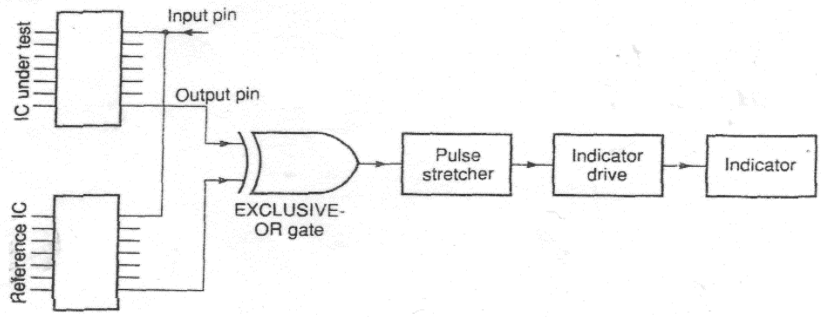
Varley Loop Test for short circuit fault in cables

(8)
[17]

QUESTION 6

6.1 A group of integrated circuit devices manufactured using similar technology to possess similar attributes and work together using direct interconnection rather than elaborate interfacing circuitry. (4)

6.2



✓✓✓✓

Is designed to clip into a powered TTL or DTL – IC and to display any logic static difference between the IC under test and a reference IC. Logic differences are identified to the specific pin on 14- or 16-pin dual in-line packages with a display of 16 L.E.Ds in the comparator. A lighted diode corresponds to a logic difference. In practice, a good IC of the same type is inserted into the comparator, and the comparator is clipped onto the IC to be tested, showing any errors.✓✓✓✓ (8)

6.3
- Bi-directional breakdown device – both directions reasonably fast to withstand high current densities.
- High dissipation energy. (2)

[14]

TOTAL: 100

Copyright reserved